

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
PHOENIX, ARIZONA**



**METRO PHOENIX ADMP  
LEVEL II REPORT  
FCD 2004C040**

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## 1.0 INTRODUCTION

### 1.1 Purpose of Study

The purpose of the Metro Phoenix Area Drainage Master Plan (ADMP) is to identify and quantify flood hazards within the central Phoenix area and develop a recommended plan for mitigation of the identified flooding problems.

### 1.2 Purpose of this Report

The purpose of this report is to document and summarize the potential flood control solutions for the Metro Phoenix ADMP. This is a summary of the Level II Analysis, which is the second step in the process of developing flood control alternatives. This step involves an analysis of a selected number of flood control measures in order to establish the alternatives which will be carried forward into the recommended plan. The next phase, or the Level III Analysis, will involve further development of the recommended alternatives and production of the design concept plans.

### 1.3 Study Area

The study area for the Metro Phoenix ADMP is shown in Figure 1.3. The area is bounded by the Arizona Canal Diversion Channel (ACDC) on the north, I-17 on the west, the Salt River on the south, and the ridgeline in the Papago Buttes on the east. Between 44<sup>th</sup> Street and 60<sup>th</sup> Street, the study area extends north of the Arizona Canal up to the ridgeline of Camelback Mountain. The total study area is approximately 90 square miles. The study also includes a portion of the Durango ADMP study area, west of I-17, which encompasses the Cave Creek floodplain and its corresponding watershed (blue shaded area on Figure 1). The reason for including the Durango area in the Metro Phoenix ADMP is for the re-study of the Cave Creek floodplain; no new flood mitigation plans will be developed for the Durango watershed, as this effort was previously accomplished as part of the Durango ADMP.

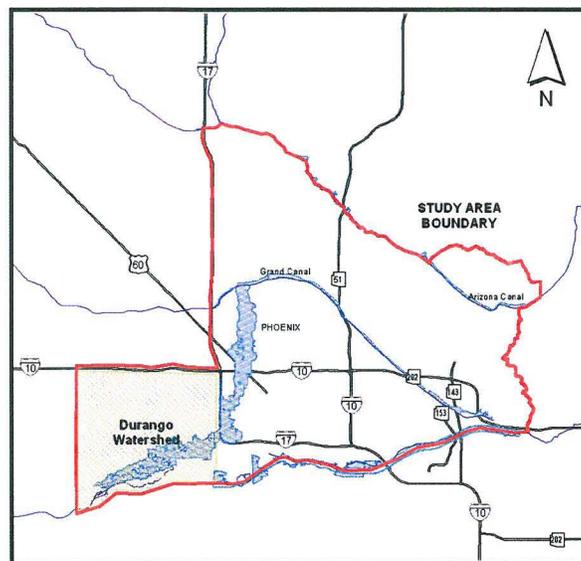
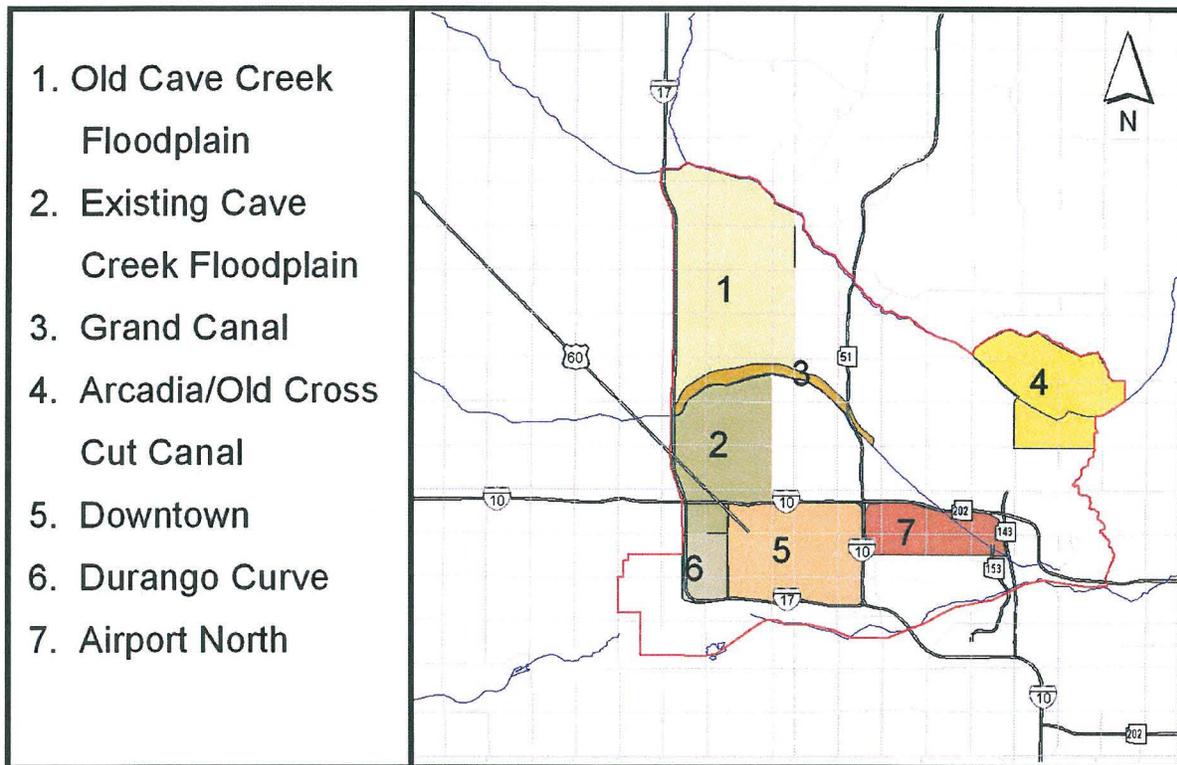


Figure 1.3 Study Area Map

## 2.0 FLOODPRONE AREAS

The following paragraphs describe the eight flood prone areas that were identified in the first phase of the Metro Phoenix ADMP, which was carried out between May 2005 and October 2006 and consisted of data collection, analysis of existing conditions, and identification of flood prone areas. The work included 1) review of flooding complaints compiled by the City of Phoenix (COP) through the drainage complaint department, 2) receiving input from the public on drainage issues at public meetings, 3) consulting with affected agencies, 4) reviewing existing flood studies and drainage reports, 5) preparing an inventory of existing and planned drainage infrastructure, 6) developing a comprehensive rainfall-runoff model of the study area, and 7) preparing a re-delineation of the Cave Creek floodplain.



**Figure 2.0 Floodprone Areas**

The data obtained from this first phase of the work was used to define the following flood hazards:

Old Cave Creek Floodplain: As evidenced by numerous drainage complaints, the low-lying areas within the old Cave Creek floodplain are still susceptible to flooding. This area is approximately 10 square miles in size, located between the ACDC to the north, the Grand Canal to the south, I-17 to the west, and 7<sup>th</sup> Street to the east. Prior to construction of the ACDC, flood flows from Cave Creek would inundate this area, hence the name old Cave Creek Floodplain. But even though the ACDC captures and diverts the upstream flows in Cave Creek, eliminating the floodplain designation, the area still experiences flooding problems. These problems are primarily due to the topographic shape of the area, which is a very wide and shallow conveyance

corridor lacking a defined low-flow channel. The rest of the Metro Phoenix study area is more characteristic of a sloping plain where runoff, that exceeds the conveyance capacity of the streets, flows overland as shallow sheet flow. In contrast, the topography of the old Cave Creek floodplain tends to concentrate runoff. Consequently, during times of heavy rainfall, runoff can exceed the capacity of the 2-year storm drain system and accumulate, causing flood damage to those properties located in low-lying areas.

Cave Creek Floodplain: The Cave Creek floodplain area from the Grand Canal downstream to I-10 is approximately 6 square miles in size, which incorporates the designated floodplain as well as some areas outside of the floodplain. The defined floodplain lies roughly between 19<sup>th</sup> Avenue to the west and 15<sup>th</sup> Avenue to the east, encompassing over 2000 homes and businesses. However, the Metro Phoenix ADMP hydrologic model indicates that the risk of flooding in adjacent conveyance corridors, outside of the designated floodplain limits, is essentially the same as the flood risk within the floodplain. That is, the 100-year peak discharge that is conveyed within the floodplain between 19<sup>th</sup> Avenue and 15<sup>th</sup> Avenue is roughly equivalent to the peak discharge in the other adjacent half mile wide conveyance corridors; including I-17 to 19<sup>th</sup> Ave., 15<sup>th</sup> Ave. to 7<sup>th</sup> Ave., and 7<sup>th</sup> Ave. to Central Ave. As is the case with the old Cave Creek floodplain area upstream of the Grand Canal, the flooding problems downstream of the Grand Canal are primarily due to the topographic shape of the area which is a very wide, shallow conveyance corridor stretching from I-17 to Central Avenue. Runoff tends to concentrate within this area and, during times of heavy rainfall, runoff can exceed the capacity of the 2-year storm drain system and accumulate to significant depths, causing flood damage to those properties located in low-lying areas.

Grand Canal Floodplain: The banks of the Grand Canal are elevated about 1 to 3 feet above the existing ground, resulting in a shallow floodplain along it's upstream side. An estimated 530 homes, plus a number of businesses and apartment buildings, are located within the Grand Canal floodplain between I-17 and 22<sup>nd</sup> Street. Some areas within the floodplain experience flooding on a much more frequent basis than others, such as the neighborhood located between 3rd Street and 12th Street. This area has been flooded twice within the past year, whereas other areas behind the Canal haven't flooded for decades. Nonetheless, the entire area that lies below the elevation of the Canal bank is susceptible to flooding. Moreover, the flooding can be caused by storms much smaller than the 100-year event because the problem is a result of the elevated Canal bank. That is, once the capacity of the 2-year storm drain system is exceeded, excess runoff ponds behind the Canal and causes flooding of homes and businesses.

Downtown Area: For purposes of this study, the Downtown Area is defined as the 7.8 square mile region bounded by 19<sup>th</sup> Ave. on the west, I-10 on the north and east, and I-17 on the south. I-10 is a drainage divide for the Downtown Area; capturing upstream runoff and conveying it to the Salt River, but the local watershed still generates relatively high rates of runoff due to the level of development and lack of pervious areas. Surface flows run east to west through the Downtown area, with the highest concentrations of runoff occurring along Fillmore Street, the Union Pacific Railroad, Buckeye Road, and I-17. The hydrologic model predicts that these concentrations of runoff range from 100cfs to over 1200cfs for the 100-year flood, indicating a significant flood hazard. The flooding problems are exacerbated since many of the storm water catch basins are dysfunctional drywells that leave standing water after the storms have passed.

In addition, even though 2-year storm drains exist on half-mile intervals, many of the inlets in the Downtown area seem inadequate to capture the runoff from a 2-year storm.

Durango Curve Area: At Durango Street, the 90 degree curve in the I-17 Freeway is on an elevated embankment which impounds floodwaters, to a depth of about 3 feet, according to the effective floodplain map and verified with the Metro Phoenix hydrologic model. The flooded area is about 1/2 square mile in size and includes about 670 homes and businesses along the east side of I-17, from the Freeway curve upstream to the Union Pacific Railroad. The contributing watershed to the Durango Curve area extends all the way up to the ACDC. Storm water runoff from the watershed, that exceeds the existing storm drain system, concentrates along the north side of the Union Pacific Railroad and is diverted into I-17 filling the depressed part of the highway north of the curve. Since the existing storm drain system is designed to convey the 2-year flood, storms exceeding the 2-year event can cause this problem of floodwater spilling into I-17. Once the storage volume of I-17 is exceeded, floodwaters spill over the east side of I-17, flooding the area in the northeast quadrant of the curve. The west bank of the depressed freeway is higher than the east bank, which results in the spill to the east. This flooding problem not only impacts homes and businesses, but can also flood I-17, making the Freeway impassable on a fairly frequent basis.

Arizona Country Club Swale: This swale is downstream of the Arizona Country Club, located between the Papago Buttes on the south and the elevated Arizona Canal on the north. The swale runs east to west through the Arizona Country Club and continues west, in an alignment north of Thomas Road, until it reaches the Old Cross Cut Canal at 48<sup>th</sup> Street. The swale tends to lose its definition downstream of 52<sup>nd</sup> Street, transforming from a swale that contains floodwater into a spread out surface flow. There are records of several flooding complaints from homeowners who live along the low-lying part of the swale.

Arcadia Area: The Arcadia area has long been a flooding concern for both the COP and the Flood Control District (District). Storm water runoff from Camelback Mountain causes flooding problems for the homeowners whose property lies adjacent to the flow corridors. These flow corridors are the north-south aligned streets that convey the mountain runoff from Camelback Mountain's slopes down to the Arizona Canal. Another issue is the elevated embankment of the Arizona Canal. Much like the Grand Canal described previously, the Canal embankment impounds floodwaters resulting in a designated floodplain along the upstream side of the Canal. The homeowners at Camelback Castille (on 40<sup>th</sup> Street and Camelback Road) experience this flooding. These flooding issues have resulted in numerous flooding complaints, prompting the inclusion of Arcadia into the list of flood hazard areas.

Area north of Sky Harbor Airport: This area is located between the Loop 202 Highway on the north and the Union Pacific Railroad on the south, from the I-10 Freeway upstream to the SR 143 Highway. The drainage area is approximately four square miles in size and the general fall of the land is from northeast to southwest. The railroad forms a drainage divide along the north boundary of Sky Harbor Airport. North of the railroad, a wide swale is formed along the Washington Street alignment where the grade is due west. This swale accumulates surface flow that exceeds the capacity of the existing 2-year storm drain system. According to the Metro Phoenix hydrologic model, the 100-year surface flow along Washington Street exceeds 1000cfs.

### **3.0 TECHNICAL ANALYSIS**

The alternatives that were carried forward from Level I analysis were further analyzed to ascertain their feasibility and refining the associated cost. Additional criteria included identification of fatal flaws that would make a project impossible or impractical to construct. These included location of conflicting major utilities, impractical right-of-way acquisitions, and environmental and cultural impacts.

Refinements to the technical analysis included preparation of typical cross sections for storm drain alternatives that show the potential street location of the new pipe and its relation to existing utilities. This helps determine the alternatives feasibility as well as to better estimate the associated costs of utility relocations. In addition, for proposed alternatives that include storm water storage, new contoured basins were developed that provide the following:

- A better estimate of the storage volume was used as the basis of a stage-storage relationship within the HEC-1 modeling to determine the mitigating effect the storm water storage basin has on the flood hydrographs.
- Provides an estimate of the quantity of haul material for the cost estimate.
- Helps people visualize the storage basin and how the basin could be used for recreation. In the case of the golf courses, it also shows how the drainage will be routed through the basin to prove feasibility as well as refining the cost estimate.

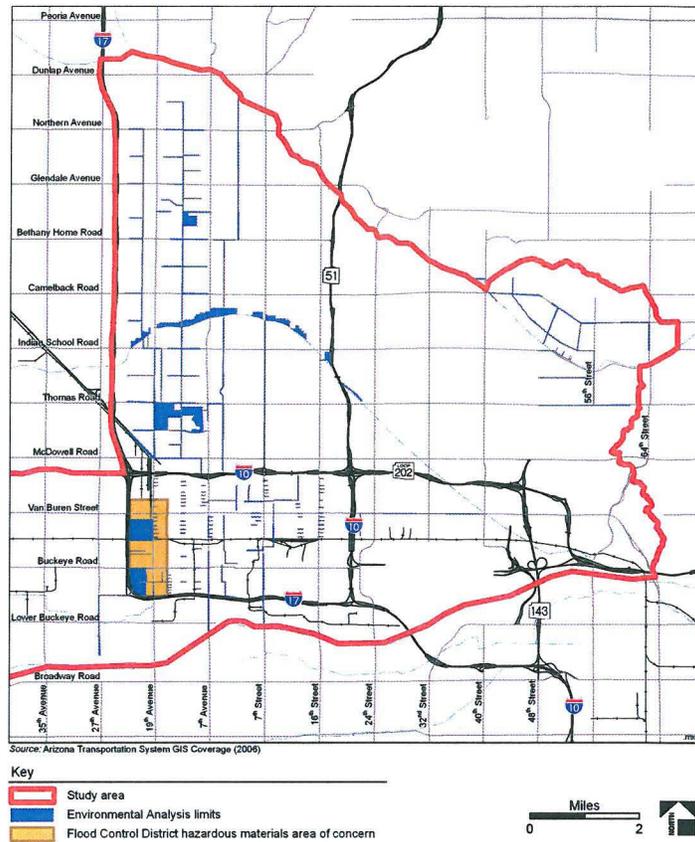
### **4.0 ENVIRONMENTAL CONSIDERATIONS**

As part of the Area Drainage Master Plan process, an analysis was completed to identify environmental considerations including hazardous materials sites and facilities and previously identified cultural resources. Identification of these factors will be used in the selection of the recommended alternative.

There is still considerable habitat value in the area, especially in areas with mature trees. These characteristics were looked at and their value was considered as part of the assessment.

#### **4.1 Hazardous Materials Investigation**

A hazardous materials area of concern (HMAC) was identified (Figure 4.1) and a hazardous materials investigation was conducted. Arizona Department of Environmental Quality (ADEQ) and Environmental Protection Agency (EPA) databases were searched and the resulting information was reviewed to identify facilities or sites that have reported incidents involving hazardous materials. A total of 336 hazardous materials incidents or sites were recorded within the HMAC (See the Appendix 2 for the complete list). A more detailed summary of the hazardous materials incidents or sites by type can be found in Appendix 2. The final Metro Phoenix ADMP project area and selected alternative(s) will need to be evaluated for specific hazardous materials impacts before plan implementation.



**Figure 4.1 HMAC Location**

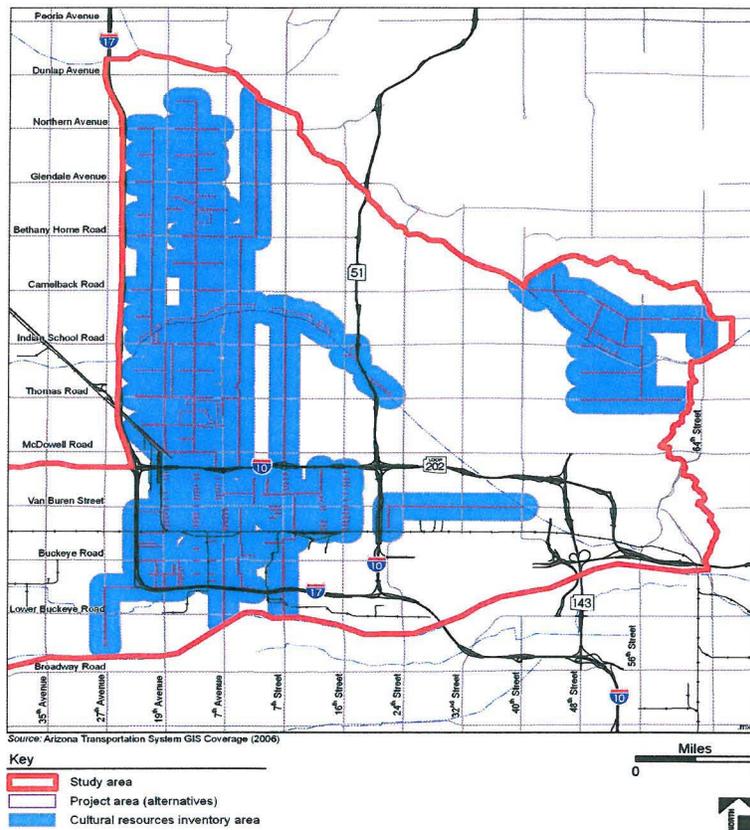
## 4.2 Cultural Resources Investigation

A cultural resources inventory area was identified (Figure 4.2) and a cultural resources investigation was conducted to identify any cultural resources in the inventory area that could be affected by the proposed Metro Phoenix ADMP alternatives. The investigation included background research to compile the previously documented archaeological and historic sites and surveys conducted. Cultural considerations were identified from information gathered from the Arizona State Historic Preservation Office, the Arizona State Museum, and the National Park Service’s National Register Information System.

The cultural resources records search indicated that 56 surveys were previously conducted in the inventory area, resulting in coverage of approximately 6 percent of the project area. In total, 53 known archaeological sites, 34 historic districts, and numerous National Register of Historic Places listing historic properties were previously recorded in the inventory area. Twenty-eight of these archaeological sites overlap the project area. Encanto Golf Course and Encanto Park both have historic designations. There is also a proposed basin at I-17 and the Union Pacific Railroad that has homes with a historic designation within the footprint. If these alternatives move forward, the historic designation will need to be considered. A more detailed listing of the numbers and types of sites affecting each of the project alternatives can be found in Appendix 2.

A more detailed assessment of known cultural resources is recommended prior to plan implementation. The level of detail needed, identification of potential agencies involved and

construction related recommendations to preserve cultural resources are further described in Appendix 2.



**Figure 4.2 Cultural Resource Inventory Area**

## 5.0 SCENERY AND RECREATION RESOURCE ASSESSMENT

The following is a summary of the Scenery and Recreation Resource Assessment (SRRA) for the Metro Phoenix ADMP, see appendix 3 for the complete report.

In addition to the overall goal of the Metro Phoenix ADMP to develop alternatives to mitigate the identified drainage and flooding concerns, a companion goal is the preservation and enhancement of the landscape character and recreational qualities of flood protection facilities within the community.

The multidisciplinary information gathering effort provided information used as the basis for developing drainage alternatives in the study area that are technically sound, environmentally sensitive, supported by the community, and complimentary to existing land use. This scenery and recreation resource assessment concentrated the assessment efforts to the area that encompasses the visual above ground drainage alternatives which will have an impact to scenic quality.

### 5.1 Scenery, Recreation, Open Space Goals & Objectives

The District's goal for the landscaping and aesthetic treatment of flood control projects is to preserve the visual beauty and other aesthetic qualities of the urban, rural and natural settings in Maricopa County as an integral part of the planning and designing flood control facilities. The District's recreation goal is to promote recreation multiple-uses of its properties to the extent that

such uses do not compromise the flood control function, operation and maintenance of those facilities.

The purpose of the Scenery and Recreation Resources Assessment is to:

- Assess the character, quality and visual sensitivity of lands contained within and adjacent to the project area of influence;
- Provide an analysis of scenery and recreation opportunities and constraints for flood protection activities;
- Identify a range of appropriate landscape themes and associated landscape features to apply to the plan alternatives;
- Identify and develop plan alternatives that emphasize achievement of project landscape aesthetic goals;
- Provide an analysis of the scenic impacts, benefits and costs associated with plan alternatives;
- Identify recreation resources, needs, and opportunities;
- Assist in developing the preferred plan, including aesthetic planning and design guides, cost estimates for landscaping, aesthetic, and recreational features, and guidance on needed right of way acquisition; and
- Assist in development of the maintenance and implementation plan.

## **5.2 SRRA Data Collection**

Phase I of the Metro Phoenix ADMP included the data collection and assessment of the existing and planned future landscape character and the recreational land use for the entire study area. This mapping was used to generate a landscape character compatibility analysis which identified the appropriateness of the various flood protection methods use in regards to landscape character within the study area. This county-wide data was appropriate for the regional context of the Metro Phoenix ADMP and the preliminary identification of the use of flood protection methods, but because of the intense urban development and varying landscape character contextual settings, a more local context assessment was made for the area surrounding the visually sensitive drainage alternatives identified.

An assessment was made for this area in regards to landscape character, scenic quality and visual sensitivity. The landscape character assessment included; existing, planned future, and historic and cultural landscape character. The scenic quality assessment included landscape variety and scenic integrity; this assessment identified features and areas that should be preserved for their outstanding scenic quality, and features and areas that may represent opportunities for landscape enhancement or improvement due to the lack of landscape variety or the presence of discordant features that appear to detract from the desired characteristics within the study area. And lastly, an assessment was made for visual sensitivity, taking into account the numbers and types of viewers; their concern for the visual environment; and the relative visibility of landscape areas within the study area.

## **5.3 SRRA Opportunities & Constraints Analysis**

To assist in identifying the opportunities and constraints for applying the various flood protection methods, a composite map was produced for the local study area consisting of the Scenic Integrity ranges, the Visual Sensitivity Compatibility, Existing Landscape Character Compatibility, and the Variety Classes Compatibility.

The scenery and recreation resource assessment identified areas that could be enhanced in both scenic quality and recreational use. Opportunity for enhancement exists south of Grand Avenue, where both scenic quality and recreational resources are lacking. The appropriate use of flood protection methods such as the Soft or Semi-Soft methods, along with including multi-use recreational components will significantly improve the harsh industrial character of the area, and provide needed recreation.

This assessment also identified an opportunity for local and regional recreational enhancement along the Grand Canal, in areas which currently fall within the Cave Creek Floodplain. Alternatives developed in this area could provide for the enhancement of existing regional pathway system along the canal, providing open space, pocket parks, trailheads, and general aesthetic improvements to the canal area.

Other opportunities for scenery enhancement presented themselves during team discussions about possible flood protection alternative solutions. Most notably are two municipal golf courses, which not only provide great floodwater storage opportunity, but also opportunity and desire of the City, to improve the aesthetics and appeal of the golf courses.

Further evaluation will be made on these alternatives, and the scenery and recreation multi-use impacts will be a significant consideration as the alternatives are developed. For example, the grading of the Floodwater Storage at Encanto Golf Course Alternative will be required to be done in an aesthetic manner to fit into its sensitive context of the historic residential district. To help in identifying the future design of these alternatives, landscape themes were prepared which are suitable to the flood protection methods assessment, and the stakeholder's goals and objectives. These various themes will be evaluated by the planning team, the stakeholders, as well as the general public.

#### **5.4 SRRA Landscape Design Themes**

Landscape design themes have been identified for the flood protection alternative solutions which are being studied by the planning team. These alternatives include above ground features which could have visual or recreational impacts in the study area. Landscape themes were developed based on the appropriate flood protection methods identified during the SRRA. Alternative themes were developed for the Existing Landscape Character, Future Planned Landscape Character, and the Historical Landscape Character, they include:

##### *❖ Floodwater Storage at Encanto Golf Course Alternative*

The Encanto Golf Course is partially located in the Encanto Palmcroft Historic District. The existing landscape character of the area is quite mesic with palm trees, tall shade trees, and manicured turf and landscaping. In response to the Soft Structural Method anticipated for the site and the intended continued use as a golf course, the recommended landscape design theme is ***Suburban Park-Like***. This theme illustrates the aesthetic contouring of the golf course to provide the floodwater storage, and also illustrates landscaping which would maintain the existing turf character of the course and the preservation of mature trees (Figure 5.4.1).

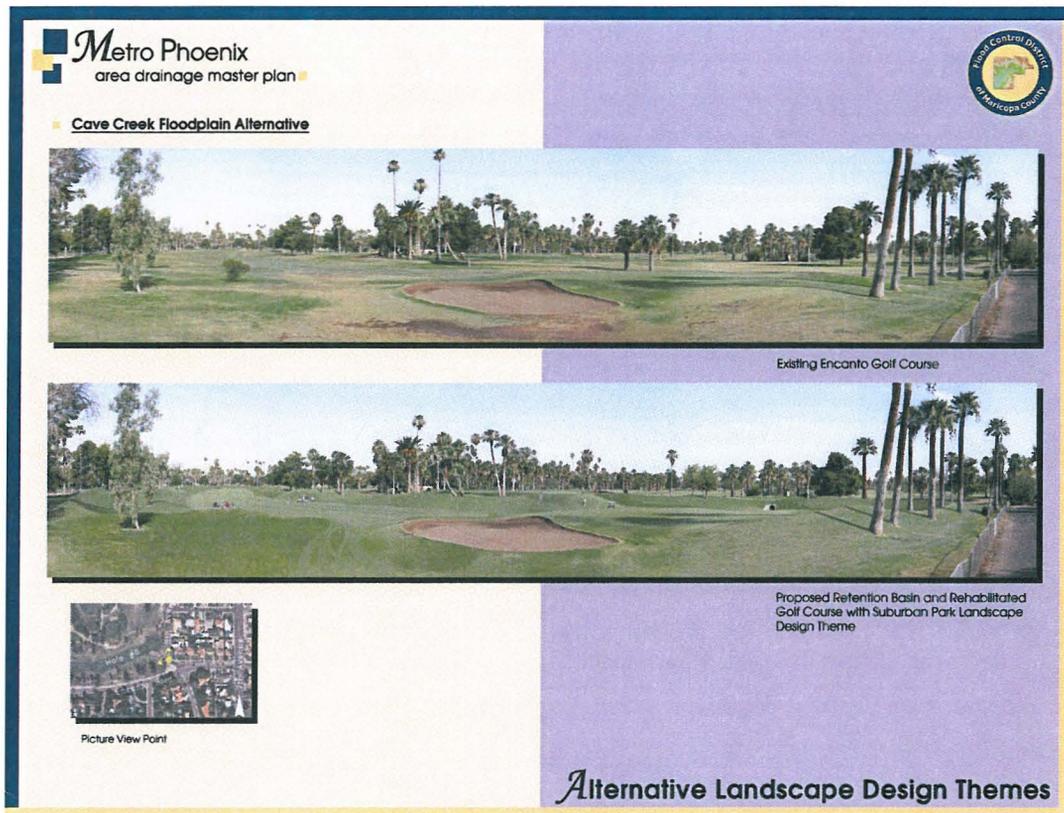


Figure 5.4.1

❖ *Floodwater Storage at Palo Verde Golf Course Alternative*

Two alternative themes were developed: A **Suburban Park-Like** theme that illustrates the aesthetic contouring of the golf course to provide the floodwater storage, and also illustrates landscaping which would maintain the existing all turf character of the course; and a second **Desert Oasis** theme, illustrates an alternative desert landscape theme on the edges of the golf course fairways (Figure 5.4.2).

❖ *Linear Park at Grand Canal Alternative*

Two themes were developed: An **Enhanced Desert Park** theme without hardscape, sidewalks, headwalls, etc. Only aesthetic grading and landscaping is shown. This concept illustrates desert landscaping on the peripheral with small passive turf areas on the interior of the small parks. This theme may appeal to residents who do not want developed park amenities that would invite people into the canal corridor; and a second **Suburban Park** theme which includes typical urban park amenities, including sidewalks, ramadas, playgrounds, etc, along with trees and all turf landscaping. This theme also shows the sites multi-use potential with a connection to the Grand Canal pathway (Figure 5.4.2).

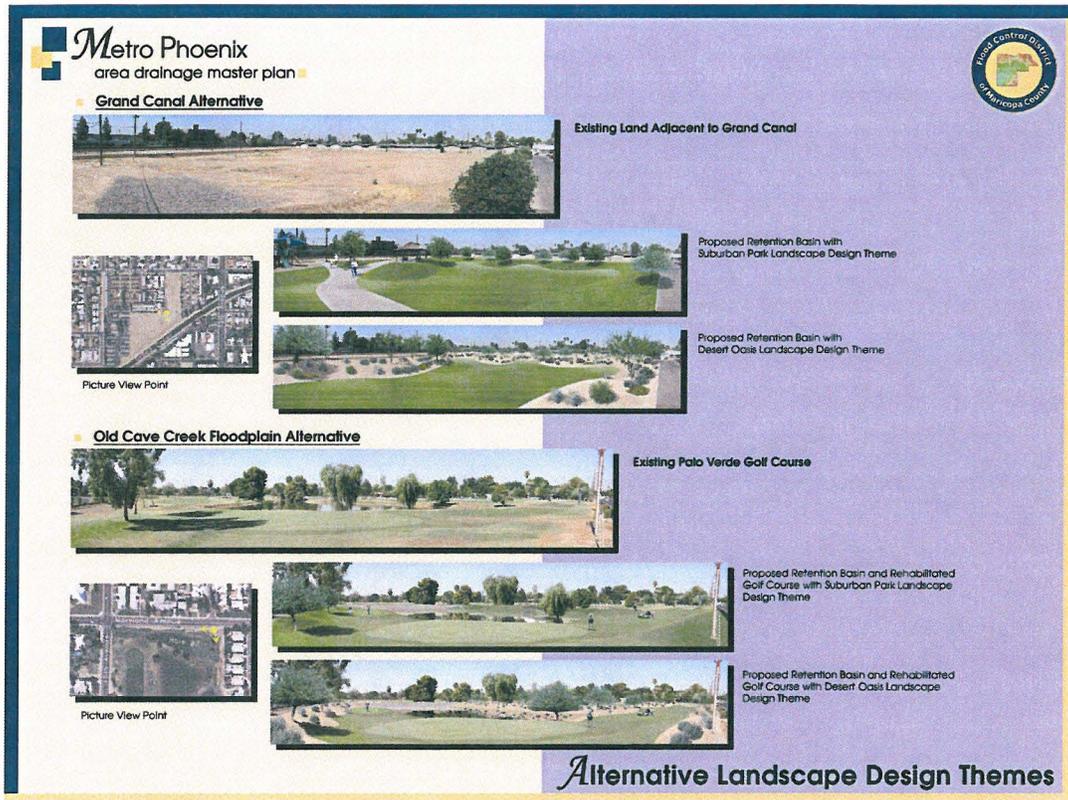


Figure 5.4.2

❖ *Durango Curve Alternative*

Three themes were identified: Suburban Park Landscape Theme; Enhanced Desert Landscape Theme, and Suburban Park Recreation Complex Landscape Theme (Figure 5.4.3). The Floodwater Storage at the Durango Curve Alternative is not only ideally located for floodwater storage, but also could provide highly desired recreational facilities in the central part of the city. The City Parks Department has also stated that they would welcome the opportunity for a new multi-use recreational facility at the locations of the two alternatives. The Parks Department has been unable to provide facilities in this area due to the lack of property available.

❖ *Storm Drain in Central Avenue Alternative*

A **Historic Streetscape** theme illustrates the minimal degree of aesthetic changes required for the storm drain improvement, to satisfy the desire to keep the existing historical landscape character.

Based on the Scenic Quality Assessment, the theme developed in response to the assessment of historic character, and the understood sensitivity to any aesthetic changes to the Central Avenue/Murphy Bridle Path, is developed from the Semi-Soft Structural flood protection method (Figure 5.4.3).

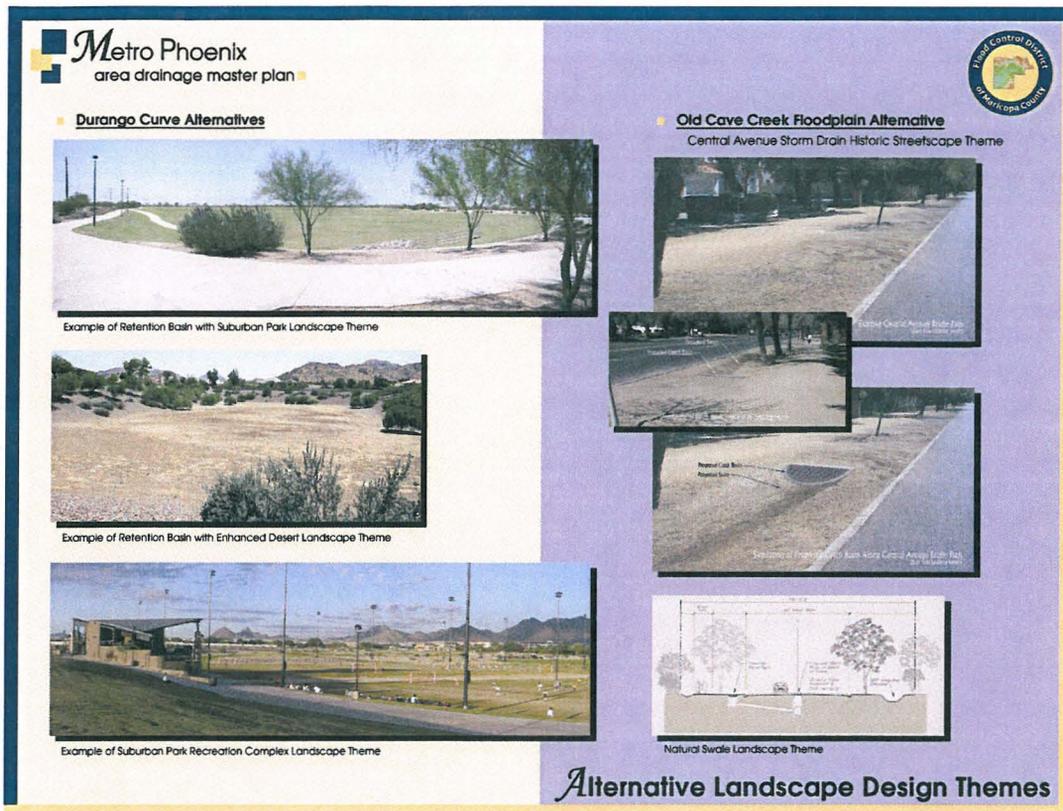


Figure 5.4.3

## 6.0 COST ESTIMATING

Cost estimates were prepared for each alternative based upon the unit and quantity of materials necessary to construct that alternative. Those materials include, among other things, linear feet of various sized storm drain pipe, cubic yard of cut/fill material for the constructions of basin storage areas, utility relocation costs per mile of storm drain mainline, square feet of right-of-way necessary for the proposed improvements, raising homes for flood proofing including temporary relocation of residents, and assessed value plus moving/relocation costs for the acquisition of private property. The costs for unit prices came from recently constructed COP and District projects. For this level of analysis the addition for contingencies is twenty percent. See the appendices for itemized cost estimates.

## 7.0 POTENTIAL ALTERNATIVES (Level I)

During Level I forty alternatives were developed to solve or improve the regional flooding problems. After the Level I alternatives review meeting and passing an analysis by the project team, this number was reduced to thirty-two and these alternatives were carried forward into Level II (see the Level I report).

## 8.0 ALTERNATIVES

The thirty-two alternatives have been further evaluated and refined. Following is the description of these evaluations and refinement of these alternatives.

## **8.1 Old Cave Creek Floodplain (ACDC to Grand Canal)**

### **8.1.1 No Action**

The no action alternative will result in continued flooding problems in the old Cave Creek floodplain area. These problems include house flooding and disruption to vehicular traffic due to flooded streets. Some of the specific flood problems identified with this study include:

- Frequent flooding of low lying houses along Central Avenue (Central Avenue doesn't have a storm drain or curb and gutter north of Bethany Home Road)
- Flooding of homes in the area north of Glendale Avenue and east of 15<sup>th</sup> Avenue (this area is lower than the crowns of 15<sup>th</sup> Avenue and Glendale Avenue)
- Flooding of properties along the downstream side of Bethany Home Road (Bethany is essentially level in an east-west direction which results in downstream flooding once the storm drain capacity is exceeded)
- 23<sup>rd</sup> Avenue Storm Drain terminates at Northern Avenue resulting in flooding along Northern Avenue
- Flooding of properties along the downstream side of Butler Avenue (as is the case with Bethany Home, Butler is essentially level in an east-west direction. The flat slope creates very little conveyance capacity in the street which results in flooding of the downstream properties once the street capacity is exceeded. This is a common problem throughout the old Cave Creek floodplain area.)

Cost = \$0

### **8.1.2 10-year Storm Drain System without Storage (See Exhibit 2.2)**

This potential solution is to increase the capacity of the existing 2-year storm drain system to a 10-year design for the area between I-17 and Central Avenue. It includes new storm drains in 21<sup>st</sup> Avenue, 15<sup>th</sup> Avenue, 3<sup>rd</sup> Avenue, and Central Avenue. This solution is dependent on all the elements of the Cave Creek Floodplain solution being in place. The following individual alternative elements make up this solution:

- Alternative 01 – 21<sup>st</sup> Avenue Storm Drain, Northern Ave. to Grand Canal (10-year design) – 4.1 Linear miles
- Alternative 02 – Central Avenue Storm Drain, Arizona Canal to Bethany Home Rd. (10-year design) – 2.2 Linear miles
- Alternative 03 – 3<sup>rd</sup> Avenue Storm Drain, Bethany Home Rd. to Grand Canal (10-year design) – 1.4 Linear miles
- Alternative 04 – 15<sup>th</sup> Avenue Storm Drain, Butler Dr. to Grand Canal (10-year design) – 4.1 Linear miles

Utility conflicts to be addressed:

1. 15<sup>th</sup> Avenue – There is an existing 30” sanitary sewer line that is a potential problem. The existing storm drain is approximately 6’ lower than the sanitary sewer. A new parallel storm drain in 15<sup>th</sup> Avenue would likely be at the same depth as the existing and therefore shouldn't conflict with the existing sanitary sewer.

2. 7<sup>th</sup> Avenue – The existing storm drain and 30” sanitary sewer lines are manageable. There is horizontal separation and vertical separation will not be an issue since it is not being crossed.

Opportunities

- Increase to a 10-year Level of protection for a large area when all proposed storm drains are constructed
- Requires no additional right-of-way

Constraints

- The Murphy Bridle Trail is considered very important to the local residents and needs to be preserved because of its historic designation
- Potential problem with utility conflicts particularly along 15<sup>th</sup> Avenue.
- Central Avenue Storm Drain – The new storm drain would be located in the center of the road and would not impact the bridle path. The majority of the inlets will be located on the connecting side streets with a few additional inlets located discreetly down the east side of Central Avenue.

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
1	New Storm Drain in 21st Avenue (10-year, 4.1 miles)	\$ 29,819,000.00
2	New Storm Drain Extension in Central Avenue (2-year, 2.2 miles)	\$ 8,732,400.00
3	New Storm Drain in 3rd Avenue (10-year, 1.4 miles)	\$ 5,843,700.00
4	New Parallel Storm Drain in 15th Avenue (Supplement 10-year, 4.1 miles)	\$ 31,973,000.00
<b>TOTAL</b>		<b>\$ 76,368,100.00</b>

**8.1.3 10-year Storm Drain with Storage at Palo Verde Golf Course (See Exhibit 2.3)**

This potential solution would increase the capacity of the existing 2-year storm drain system to a 10-year design for the area between I-17 and Central Avenue. It includes new storm drains in 21<sup>st</sup> Avenue, 15<sup>th</sup> Avenue, 3<sup>rd</sup> Avenue, and Central Avenue, new 10-year storage basin within Palo Verde Golf Course at 15<sup>th</sup> Avenue and Maryland, as well as new laterals in the drainage areas downstream of the golf course to increase the existing storm drain to a 10-year level of protection. This solution is dependent on all the elements of the Cave Creek Floodplain solution being in place. This alternative includes the following individual alternative elements:

- Alternative 01 – 21<sup>st</sup> Avenue Storm Drain, Northern Ave. to Grand Canal (10-year design) – 4.1 Linear miles
- Alternative 02 – Central Avenue Storm Drain, Arizona Canal to Bethany Home Rd. (2-year design) – 2.2 Linear miles
- Alternative 03 – 3<sup>rd</sup> Avenue Storm Drain, Bethany Home Rd. to Grand Canal (10-year design) – 1.4 Linear miles

- Alternative 05 – 15<sup>th</sup> Avenue Storm Drain, Butler Drive to Maryland Ave., with Storage at Palo Verde Golf Course (32 acres providing 130 acre-feet) and new storm drain laterals downstream of Palo Verde G.C.(10-year design) – 2.1 Linear miles

There are utility conflicts to be addressed including:

1. 15<sup>th</sup> Avenue – There is an existing 30” sanitary sewer line that is a potential problem. The existing storm drain is approximately 6’ lower than the sanitary sewer. A new parallel storm drain in 15<sup>th</sup> Avenue would likely be at the same depth as the existing and therefore shouldn’t conflict with the existing sanitary sewer.
2. 7<sup>th</sup> Avenue – The existing storm drain and 30” sanitary sewer lines are manageable. There is adequate horizontal separation and vertical separation will not be an issue since it is not being crossed.

Opportunities

- Increase to a 10-year Level of protection for a large area when all proposed storm drains are constructed
- The reconstructed golf course would provide significant storm water storage
- The reconstructed golf course would be more interesting and it is anticipated that it would be economically viable
- The City owns the golf course, therefore new right-of-way is unnecessary
- Precludes the need for the 15<sup>th</sup> Avenue storm drain downstream of the golf course; avoiding potential difficult utility relocations

Constraints

- The Murphy Bridle Trail is considered very important to the local residents and needs to be preserved because of its historic designation
- Potential problem with utility conflicts particularly along 15<sup>th</sup> Avenue.
- Central Avenue Storm Drain – The storm drain will be located in the center of the road and will not impact the bridle path. The majority of the storm drain inlets will be located in the adjacent side streets with a few additional inlets located discreetly along the east side of Central Avenue.
- Palo Verde Golf Course – The COP is currently deciding what to do with the Palo Verde Golf Course. Depending upon that decision this alternative may be unfeasible.

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
1	New Storm Drain in 21st Avenue (10-year, 4.1 miles)	\$ 29,819,000.00
2	New Storm Drain Extension in Central Avenue (2-year, 2.2 miles)	\$ 8,732,400.00
3	New Storm Drain in 3rd Avenue (10-year, 1.4 miles)	\$ 5,843,700.00
5	15th Avenue Storm Drain and Storage in Palo Verde Golf Course (10-year, 130 acre-feet, 2.1 miles)	\$ 37,971,800.00
<b>TOTAL</b>		<b>\$ 82,366,900.00</b>

### 8.1.4 Floodproofing (See Exhibit 2.4)

This potential solution raises the floor elevations of homes within the old Cave Creek floodplain that experience repetitive flooding. The homes are typically slab-on-grade construction so the home will be taken off the slab, fill will be placed underneath the home, a new slab constructed, and the home will be set back down having a higher finished floor elevation. The utilities on many of the homes may need to be upgraded to conform to the current standards. The number of homes that would receive floodproofing was estimated from the reported flood complaints as 43 and is documented in the Data Collection Report. This solution includes the following individual alternative elements:

- Alternative 06 – Floodproofing

#### Opportunities

- This solution would protect low-lying homes from flooding

#### Constraints

- This solution does not prevent the disruption caused by street flooding
- This solution does not prevent property flooding
- This solution only solves flooding problems for individual residents based upon the desire of the property owners to participate

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
6	Floodproofing (43 homes)	\$ 9,030,000.00
<b>TOTAL</b>		<b>\$ 9,030,000.00</b>

## 8.2 Cave Creek Floodplain (Grand Canal to I-10)

### 8.2.1 No Action

The no action alternative will result in no change to the existing floodplain boundaries which encompass thousands of properties, requiring owners to purchase flood insurance. In addition, shallow flooding in the area results in house flooding and causes disruption to vehicular traffic due to flooded streets. Some of the specific flooding problems identified with this study include:

- Over 2000 homes and businesses located within the designated floodplain, requiring property owners to purchase flood insurance.
- Flooding of properties along the downstream side of Osborn Road between 19<sup>th</sup> Avenue and 7<sup>th</sup> Avenue (Osborn Road is very flat in the east west direction. The flat slope creates very little conveyance capacity in the street which results in flooding of the downstream properties once the street capacity is exceeded. This is a common problem throughout the Cave Creek floodplain area.)

Cost = \$0

### 8.2.2 10-year Storm Drain with Storage at Encanto Golf Course (See Exhibit 3.2)

This potential solution would increase the capacity of the existing 2-year storm drain system to a 10-year design for the area between I-17 and Central Avenue. It includes new storm drains in 18th Avenue, 15<sup>th</sup> Avenue, Thomas Road, and 3<sup>rd</sup> Avenue, new 10-year, 400 ac-ft storage basin within Encanto Golf Course at 15<sup>th</sup> Avenue and Thomas, as well as new laterals in the areas downstream of the golf course to increase the existing storm drain system to a 10-year level of protection. Excess runoff from storms larger than the 10-year event would be conveyed in the streets providing homes with a level of protection that exceeds the 10-year flood. This solution is dependent on all of the elements of one of the two solutions for the Old Cave Creek Floodplain being in place. This solution includes the following individual alternative elements:

- Alternative 7 – Storage at Encanto Golf Course (10-year design, 400 ac-ft)
- Alternative 8 – 18<sup>th</sup> Avenue Storm Drain, Grand Canal to Thomas Rd. (10-year design) – 1.5 Linear mile (0.7 Linear miles for major lateral)
- Alternative 9 – Thomas Road Storm Drain, 24<sup>th</sup> Ave. to 18<sup>th</sup> Ave. (10-year design) – 0.7 Linear miles
- Alternative 10 – 15<sup>th</sup> Avenue Storm Drain, Grand Canal to Thomas Rd. (10-year design) – 1.5 Linear Miles
- Alternative 11 – 3rd Avenue Storm Drain, Grand Canal to Thomas Rd. (10-year design) – 2.1 Linear miles

#### Opportunities

- The reconstructed golf course would provide significant storm water storage
- The reconstructed golf course would be more interesting and economically viable
- The City owns the golf course, therefore new right-of-way is unnecessary

#### Constraints

- Encanto Golf Course – The front nine is part of the historic registry; this may prevent some of the work from being completed. Also, the back nine is up for historical registration.
- Proposed storm drain crosses numerous water and sewer service lines; however, no main lines interfere with the proposed pipe alignment.

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
7	Storage in Encanto Municipal Golf Course (400 acre-feet)	\$ 41,856,800.00
8	New Storm Drain in 18th Avenue (10-year, 1.5 miles)	\$ 16,231,800.00
9	New Storm Drain in Thomas Road (10-year, 0.7 miles)	\$ 3,877,000.00
10	New Parallel Storm Drain in 15th Avenue (10-year, 1.5 miles)	\$ 21,649,400.00
11	New Storm Drain in 3rd Avenue (10-year, 2.1 miles)	\$ 14,836,500.00
<b>TOTAL</b>		<b>\$ 98,451,500.00</b>

### 8.2.3 Floodproofing (See Exhibit 3.3)

This potential solution is to raise the floor elevations of the homes within the old Cave Creek floodplain that experience repetitive flooding. The homes are typically slab-on-grade construction so the home will be taken off the slab, fill will be placed underneath the home, a new slab constructed, and the home will be set back down having a higher finished floor elevation. The utilities on many of the homes may need to be upgraded to conform to the current standards. The number of homes that would receive floodproofing was estimated from the reported flood complaints documented in the Data Collection Report. Although this solution would protect low-lying homes from flooding, it would not prevent the disruption caused by street flooding nor would it prevent property flooding. This solution includes the following individual alternative elements:

- Alternative 12 – Floodproofing

#### Opportunities

- This solution would protect low-lying homes from flooding

#### Constraints

- This solution does not prevent the disruption caused by street flooding
- This solution does not prevent property flooding
- This solution only solves flooding problems for individual residents based upon the desire of the property owners to participate

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
12	Floodproofing (20 homes)	\$ 4,200,000.00
<b>TOTAL</b>		<b>\$ 4,200,000.00</b>

## 8.3 GRAND CANAL FLOODPLAIN (I-17 to 24<sup>th</sup> Street)

### 8.3.1 No Action

The no-action alternative will not eliminate the existing floodplain nor will it alleviate the frequent flooding problems experienced by some of the neighborhoods located along the Canal. However, if the 10-year storm drain system is installed upstream of the Canal (refer to solutions described in Section 1.0), the frequency of flooding will be substantially reduced. Some of the specific flood problems identified with this study include:

- Over 500 homes and businesses are located within the designated floodplain, requiring property owners to purchase flood insurance.
- The neighborhood between 3<sup>rd</sup> Street and 12<sup>th</sup> Street has flooded repeatedly over the past several years.

Cost = \$0

**8.3.2 Buyout Homes and Resell Lots in Floodplain (See Exhibit 4.2)**

This potential solution involves buying out the single-family homes that are located within the floodplain and reselling the lots. This solution does not provide any flood control benefit downstream, it only removes the homes from the floodplain. The buyers would construct new homes with finished floors located above the Canal bank. This solution would protect the residential homes from flooding, but the businesses would still be susceptible to flooding. This solution includes the following individual alternative element.

- Alternative 13 – Buyout Homes and Re-sell Lots (100-year design, 507 homes)

Opportunities

- For those homeowner desiring to move this is a good opportunity for them to sell a property that is hindered with flooding problems and flood insurance requirements
- New residences, built above the 100-year floodplain, would likely increase the value of the surrounding neighborhood

Constraints

- Buying Homes – There are serious political limitations and liabilities involved with the buy-out program and some homeowners may not want to participate. If they do not want to participate, the decision must be made on whether or not to obtain the property through condemnation
- High cost

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
13	Buyout Homes and Resell Lots in Floodplain (100-year, 507 homes)	\$ 80,394,700.00
<b>TOTAL</b>		<b>\$ 80,394,700.00</b>

**8.3.3 Buyout Homes and Create Storage Basins with Linear Park (See Exhibit 4.3)**

This potential solution involves buying out the existing single-family homes that are located within the floodplain, demolishing the homes and turning the property into floodwater storage basins. The combined area is about 155 acres which could provide approximately 700 acre-feet of storage. This is a substantial volume which, when combined with the existing storm drain system, could probably store enough runoff to contain the 10-year flood. And, since the homes would be removed from the floodplain, floods greater than the 10-year flood would simply spill over the Canal without causing upstream flooding. Some businesses would still be susceptible to flooding, but the 10-year storage system would greatly reduce the chance of flooding. The basins would be developed into parks/open space and connected by a trail system creating a 4.5 mile long linear park along the Canal. This solution includes the following individual alternative element.

- Alternative 14 – Storage Basins and Linear Park (100-year design)

Opportunities

- The addition of the a linear park would provide a new recreation component to each neighborhood and enhance the trail system along the Grand Canal
- The new parks would provide significant storm water storage

Constraints

- Buying Homes – There are serious political liabilities and some homeowners may not want to participate. If they do not want to participate, the decision must be made on whether or not to obtain the property through condemnation.
- Very high cost

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
14	Buyout Homes (411 homes) and Create Storage Basins and Linear Park in Floodplain	\$ 190,813,300.00
<b>TOTAL</b>		<b>\$ 190,813,300.00</b>

**8.3.4 Floodproofing (See Exhibit 4.4)**

This potential solution involves raising the finished floor elevations of the homes within the old Cave Creek floodplain that experience repetitive flooding. The homes are typically slab-on-grade construction so the home will be taken off the slab, fill will be placed underneath the home, a new slab constructed, and the home will be set back down having a higher finished floor elevation. The utilities on many of the homes may need to be upgraded to conform to the current standards. This solution does not provide any flood control benefit downstream, it only removes the homes from the floodplain. There are approximately 520 homes that would be floodproofed based upon reported flood complaints documented in the Data Collection Report. Although this solution would protect low-lying homes from flooding, it would not prevent the disruption caused by street flooding nor would it prevent property flooding. This solution includes the following individual alternative elements:

- Alternative 15 – Floodproofing

Opportunities

- This solution would protect low-lying homes from flooding

Constraints

- This solution does not prevent the disruption caused by street flooding
- This solution does not prevent property flooding
- This solution only solves flooding problems for individual residents based upon the desire of the property owners to participate
- The potential for increased flood hazard goes up to those property owners that don't elect to floodproof

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
15	Floodproofing (100-year, 507 homes)	\$ 85,470,000.00
<b>TOTAL</b>		<b>\$ 85,470,000.00</b>

## 8.4 DOWNTOWN AREA

### 8.4.1 No Action

The no action alternative will result in no change to the existing flooding problems in the Downtown area which encompasses the offices of State, County and City government, as well as ASU's Downtown Campus, numerous high-rise commercial office buildings, the Baseball stadium, and the Basketball arena. The no action alternative leaves this center of government and commerce susceptible to flooding of buildings and traffic disruption. Some specific flooding issues include:

- There are numerous locations where water stands for long period of times because the catch basins are dysfunctional drywells,
- The storm of August 2005 resulted in traffic disruption and flooded buildings.

Cost = \$0

### 8.4.2 10-year Storm Drain between I-10 and I-17 (See Exhibit 5.2)

This solution increases the level of protection provided by the storm drain system to a 10-year design, however, it only covers the portion of the Downtown area that lies north of Jackson Street (the Union Pacific Railroad Tracks). It was found that this northern portion of the downtown area, which represents about half of the total area, could be protected from the 10-year flood by simply supplementing the existing storm drains. That is, this solution does not require any new outfall pipes to the Salt River. It is based on the assumption that the upstream flows in the 15<sup>th</sup> Avenue and 19<sup>th</sup> Avenue storm drains will be stored and/or diverted upstream of I-10, leaving the capacity of those pipes to convey runoff from the Downtown Area. The diversion of the 15<sup>th</sup> and 19<sup>th</sup> Avenue storm drains is part of the solution for this ADMP within the Cave Creek Floodplain area (Section 8.2.2). This solution takes advantage of the Tunnel connections at Fillmore, Grant and Tonto Streets that were built by ADOT, at the City's request, during construction of the Tunnel. It also takes advantage of the excess capacity in the City's storm drains that was created when the construction of I-10 diverted upstream flows, this includes the storm drains in 16<sup>th</sup> Street, 3<sup>rd</sup> Street and 11<sup>th</sup> Avenue. The following individual alternative elements make up this solution:

- Alternative 16 – Add inlets to the 16<sup>th</sup> Street Storm Drain, I-10 to Railroad (10-year design)
- Alternative 17 - Fillmore Street (East) Storm Drain, 13<sup>th</sup> St. to West Tunnel (10-year design) – 1.4 Linear miles

- Alternative 18 – 9<sup>th</sup> Street Storm Drain, Van Buren to Grant (10-year design) – 1.3 Linear miles
- Alternative 19 – Fillmore Street (West) Storm Drain, Central Ave. to 9<sup>th</sup> Ave. (10-year design) – 1.1 Linear miles
- Alternative 20 – 3<sup>rd</sup> Avenue Storm Drain, Van Buren St. to Tonto St. (10-year design) – 1.1 Linear miles
- Alternative 21 - Add inlets to the 15<sup>th</sup> Ave. Storm Drain, I-10 to Railroad (10-year design)
- Alternative 22 - Add inlets to the 19<sup>th</sup> Ave. Storm Drain, I-10 to Railroad (10-year design)

This solution includes two new storm drains that outfall to the Salt River; located in 7<sup>th</sup> Street and 7<sup>th</sup> Avenue. It also includes an additional storm drain connection to the West Tunnel; located on the upstream side of I-17. This solution is based upon the assumption that the upstream flows in the 15<sup>th</sup> Avenue and 19<sup>th</sup> Avenue storm drains will be stored and/or diverted upstream of I-10, leaving the capacity of those pipes to collect runoff in the Downtown Area. The following individual alternative elements make up this solution:

- Alternative 23 – 7<sup>th</sup> Street Storm Drain, Sherman St. to Salt River (10-year design) – 1.3 Linear miles
- Alternative 24 – 3<sup>rd</sup> Avenue (South) Storm Drain, Buckeye Rd. to I-17 (10-year design) – 0.8 Linear miles
- Alternative 25 – 7<sup>th</sup> Avenue Storm Drain, Grant St. to Salt River (10-year design) – 1.5 Linear miles

Utility conflicts to be addressed:

1. Sanitary Sewer Line – There is an existing 66” sanitary sewer line that is a potential problem. The sewer alignment runs from east to west in Watkins Street which is south of and parallel to I-17. The proposed pipes would have to be shallow in order to pass over the sewer line. If the proposed pipes were to be located below the sewer line, they would be below the bottom of the Salt River and would have to be a bubble up system similar to the ADOT tunnels.

#### Opportunities

- The COP currently has some funding available for drainage improvements in the downtown area
- Provides an increase in the level of protection to a large area containing significant commercial, education, civic, entertainment, state and local government buildings
- An agreement is in place, between the City and ADOT, to discharge storm water into ADOT’s west tunnel at four locations
- Many of the existing storm drain main lines are under utilized due to being cut off by I-10.

#### Constraints

- Disruption during construction
- Potential difficult utility relocations

- Construction – The downtown areas has been under heavy construction for the Light Rail so it may be unpleasant to propose storm drains that would cause more construction in the future.

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
16	Modifications to 16th Street Storm Drain	\$ 1,012,100.00
17	Fillmore Street (East) Storm Drain (1.4 miles)	\$ 6,118,300.00
18	9th Street Storm Drain (1.3 miles)	\$ 8,083,400.00
19	Fillmore Street (West) Storm Drain (1.1 miles)	\$ 5,564,600.00
20	3rd Avenue (North) Storm Drain (1.1 miles)	\$ 5,713,100.00
21	Modifications to 15th Avenue Storm Drain	\$ 949,300.00
22	Modifications to 19th Avenue Storm Drain	\$ 949,300.00
23	7th Street Storm Drain (1.3 miles)	\$ 6,239,600.00
24	3rd Avenue (South) Storm Drain (0.8 miles)	\$ 3,964,100.00
25	7th Avenue Storm Drain (1.5 miles)	\$ 8,659,000.00
<b>TOTAL</b>		<b>\$ 47,252,800.00</b>

## 8.5 DURANGO CURVE AREA

### 8.5.1 No Action

The no action alternative will result in no change to the existing floodplain boundaries which encompass hundreds of properties, requiring owners to purchase flood insurance. In addition, flooding in the area results in house flooding and causes disruption to vehicular traffic due to flooded streets. Some of the specific flood problems identified with this study include:

- The depressed section of I-17 becomes flooded and impassable on a fairly frequent basis.
- Over 670 homes and businesses are located within the designated floodplain, requiring property owners to purchase flood insurance.
- Properties south of Buckeye Road and west of 19<sup>th</sup> Avenue are susceptible to flooding up to 3-ft in depth since they lie in the upstream floodpool of the Durango Curve Area.

Cost = \$0

### 8.5.2 100-year Collection System without Storage (See Exhibit 6.2)

This potential solution is for a new storm drain system that would intercept and convey stormwater from the Durango Curve area while preventing I-17 from flooding. This 100-year system is based on the assumption that new 10-year systems are located upstream within both the Cave Creek Floodplain area and the Downtown area. New storm drains would be located in the I-17 frontage road and in Durango Street. The combined inflow will discharge into a new outlet pipe that follows Durango Street west to 27<sup>th</sup> Avenue and then 27<sup>th</sup> Avenue south to the Salt River. This solution is based on the Old Cave Creek Floodplain, Cave Creek Floodplain, and

downtown solutions being in place. The following individual alternative elements make up this solution:

- Alternative 26 – 100-year Collection System without Storage

Utility conflicts to be addressed:

I-17 – There are many utilities adjacent to I-17. Proposed storm drain crosses numerous water and sewer service lines; however, no main lines interfere with the proposed pipe alignment.

Opportunities

- From a drainage standpoint this is the upstream concentration point where collection of runoff is the most convenient
- Protect I-17 and homes from flooding

Constraints

- Located within an identified environmental hazardous materials area of concern (HMAC)
- Difficult construction with large outfall box culvert and large diameter collection pipes
- Construction of box culvert under I-17

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
26	New Conveyance System from Durango Curve to Salt River	\$ 83,431,700.00
<b>TOTAL</b>		<b>\$ 83,431,700.00</b>

**8.5.3 100-year Collection System with Single Storage Basin (See Exhibit 6.3)**

This potential solution is for a new storm drain system to intercept and convey stormwater runoff and discharge that runoff into a new storage basin located in the Durango Curve area. The basin and storm drains are sized for the 100-year event assuming that there is a new 10-year system in place upstream. New storm drains would be located in the I-17 frontage road, Pima Street, and in Durango Street. A metered outflow of 400 cfs will be conveyed in a new storm drain, from the storage basin, west in Durango Street to 27<sup>th</sup> Avenue and then south in 27<sup>th</sup> Avenue to the Salt River. This solution is based on the Old Cave Creek Floodplain, Cave Creek Floodplain, and downtown solutions being in place. The following individual alternative elements make up this solution:

- Alternative 27 – 100-year Design with a Single Storage Basin (35 acres, 155 acre-feet, 250 cfs outflow)

Utility conflicts to be addressed:

I-17 – There are many utilities adjacent to I-17. Proposed storm drain crosses numerous water and sewer service lines; however, no main lines interfere with the proposed pipe alignment.

### Opportunities

- From a drainage standpoint this is the upstream concentration point where collection of runoff is the most convenient
- Provides a significant storm water storage basin
- The new detention basin offers opportunity for a public park or recreation complex
- Significantly reduces the size of the outfall pipe to the Salt River
- Protect I-17 and homes from flooding

### Constraints

- Located within an identified environmental hazardous materials area of concern (HMAC)
- The purchase of properties may be difficult in this highly industrial area. Some property owners may not want to participate. If they do not want to participate, the decision must be made on whether or not to obtain the property through condemnation
- There is an existing low income housing complex adjacent to the proposed detention basin. Disruption to this site should be avoided.

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
27	New Storage Basin at Durango Curve with Conveyance to Salt River (35 acres, 155 acre-feet, 250 cfs outflow)	\$ 74,146,100.00
<b>TOTAL</b>		<b>\$ 74,146,100.00</b>

#### **8.5.4 100-year Collection System with Multiple Storage Basins (See Exhibit 6.4)**

This potential solution is for a new storm drain system to intercept and convey stormwater runoff and discharge that runoff into two new storage basins located in the Durango Curve area. The basins and storm drains are sized for the 100-year event assuming that there is a new 10-year system in place upstream. The first storage basin would be located within the existing Cave Creek floodplain north of the Union Pacific Railroad to Washington Street and adjacent to I-17 to 21<sup>st</sup> Avenue on the eastern side (28 acres, 170 acre-feet). This basin would collect the 100-year flood and meter out 200 cfs to a new storm drain in the 1-17 frontage road that would convey the runoff to the second storage basin. This basin has Durango Street as its southern boundary, I-17 frontage road as its western boundary, Buckeye Road to the north and 21<sup>st</sup> Ave as the eastern boundary. Additional new storm drains would be located in Pima Street and in Durango Street to help capture more flow. A metered outflow of 400 cfs would be conveyed, from the second storage basin, within a new storm drain west in Durango Street to 27<sup>th</sup> Avenue and then south in 27<sup>th</sup> Avenue to the Salt River. This solution is based on the Old Cave Creek Floodplain, Cave Creek Floodplain, and Downtown solutions being in place. The following individual alternative elements make up this solution:

- Alternative 28 – 100-year Collection System with Multiple Storage Basins (28 acres, 170 acre-feet, 400 cfs outflow and 20 acres, 124 acre-feet, 340 cfs outflow)

Utility conflicts to be addressed:

I-17 – There are many utilities adjacent to I-17. Proposed storm drain crosses numerous water and sewer service lines; however, no main lines interfere with the proposed pipe alignment.

Political conflicts to be addressed:

1. Residential/Commercial/Light Industrial – There are serious political liabilities and some property owners may not want to participate. If they do not want to participate, the decision must be made on whether or not to obtain the property through condemnation.

Opportunities

- From a drainage standpoint this is the upstream concentration point where collection of runoff is the most convenient
- Provides a significant storm water storage basin
- The new retention basin offers opportunity for two new public parks or recreation complexes.
- Significantly reduces the size of the outfall pipe to the Salt River
- Reduces the collection pipe size along I-17 north of the Durango Curve compared to the single storage basin alternative
- Protects I-17 and homes from flooding

Constraints

- The southern park/storm water storage area is located within an identified environmental hazardous materials area of concern (HMAC)
- There are homes that have a historic designation in the upper retention basin
- There is an existing low income housing complex adjacent to the southern detention basin. Disruption to this site should be avoided.

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
28	Multiple Storage Basins with Conveyance to Salt River (28 acres, 170 acre-feet, 400 cfs and 20 acres, 120 acre-feet, 340 cfs)	\$ 80,827,100.00
<b>TOTAL</b>		<b>\$ 80,827,100.00</b>

**8.6 ARIZONA COUNTRY CLUB SWALE**

**8.6.1 No Action**

The no action alternative will not result in any change to the existing conditions which effects the properties that are located along the flowline of the swale. The area is not within an existing floodplain and therefore, owners are not required to carry flood insurance. Flooding in the area typically results where the flow path is blocked by rows of homes built perpendicular to the swale. The flooding also results in a disruption to vehicular traffic due to flooded streets. Some of the specific flood problems identified with this study include:

- Residential flooding along the thalweg of the swale.
- Residential and street flooding where flow is blocked by structures and fences

Cost= \$0

### 8.6.2 10-year Storm Drain (Thomas Road) (See Exhibit 7.2)

This potential solution is for a new system that would intercept and convey stormwater within a new storm drain located in Thomas Road. This 10-year system would begin on Thomas Road just east of 60<sup>th</sup> Street so as to intercept flow from the south. The storm drain outlets into the Old Cross Cut Canal. A new storm drain lateral would be located in 56<sup>th</sup> Street beginning at the low point of the swale and continuing, to the south, to Thomas Road. The following individual alternative elements make up this solution:

- Alternative 29 – Thomas Road Storm Drain, 62<sup>nd</sup> St. to Old Cross Cut Canal (10-year design)

#### Opportunities

- Provide increased flooding protection to residents located within the low flow swale north of Thomas Road

#### Constraints

- Traffic disruption during construction

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
29	New Storm Drain in Thomas Road (10-year, 1.6 miles)	\$ 10,426,300.00
<b>TOTAL</b>		<b>\$ 10,426,300.00</b>

## 8.7 ARCADIA AREA

### 8.7.1 No Action

The no action alternative will result in no change to the existing conditions. Some of the specific flooding problems identified with this area are:

- Flooding of residential properties located within the flow corridors between Camelback Mountain and the Arizona Canal.
- Flood hazard to the properties that are located within the existing FEMA floodplain on the upstream side of the Arizona Canal. These properties are subject to serious, repetitive and frequent flood losses due to the lack of an adequate stormwater collection system.

Cost = \$0

### 8.7.2 10-year Storm Drain System (See Exhibit 8.2)

This potential solution is described as Alternative 2 in the report by Huitt-Zollars (*Final Recommendations Report-March 1997*) and consists of several components including the following:

- 40<sup>th</sup> Street Storm Drain, beginning at Camelback Road and 41<sup>st</sup> Street, west in Camelback Road to the Arizona Canal, north along the upstream side of the Arizona Canal within

SRP's right of way to 40<sup>th</sup> Street, north in 40<sup>th</sup> Street to Colter Street, west to the Cudia City Wash Sedimentation Basin and discharges to the ACDC.

- Arcadia Drive Storm Drain from Camelback Road to the Arizona Canal including a new undercrossing of the Canal and connection to the existing downstream conveyance channel (Old Cross Cut Canal).
- Camelback Road Storm Drain from ¼ mile east of 56<sup>th</sup> Street to Arcadia Drive.
- Camelback Road Storm Drain from Dromedary Road to Arcadia Drive.
- Lafayette Boulevard Storm Drain, beginning at Colter Street and 44<sup>th</sup> Street, south in 44<sup>th</sup> Street to Camelback Road, south and then east in Lafayette Boulevard to Arcadia Drive.
- 64<sup>th</sup> Street Storm Drain, beginning at Jokake Road and Camelback Road, east in Camelback Road to 64<sup>th</sup> Street and then south in 64<sup>th</sup> Street to Lafayette Boulevard where it connects to an existing storm drain.

Opportunities

- Acceptance by the local residents within the ACMHOA
- Provides a 10-year level of protection

Constraints

- Disruption on local residential streets during construction
- The character of Camelback Road is considered very important to the local residents and needs to be preserved
- Utility conflicts
- Obtaining right of way from SRP

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
30	10-year Camelback Road Collection System (Huitt Zoellers Alternate 2)	\$ 25,110,700.00
<b>TOTAL</b>		<b>\$ 25,110,700.00</b>

**8.7.3 10-year Storm Drain System (See Exhibit 8.3)**

This potential solution is described as Alternative 3 in the report by Huitt-Zollars (*Final Recommendations Report-March 1997*) and consists of several components including the following:

- 40<sup>th</sup> Street Storm Drain, beginning at Camelback Road and 41<sup>st</sup> Street, west in Camelback Road to the Arizona Canal, north along the upstream side of the Arizona Canal within SRP's right of way to 40<sup>th</sup> Street, north in 40<sup>th</sup> Street to Colter Street, west to the Cudia City Wash Sedimentation Basin and discharges to the ACDC.
- Arcadia Drive Storm Drain from Lafayette Boulevard to the Arizona Canal including a new undercrossing of the Canal and connection to the existing downstream conveyance channel (Old Cross Cut Canal).
- Lafayette Boulevard Storm Drain, beginning at Colter Street and 44<sup>th</sup> Street, south in 44<sup>th</sup> Street to Camelback Road, south and then east in Lafayette Boulevard to Arcadia Drive.

- Indian School Road Storm Drain from 52<sup>nd</sup> Street to the Old Cross Cut Canal at 48<sup>th</sup> Street.
- Osborn Road Storm Drain, beginning at 54<sup>th</sup> Street and Lafayette Boulevard, east in Lafayette Boulevard to 56<sup>th</sup> Street, south in 56<sup>th</sup> Street under the Arizona Canal to Osborn Road, east in Osborn Road to the Old Cross Cut Canal at 48<sup>th</sup> Street.

Opportunities

- Provides a 10-year level of protection

Constraints

- Not the preferred alternative by the local residents within the ACMHOA, and therefore likely to meet resistance
- Disruption on local residential streets during construction
- Utility conflicts
- The character of Camelback Road is considered very important to the local residents and needs to be preserved

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
31	10-year Lafayette Interceptor System (Huit Zoellers Alternate 3)	\$ 25,969,900.00
<b>TOTAL</b>		<b>\$ 25,969,900.00</b>

**8.8 AREA NORTH OF SKY HARBOR AIRPORT**

**8.8.1 No Action**

The no action alternative will result in no change to the existing conditions. Some of the specific flooding problems identified within this area are:

- Potential flooding of residential and commercial properties located, within the swale, along Washington Street.
- Potential flood hazard to the new light rail corridor in Washington Street.
- Missed opportunity to improve drainage conditions at Sky Harbor Airport.

Cost = \$0

**8.8.2 10-year Storm Drain System (See Exhibit 9.2)**

This potential solution includes cutting off the north-south flows from the existing 2-year storm drains in 24<sup>th</sup> Street, 32<sup>nd</sup> Street and 40<sup>th</sup> Street and convey this flow plus the local 10-year discharge in a new storm drain located in Van Buren Street. The three existing storm drains that are truncated at Van Buren Street provide a significant benefit for the Airport. The City's Aviation Department is currently investigating alternatives to improve drainage on the Airport property and they have expressed a desire to utilize these existing storm drains. Truncating the existing storm drains at Van Buren Street leaves them with considerable excess capacity through

the Airport. The new 10-year storm drain in Van Buren Street would ultimately discharge into ADOT's east tunnel located under I-10.

- Alternative 32 – Van Buren Street Storm Drain, 40<sup>th</sup> St. to I-10 (10-year design)

Opportunities

- Provides a 10-year level of protection in an area that is currently flood prone
- Frees up storm drain capacity within Sky Harbor Airport

Constraints

- Requires ADOT acceptance

Alternative	Description (See Appendix for Individual Alternative Itemized Cost)	Amount
32	New Storm Drain in Van Buren Street (10-year, 2.2 miles)	\$ 25,184,000.00
<b>TOTAL</b>		<b>\$ 25,184,000.00</b>

## 9.0 PUBLIC INPUT

Two public meetings were held during the Level II Analysis. The emphasis of these meetings was to present the public with the redelineation of the Cave Creek floodplain, present the developed alternatives for each flood prone area, and to determine the public preference for landscape aesthetic treatment that accompany the developed alternatives.

Many of the attendees were acutely interested in the outcome of the Cave Creek floodplain redelineation. In both the presentation and in one-on-one conversations the following was emphasized by the project team:

- The proposed floodplain redelineation will remove the floodplain between the downstream side of the Grand Canal and McDowell Road.
- The floodplain redelineation has been submitted to FEMA, but until FEMA approves the redelineation the homeowners will be required to maintain their flood insurance.
- That, after the floodplain is removed by FEMA, there are homes that are still susceptible to local flooding. These homeowners are strongly encouraged to maintain flood insurance which they will be able to get at a reduced rate.

The developed alternatives were presented with a wide mixture of responses. In general, people were in favor of the majority of the alternatives that directly affect their neighborhoods. There was not public representation for every area at the public meetings, therefore feedback was not obtained for every alternative. Residents that live in the Grand Canal floodplain were less pleased mainly due to the realization that the alternatives that could potentially help them are limited in scope with most of the alternatives involving the residents to move out of the neighborhood.

In general, the public was disappointed that all of these alternatives, with the exception of the downtown area where there is some funding available, are still years away from being implemented. This was especially true of the residents within the Grand Canal floodplain where many residents experience frequent flooding.

At the two public meetings, a series of presentation boards was set up for the public to view renderings of what the aesthetic treatments, for the alternatives, might look like. The public was then asked to fill out comment forms which included rating the public's choice of aesthetic treatment for the various alternatives. Approximately one-hundred people attended the first public meeting on July 31<sup>st</sup> while the second public meeting attendance was about twenty. The following table summarizes the public's choices regarding aesthetic treatment.

## **10.0 ALTERNATIVES EVALUATION/CONCLUSIONS**

A meeting was held at the District on August 21, 2007 to evaluate the potential solutions described in Sections 2 through 9 of this report. This evaluation meeting was attended by the study team as well as other representatives from the COP and the District. An evaluation matrix was completed during the meeting which documents the discussion regarding the opportunities and constraints of each of the alternatives. The evaluation matrix can be found at the end of this section. The input received at the public meetings, as well as at the stakeholder meetings, was considered as the team evaluated the potential alternatives.

### **10.1 Summary of the Evaluation of Alternatives**

The following is a brief summary regarding the decision to carry potential solutions forward to the Level II phase of the alternatives analysis.

#### *Old Cave Creek Floodplain (ACDC to Grand Canal)*

8.1.1 No Action

8.1.2 10-year Storm Drain System without Storage

8.1.3 10-year Storm Drain System with Storage

8.1.4 Floodproofing

It was decided that the 10-year storm drain system with storage would be in the recommended plan. If Palo Verde Golf course is not available, the 10-year storm drain system without storage will be used as a backup plan. The floodproofing alternative is the least expensive but it does not address the street flooding issue nor does it help alleviate the downstream flooding problems.

#### *Cave Creek Floodplain (Grand Canal to I-10)*

8.2.1 No Action

8.2.2 10-year Storm Drain System with Storage at Encanto Golf Course

8.2.3 Floodproofing

It was decided that the 10-year storm drain with storage at Encanto Golf Course would be in the recommended plan. The primary advantage of this solution is that there is no land acquisition cost associated with the Golf Course storage, in addition it could have a positive impact on the golf course making it more interesting from a player's standpoint, and enhancing its aesthetic appeal. The group decided to eliminate the 10-year storm drain without storage because it discharges at too high of a rate into ADOT's I-10 tunnel system.

#### *Grand Canal Floodplain (I-17 to 24<sup>th</sup> Street)*

8.3.1 No Action

8.3.2 Buyout Homes and Resell Lots in Floodplain

8.3.3 Buyout Homes and Create Storage Basins with Linear Park

8.3.4 Floodproofing

For the Level II analysis, a final decision was not reached. The project team is still considering all alternatives and based on further discussions with COP staff and community leaders will decide on the final approach.

#### *Downtown Area*

8.4.1 No Action

8.4.2 10-year Storm Drain System (between I-10 and I-17)

These storm drain solutions will be carried forward to the recommended plan. As part of the recommended plan, a new hydrology model will be created to size the storm drains and laterals and define the drainage area to each one. The connections to ADOT Tunnels will be coordinated with ADOT.

#### *Durango Curve Area*

8.5.1 No Action

8.5.2 100-year Collection System without Storage

8.5.3 100-year Collection System with Single Storage Basin

8.5.4 100-year Collection System with Multiple Storage Basins

It was decided that the 100-year collection system with single storage basin would be in the recommended plan. The multiple storage basin option is more expensive. The storm drain option had no multi-use opportunity.

#### *Arizona Country Club Swale*

8.6.1 No Action

8.6.2 10-year Storm Drain System

There was only one alternative, the Thomas Road storm drain, which will be carried forward in the recommended plan.

#### *Arcadia Area*

8.7.1 No Action

8.7.2 10-year Camelback Road Collection System (Huitt-Zollars Alternate 2)

8.7.3 10-year Lafayette Interceptor System (Huitt-Zollars Alternate 3)

These potential solutions were presented to the Arcadia residents in the 1990's and were met with significant opposition. Therefore, the COP and the District terminated further development of a flood control plan for Arcadia. It was decided that the project team would meet with local community leaders to see if there is any interest in pursuing either of these alternatives, or some other solution. After those meetings took place, it was decided that Alternate 2 will be carried forward to the recommended plan.

#### *Area North of Airport*

8.8.1 No Action

8.8.2 10-year Storm Drain System (includes diverting storm drain flows upstream of Airport)

There was only one alternative, the Van Buren Street storm drain, which will be carried forward to the recommended plan.

## **10.2 Table of Selected Alternatives**

The following table summarizes the potential solutions that will be carried forward to the Recommended Plan:

Potential Solution	Alternative	Description
<b>1B</b>	<b>1</b>	New SD in 21st Ave (10-Yr, Grand Canal to Northern Avenue)
	<b>2</b>	New SD Ext. in Central Ave (2-Yr, Bethany Home Rd. to Arizona Canal)
	<b>3</b>	New SD in 3rd Ave. (10-Yr, Grand Canal to Bethany Home Rd)
	<b>5</b>	Storage in Palo Verde Golf Course (10-Yr)
<b>2B</b>	<b>11</b>	Storage in Encanto Municipal Golf Course (10-Yr)
	<b>12</b>	New Storm Drain in 18th Avenue (10-year, Encanto G.C. to Grand Canal)
	<b>13</b>	New Storm Drain in Thomas Road (10-year, 24th Ave. to 18th Ave)
	<b>14</b>	New Parallel Storm Drain in 15th Avenue (10-year, Encanto G.C. to Grand Canal)
	<b>15</b>	New Storm Drain in 3rd Avenue (10-year, I-10 to Grand Canal))
<b>3A</b>	<b>21</b>	Buyout, Demolish and Resale Lots within the Floodplain
<b>3C</b>	<b>23</b>	Floodproofing
<b>4B</b>	<b>24</b>	Modifications to 16th Street Storm Drain
	<b>25</b>	Fillmore Street (East) Storm Drain
	<b>26</b>	9th Street Storm Drain
	<b>27</b>	Fillmore Street (West) Storm Drain
	<b>28</b>	3rd Avenue (North) Storm Drain
	<b>29</b>	Modifications to 15th Avenue Storm Drain
	<b>30</b>	Modifications to 19th Avenue Storm Drain
	<b>31</b>	7 <sup>th</sup> Street Storm Drain
	<b>32</b>	3 <sup>rd</sup> Avenue (South) Storm Drain
	<b>33</b>	7th Avenue Storm Drain
<b>5B</b>	<b>34</b>	New 100-Yr Storage Basin at Durango Curve with Conveyance to Salt River
<b>6A</b>	<b>37</b>	New 10-year Storm Drain in Thomas Road, Old Cross Cut Canal to 62nd St.
<b>7A</b>	<b>38</b>	10-year Camelback Road Collection System (Huitt-Zollars Alternate 2)
<b>8A</b>	<b>40</b>	10-year Storm Drain in Van Buren Street, I-10 to 40th Street

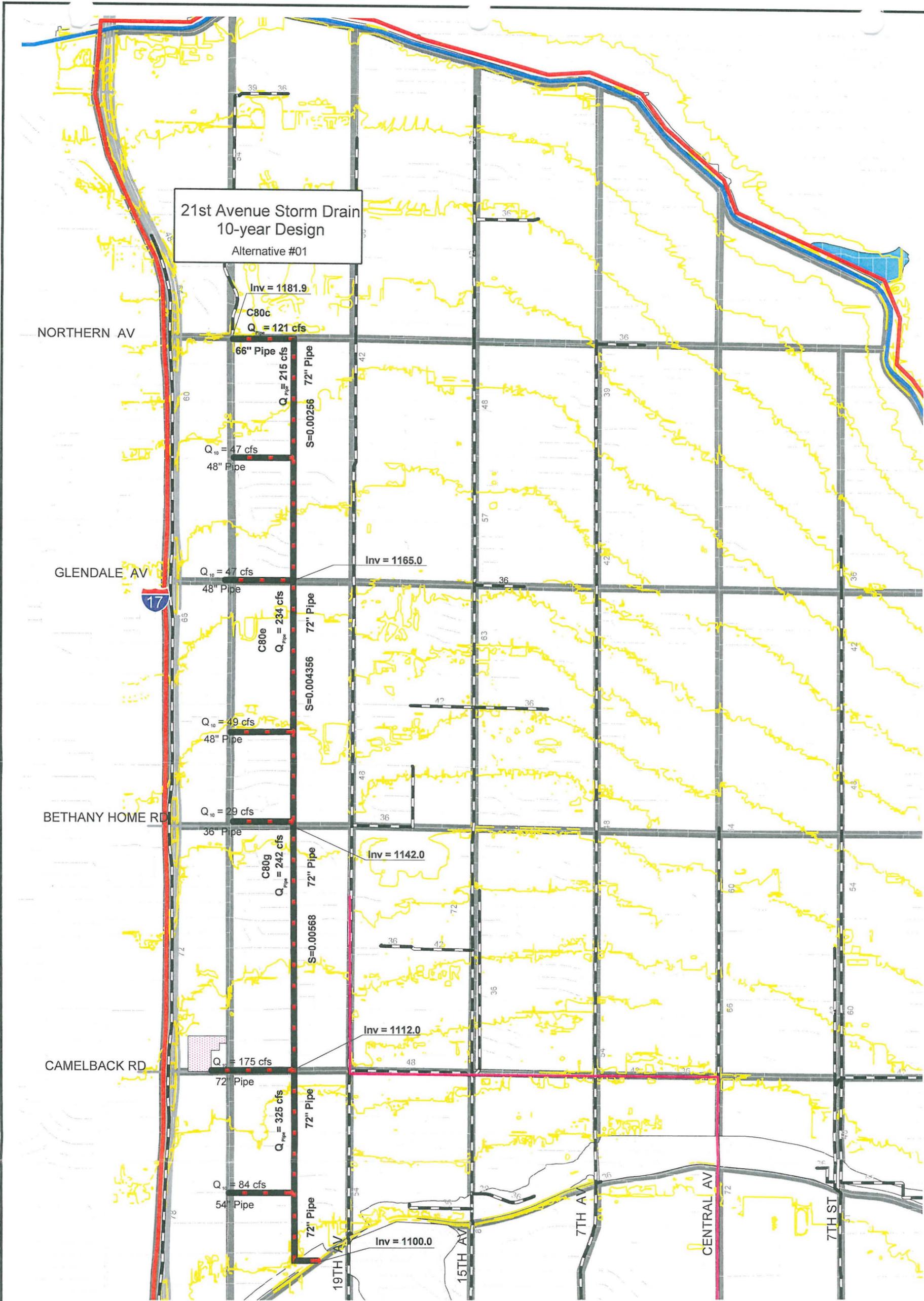
**Alternative #1 – New SD in 21st Ave (10-Yr, Grand Canal to Northern Avenue)**

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<b>Hydraulic Calculations for Proposed Storm Drains</b>	<b>4-14</b>
<b>Cost Estimate</b>	<b>15</b>

**ALTERNATIVE #1**

**New SD in 21st Ave (10-Yr, Grand Canal to Northern Avenue)**



21st Avenue Storm Drain  
10-year Design  
Alternative #01

Inv = 1181.9  
C80c  
Q<sub>pipe</sub> = 121 cfs

66" Pipe  
Q<sub>pipe</sub> = 215 cfs  
48" Pipe  
Q<sub>10</sub> = 47 cfs  
S=0.00256  
72" Pipe

Inv = 1165.0  
Q<sub>10</sub> = 47 cfs  
48" Pipe  
C80e  
Q<sub>pipe</sub> = 234 cfs  
72" Pipe

Q<sub>10</sub> = 49 cfs  
48" Pipe  
S=0.004356  
72" Pipe

Q<sub>10</sub> = 29 cfs  
36" Pipe  
C80g  
Q<sub>pipe</sub> = 242 cfs  
72" Pipe

Inv = 1142.0  
S=0.00568  
72" Pipe

Inv = 1112.0  
Q<sub>10</sub> = 175 cfs  
72" Pipe  
Q<sub>pipe</sub> = 325 cfs  
72" Pipe

Q<sub>10</sub> = 84 cfs  
54" Pipe  
72" Pipe  
Inv = 1100.0

Metro Phoenix ADMP - Level II Analysis  
Old Cave Creek Floodplain  
Alternative #1

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- Future Detention Basins (Planned with 24th Ave. and Camelback Rd. DCR)

- Pipe Dimensions (inches)
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

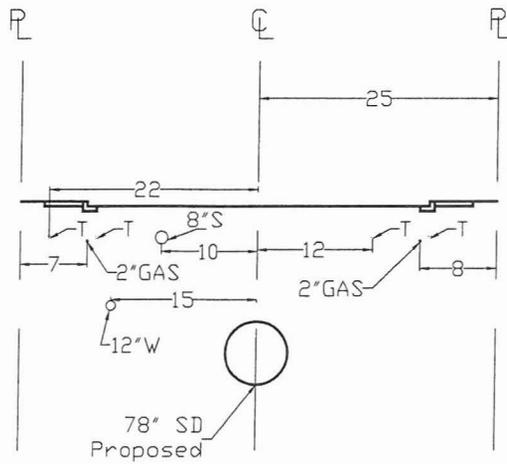


Scale: 1" = 2,000'

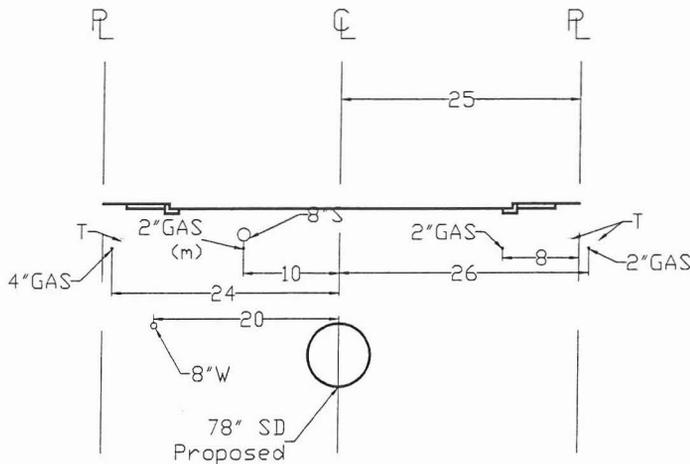


Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

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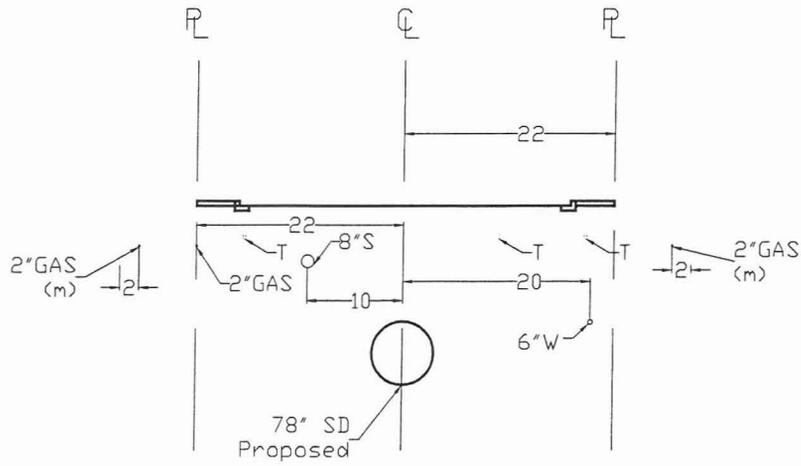
21st Ave - Northern Ave to Glendale Ave. 50' ROW  
 Proposed 78" SD - 10 year Design  
 Inv @ Northern = 1181.9  
 Inv @ Glendale = 1165.0  
 Alternative #1



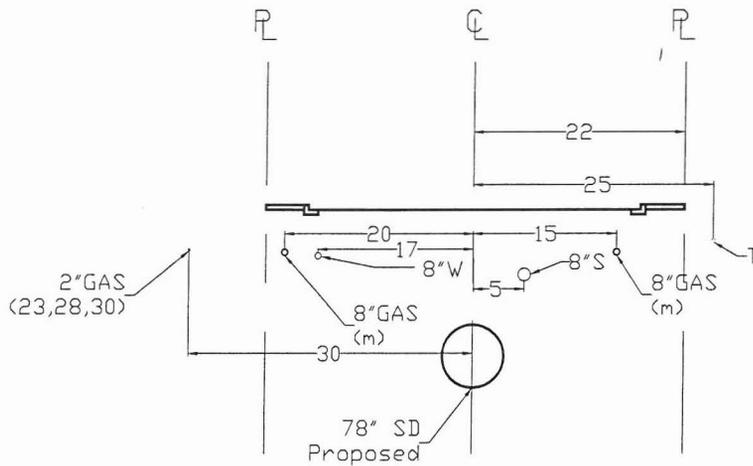
21st Ave - Glendale Ave. to Bethany Home 50' ROW  
 Proposed 78" SD - 10 year Design  
 Inv @ Glendale = 1165.0  
 Inv @ Bethany Home = 1142.0  
 Alternative #1

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 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>		
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>		
PRELIMINARY NOT FOR CONSTRUCTION	BY	DATE
	DESIGNED	CTG 03/2007
	DRAWN	KLH 03/2007
CHECKED	LAV 03/2007	
 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2805 TEL: (602)248-7702 FAX: (602)248-7851</small>		
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS	SHEET OF 2 / 15



21st Ave - Bethany Home to Camelback Rd 44' ROW  
 Proposed 78" SD - 10 year Design  
 Inv @ Bethany Home = 1142.0  
 Inv @ Camelback = 1112.0  
 Alternative #1



21st Ave - Camelback Rd to Grand Canal 44' ROW  
 Proposed 78" SD - 10 year Design  
 Inv @ Camelback = 1112.0  
 Inv @ Grand Canal = 1100.0  
 Alternative #1

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 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN</b> <b>FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	BY DATE
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
 Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 500 Phoenix, Arizona 85012-2805 TEL: (602)248-7702 FAX: (602)248-7851			
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 3 / 15

## Worksheet for S1 - Northern Ave - 23rd to 21st Ave

### Project Description

Friction Method                      Manning Formula  
 Solve For                              Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00256	ft/ft
Normal Depth	4.84	ft
Diameter	4.84	ft ⇒ 60" PIPE
Discharge	121.00	ft <sup>3</sup> /s

### Results

Diameter	4.84	ft
Normal Depth	4.84	ft
Flow Area	18.42	ft <sup>2</sup>
Wetted Perimeter	15.21	ft
Top Width	0.00	ft
Critical Depth	3.17	ft
Percent Full	100.0	%
Critical Slope	0.00437	ft/ft
Velocity	6.57	ft/s
Velocity Head	0.67	ft
Specific Energy	5.51	ft
Froude Number	0.00	
Maximum Discharge	130.17	ft <sup>3</sup> /s
Discharge Full	121.01	ft <sup>3</sup> /s
Slope Full	0.00256	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 21st Ave - Northern to Glendale

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00256	ft/ft
Normal Depth	6.01	ft
Diameter	6.01	ft    ⇒ 72" PIPE
Discharge	215.00	ft <sup>3</sup> /s

### Results

Diameter	6.01	ft
Normal Depth	6.01	ft
Flow Area	28.35	ft <sup>2</sup>
Wetted Perimeter	18.87	ft
Top Width	0.00	ft
Critical Depth	4.01	ft
Percent Full	100.0	%
Critical Slope	0.00415	ft/ft
Velocity	7.58	ft/s
Velocity Head	0.89	ft
Specific Energy	6.90	ft
Froude Number	0.00	
Maximum Discharge	231.29	ft <sup>3</sup> /s
Discharge Full	215.02	ft <sup>3</sup> /s
Slope Full	0.00256	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S3 - 21st Ave - Glendale to Bethany

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00436 ft/ft  
Normal Depth                                5.61 ft  
Diameter                                      5.61 ft  
Discharge                                    234.00 ft<sup>3</sup>/s

⇒ 72" PIPE

### Results

Diameter                                      5.61 ft  
Normal Depth                                5.61 ft  
Flow Area                                    24.75 ft<sup>2</sup>  
Wetted Perimeter                            17.64 ft  
Top Width                                    0.00 ft  
Critical Depth                                4.26 ft  
Percent Full                                100.0 %  
Critical Slope                                0.00510 ft/ft  
Velocity                                      9.46 ft/s  
Velocity Head                                1.39 ft  
Specific Energy                               7.00 ft  
Froude Number                               0.00  
Maximum Discharge                        251.73 ft<sup>3</sup>/s  
Discharge Full                               234.02 ft<sup>3</sup>/s  
Slope Full                                    0.00436 ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00 ft  
Length                                      0.00 ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                100.00 %

## Worksheet for S4 - 21st Ave - Bethany to Camelback

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00568 ft/ft  
Normal Depth                                5.41 ft  
Diameter                                      5.41 ft  
Discharge                                    242.00 ft<sup>3</sup>/s

⇒ 66" PIPE

### Results

Diameter                                      5.41 ft  
Normal Depth                                5.41 ft  
Flow Area                                    22.97 ft<sup>2</sup>  
Wetted Perimeter                            16.99 ft  
Top Width                                    0.00 ft  
Critical Depth                                4.36 ft  
Percent Full                                100.0 %  
Critical Slope                                0.00587 ft/ft  
Velocity                                      10.53 ft/s  
Velocity Head                                1.72 ft  
Specific Energy                               7.13 ft  
Froude Number                               0.00  
Maximum Discharge                        260.32 ft<sup>3</sup>/s  
Discharge Full                               242.00 ft<sup>3</sup>/s  
Slope Full                                    0.00568 ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00 ft  
Length                                      0.00 ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                100.00 %

## Worksheet for S5 - 21st Ave - Camelback to Grand Canal

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Normal Depth	5.98	ft
Diameter	5.98	ft ⇒ 72" PIPE
Discharge	325.00	ft <sup>3</sup> /s

### Results

Diameter	5.98	ft
Normal Depth	5.98	ft
Flow Area	28.08	ft <sup>2</sup>
Wetted Perimeter	18.78	ft
Top Width	0.00	ft
Critical Depth	4.91	ft
Percent Full	100.0	%
Critical Slope	0.00598	ft/ft
Velocity	11.57	ft/s
Velocity Head	2.08	ft
Specific Energy	8.06	ft
Froude Number	0.00	
Maximum Discharge	349.62	ft <sup>3</sup> /s
Discharge Full	325.02	ft <sup>3</sup> /s
Slope Full	0.00600	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

# Project Summary Report

---

Project Description	
Worksheet	L1 - Orangewood - 23rd Drive to 21st Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	47.00 cfs

---

---

Results	
Depth	3.56 ft
Diameter	43 in ⇒ 48" PIPE
Flow Area	9.9 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.13 ft
Percent Full	100.0 %
Critical Slope	0.004464 ft/ft
Velocity	4.73 ft/s
Velocity Head	0.35 ft
Specific Energy	3.91 ft
Froude Number	0.00
Maximum Discharge	50.56 cfs
Discharge Full	47.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Lateral on Orangewood

# Project Summary Report

---

Project Description	
Worksheet	L2 - Glendale - 23rd Drive to 21st Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	47.00 cfs

---

---

Results	
Depth	3.56 ft
Diameter	43 in
Flow Area	9.9 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.13 ft
Percent Full	100.0 %
Critical Slope	0.004464 ft/ft
Velocity	4.73 ft/s
Velocity Head	0.35 ft
Specific Energy	3.91 ft
Froude Number	0.00
Maximum Discharge	50.56 cfs
Discharge Full	47.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

⇒ 48" PIPE

Notes: Lateral on Glendale Ave

10/15

# Project Summary Report

---

Project Description	
Worksheet	L3 - Citrus Way - 23rd Drive to 21st Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	49.00 cfs

---

---

Results	
Depth	3.61 ft
Diameter	43 in
Flow Area	10.3 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.17 ft
Percent Full	100.0 %
Critical Slope	0.004446 ft/ft
Velocity	4.78 ft/s
Velocity Head	0.35 ft
Specific Energy	3.97 ft
Froude Number	0.00
Maximum Discharge	52.71 cfs
Discharge Full	49.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

→ 48" PIPE

Notes: Lateral on Citrus Way

11/15

# Project Summary Report

---

Project Description	
Worksheet	L4 - Bethany Home - 23rd Drive to 21st Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	29.00 cfs

---

---

Results	
Depth	2.97 ft
Diameter	36 in
Flow Area	6.9 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.75 ft
Percent Full	100.0 %
Critical Slope	0.004686 ft/ft
Velocity	4.19 ft/s
Velocity Head	0.27 ft
Specific Energy	3.24 ft
Froude Number	0.00
Maximum Discharge	31.20 cfs
Discharge Full	29.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

⇒ 36" PIPE

Notes: Lateral on Bethany Home

12/15

# Project Summary Report

---

Project Description	
Worksheet	L5 - Bethany Home - 23rd Drive to 21st Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	175.00 cfs

---

---

Results	
Depth	5.82 ft
Diameter	70 in ⇒ 72" PIPE
Flow Area	26.6 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	3.64 ft
Percent Full	100.0 %
Critical Slope	0.003924 ft/ft
Velocity	6.57 ft/s
Velocity Head	0.67 ft
Specific Energy	6.50 ft
Froude Number	0.00
Maximum Discharge	188.25 cfs
Discharge Full	175.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Lateral on Bethany Home

## Project Summary Report

---

Project Description	
Worksheet	L6 - Campbell - 23rd Drive to 21st Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	84.00 cfs

---

---

Results	
Depth	4.42 ft
Diameter	53 in → 54" PIPE
Flow Area	15.4 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.70 ft
Percent Full	100.0 %
Critical Slope	0.004214 ft/ft
Velocity	5.47 ft/s
Velocity Head	0.46 ft
Specific Energy	4.89 ft
Froude Number	0.00
Maximum Discharge	90.36 cfs
Discharge Full	84.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Lateral on Cambell

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	66" SD in Northern Ave, 23rd Ave to 21st Ave	LF	\$819.44	1330	\$ 1,089,858.92
2	72" SD in 21st Ave., Northern to Glendale	LF	\$878.70	5280	\$ 4,639,523.33
3	72" SD in 21st Ave, Glendale to Bethany Home	LF	\$878.70	5280	\$ 4,639,523.33
4	72" SD in 21st Ave, Bethany Home to Camelback	LF	\$878.70	5280	\$ 4,639,523.33
5	72" SD in 21st Ave, Camelback to Grand Canal	LF	\$878.70	4440	\$ 3,901,417.34
6	48" SD Lateral in Orangewood Rd., 23rd Dr. to 21st Ave	LF	\$637.14	1300	\$ 828,278.88
7	48" SD Lateral in Glendale Ave., 23rd Dr to 21st Ave	LF	\$637.14	1460	\$ 930,220.90
8	48" SD Lateral in Citrus Way, 23rd Dr. to 21st Ave	LF	\$637.14	1330	\$ 847,393.01
9	36" SD Lateral in Bethany Home Rd., 23rd Dr to 21st Ave	LF	\$506.89	1330	\$ 674,167.96
10	72" SD Lateral in Camelback Rd., 23rd Dr. to 21st Ave	LF	\$878.70	1760	\$ 1,546,507.78
11	54" SD Lateral in Campbell Ave., 23rd Dr to 21st Ave	LF	\$698.29	1300	\$ 907,781.16
12	Utility Relocation	LM	\$50,000.00	4.1	\$ 205,000.00
	Sub Total				\$ 24,849,195.93
	Contingencies (20%)				\$ 4,969,839.19
	<b>TOTAL</b>				<b>\$ 29,819,000.00</b>

15/15

**Alternative #2 - New SD Ext. in Central Ave (2-Yr, Bethany Home Rd.  
to Arizona Canal)**

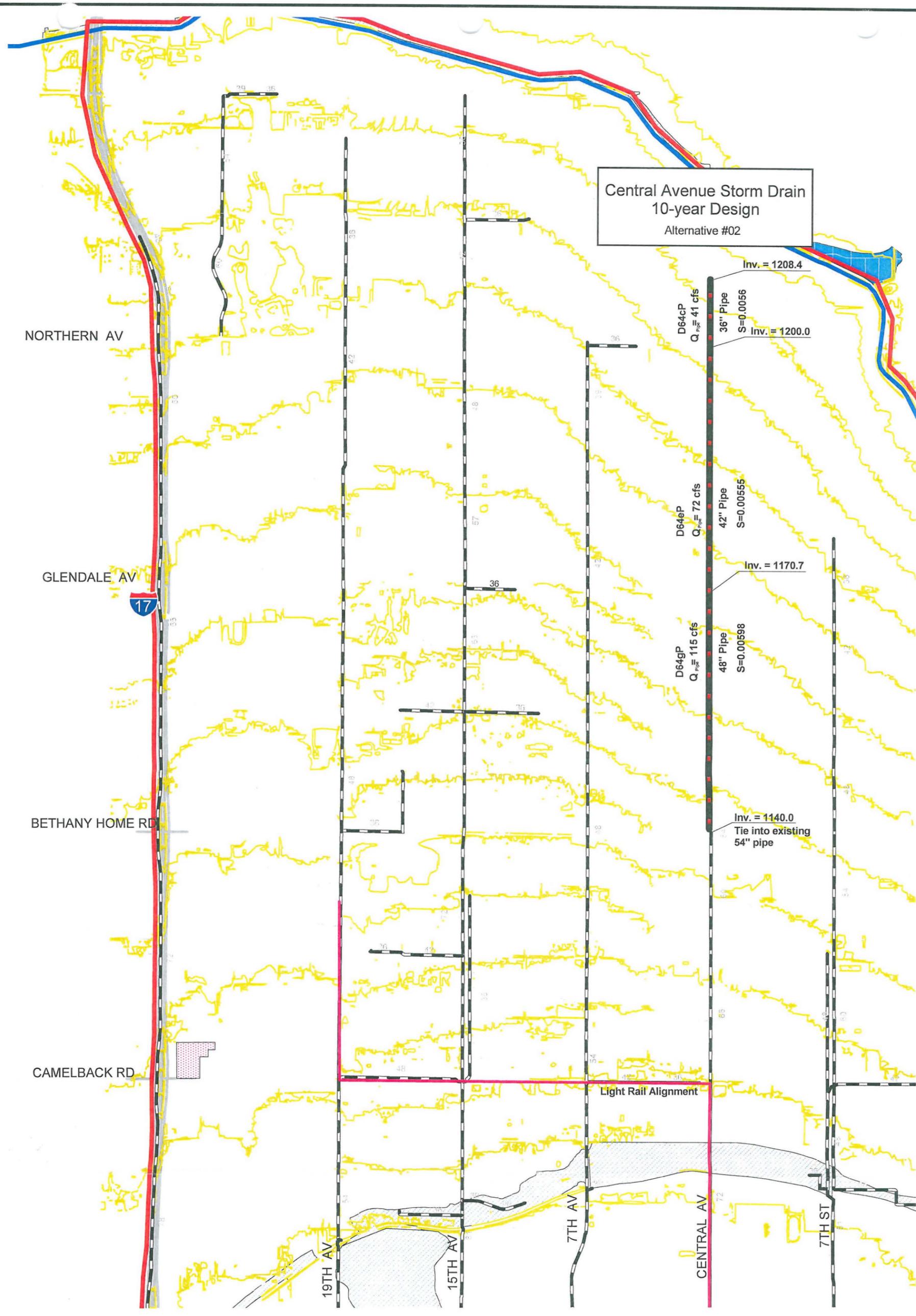
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**ALTERNATIVE #2**

**New SD Ext. in Central Ave (2-Yr, Bethany Home Rd. to Arizona Canal)**

Central Avenue Storm Drain  
10-year Design  
Alternative #02



Metro Phoenix ADMP - Level II Analysis  
Old Cave Creek Floodplain  
Alternative #2

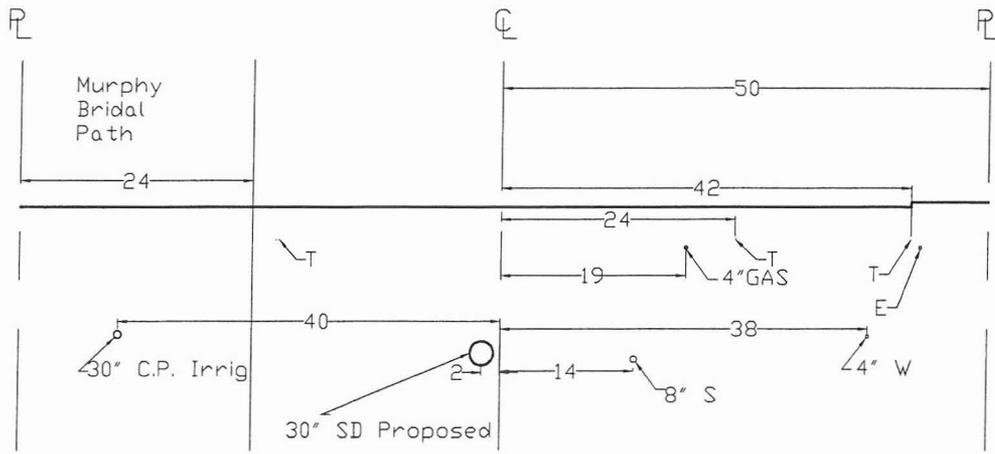
- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- Future Detention Basins (Planned with 24th Ave. and Camelback Rd. DCR)

- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

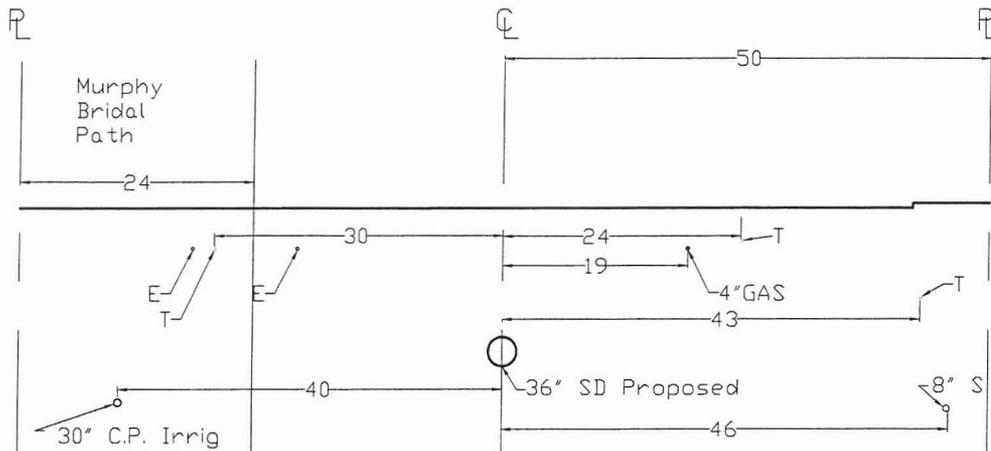
Scale: 1" = 2,000'



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Phoenix, Arizona 85012



Central - Northern Ave to Glendale Ave. 100' ROW  
 Proposed 30" SD - 10 year Design  
 Inv @ Northern = 1200.0  
 Inv @ Glendale = 1170.7



Central - Glendale Ave. to Bethany Home 100' ROW  
 Proposed 36" SD - 10 year Design  
 Inv @ Glendale = 1170.7  
 Inv @ Bethany Home = 1140.0

N:\305008\CAVE CREEK - SECTIONS.DWG, 5/22/2007 7:51:10 AM, \phxsrvt01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
 Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602)248-7702 FAX: (602)248-7851			
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 6

## Worksheet for S1 - Central Ave - Butler to Northern

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00560	ft/ft
Normal Depth	2.79	ft
Diameter	2.79	ft ⇒ 36" PIPE
Discharge	41.00	ft <sup>3</sup> /s

### Results

Diameter	2.79	ft
Normal Depth	2.79	ft
Flow Area	6.10	ft <sup>2</sup>
Wetted Perimeter	8.75	ft
Top Width	0.00	ft
Critical Depth	2.12	ft
Percent Full	100.0	%
Critical Slope	0.00649	ft/ft
Velocity	6.72	ft/s
Velocity Head	0.70	ft
Specific Energy	3.49	ft
Froude Number	0.00	
Maximum Discharge	44.10	ft <sup>3</sup> /s
Discharge Full	41.00	ft <sup>3</sup> /s
Slope Full	0.00560	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - Central Ave - Northern to Glendale

### Project Description

Friction Method                      Manning Formula  
Solve For                              Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00555 ft/ft  
Normal Depth                              3.45 ft  
Diameter                              3.45 ft  
Discharge                              72.00 ft<sup>3</sup>/s

⇒ 42" PIPE

### Results

Diameter                              3.45 ft  
Normal Depth                              3.45 ft  
Flow Area                              9.34 ft<sup>2</sup>  
Wetted Perimeter                              10.83 ft  
Top Width                              0.00 ft  
Critical Depth                              2.67 ft  
Percent Full                              100.0 %  
Critical Slope                              0.00623 ft/ft  
Velocity                              7.71 ft/s  
Velocity Head                              0.92 ft  
Specific Energy                              4.37 ft  
Froude Number                              0.00  
Maximum Discharge                              77.45 ft<sup>3</sup>/s  
Discharge Full                              72.00 ft<sup>3</sup>/s  
Slope Full                              0.00555 ft/ft  
Flow Type                              SubCritical

### GVF Input Data

Downstream Depth                              0.00 ft  
Length                              0.00 ft  
Number Of Steps                              0

### GVF Output Data

Upstream Depth                              0.00 ft  
Profile Description  
Profile Headloss                              0.00 ft  
Average End Depth Over Rise                              0.00 %  
Normal Depth Over Rise                              100.00 %

## Worksheet for S3 - Central Ave - Glendale to Bethany

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00598	ft/ft
Normal Depth	4.05	ft
Diameter	4.05	ft ⇒ 48" PIPE
Discharge	115.00	ft <sup>3</sup> /s

### Results

Diameter	4.05	ft
Normal Depth	4.05	ft
Flow Area	12.90	ft <sup>2</sup>
Wetted Perimeter	12.73	ft
Top Width	0.00	ft
Critical Depth	3.23	ft
Percent Full	100.0	%
Critical Slope	0.00630	ft/ft
Velocity	8.92	ft/s
Velocity Head	1.24	ft
Specific Energy	5.29	ft
Froude Number	0.00	
Maximum Discharge	123.71	ft <sup>3</sup> /s
Discharge Full	115.00	ft <sup>3</sup> /s
Slope Full	0.00598	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	36" SD in Central Ave, Butler to Northern	LF	\$506.89	1470	\$ 745,133.00
2	42" SD in Central Ave, Northern to Glendale	LF	\$578.17	5280	\$ 3,052,754.50
3	48" SD in Central Ave, Glendale to Bethany Home	LF	\$637.14	5280	\$ 3,364,086.53
4	Utility Relocation	LM	\$50,000.00	2.3	\$ 115,000.00
Sub Total					\$ 7,276,974.03
<i>Contingencies (20%)</i>					\$ 1,455,394.81
<b>TOTAL</b>					<b>\$ 8,732,400.00</b>

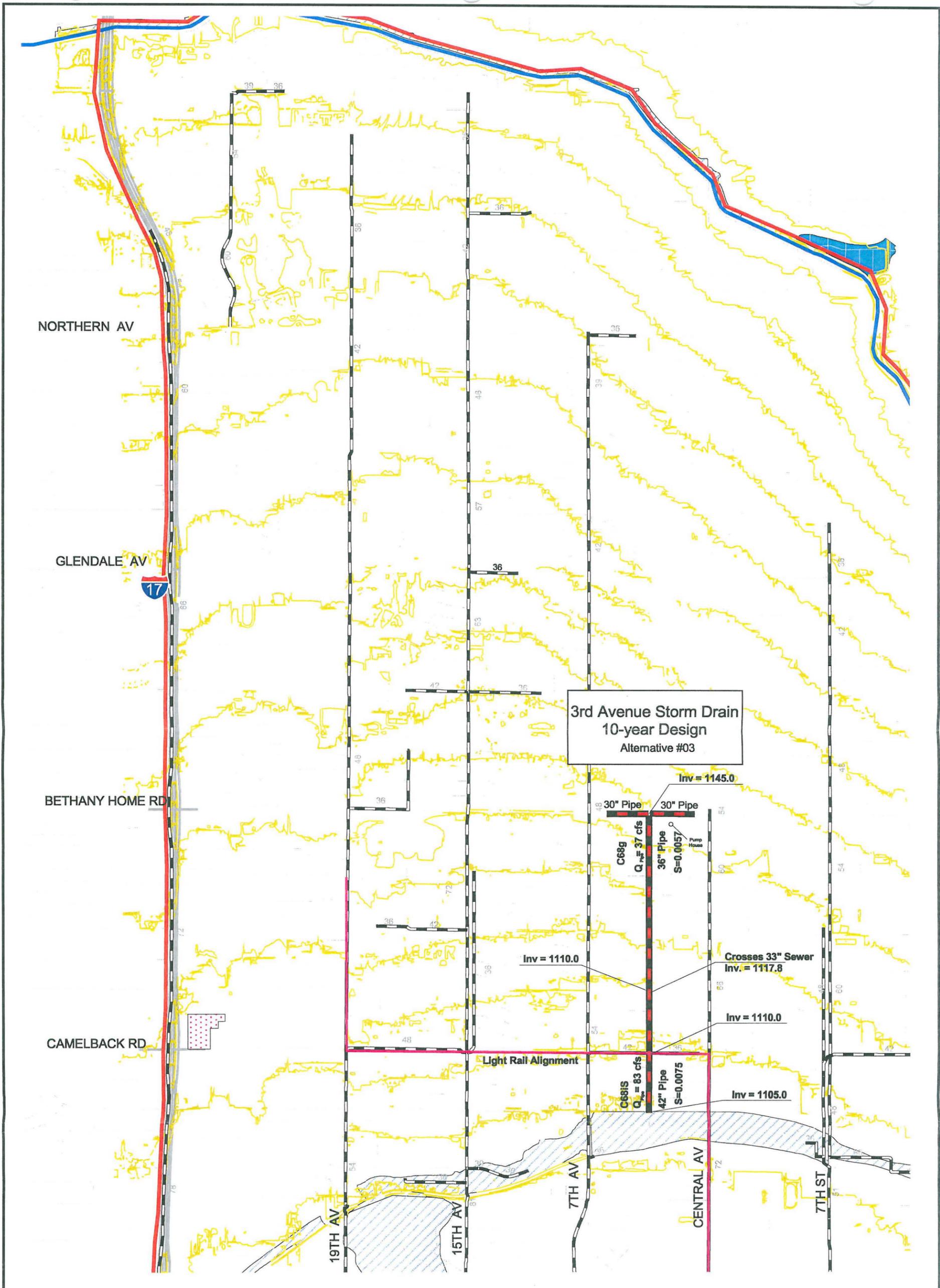
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**Alternative #3 - New SD in 3rd Ave. (10-Yr, Grand Canal to  
Bethany Home Rd)**

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**ALTERNATIVE #3**  
**New SD in 3rd Ave. (10-Yr, Grand Canal to Bethany Home Rd)**



Metro Phoenix ADMP - Level II Analysis  
 Old Cave Creek Floodplain  
 Alternative #3

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- Future Detention Basins (Planned with 24th Ave. and Camelback Rd. DCR)

- Pipe Dimensions (Inches)**
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

Scale: 1" = 2,000'



Engineering and Environmental Consultants, Inc.  
 3003 N. Central Ave Suite 600  
 Phoenix, Arizona 85012

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## Worksheet for S1 - 3rd Ave - Bethany to Camelback

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00568	ft/ft
Normal Depth	2.67	ft
Diameter	2.67	ft ⇒ 36" PIPE
Discharge	37.00	ft <sup>3</sup> /s

### Results

Diameter	2.67	ft
Normal Depth	2.67	ft
Flow Area	5.62	ft <sup>2</sup>
Wetted Perimeter	8.40	ft
Top Width	0.00	ft
Critical Depth	2.04	ft
Percent Full	100.0	%
Critical Slope	0.00659	ft/ft
Velocity	6.59	ft/s
Velocity Head	0.67	ft
Specific Energy	3.35	ft
Froude Number	0.00	
Maximum Discharge	39.80	ft <sup>3</sup> /s
Discharge Full	37.00	ft <sup>3</sup> /s
Slope Full	0.00568	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 3rd Ave - Camelback to Grand Canal

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00746 ft/ft  
Normal Depth                                3.44 ft  
Diameter                                      3.44 ft  
Discharge                                    83.00 ft<sup>3</sup>/s

⇒ 42" PIPE

### Results

Diameter                                      3.44 ft  
Normal Depth                                3.44 ft  
Flow Area                                    9.30 ft<sup>2</sup>  
Wetted Perimeter                          10.81 ft  
Top Width                                    0.00 ft  
Critical Depth                                2.85 ft  
Percent Full                                100.0 %  
Critical Slope                                0.00734 ft/ft  
Velocity                                      8.93 ft/s  
Velocity Head                                1.24 ft  
Specific Energy                               4.68 ft  
Froude Number                               0.00  
Maximum Discharge                        89.28 ft<sup>3</sup>/s  
Discharge Full                                83.00 ft<sup>3</sup>/s  
Slope Full                                    0.00746 ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                          0.00 ft  
Length                                        0.00 ft  
Number Of Steps                            0

### GVF Output Data

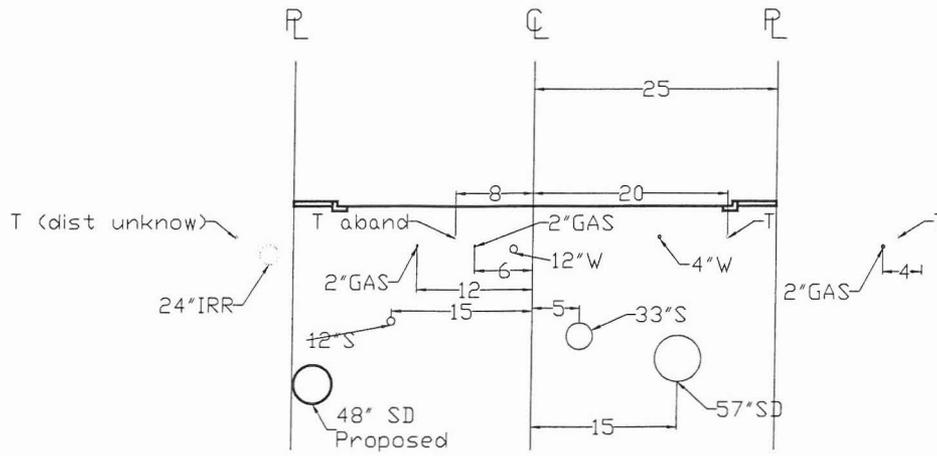
Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                   100.00 %

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	36" SD in 3rd Ave, Bethany Home to Camelback	LF	\$506.89	5280	\$ 2,676,396.10
2	42" SD in 3rd Ave, Camelback to Grand Canal	LF	\$578.17	2120	\$ 1,225,727.18
3	30" SD Lateral in Bethany Home Rd., 2nd Ave. to 3rd Ave.	LF	\$448.81	1000	\$ 448,813.20
4	30" SD Lateral in Bethany Home Rd., 5th Ave. to 3rd Ave.	LF	\$448.81	1000	\$ 448,813.20
5	Utility Relocation	LF	\$50,000.00	1.4	\$ 70,000.00
Sub Total					\$ 4,869,749.68
<i>Contingencies (20%)</i>					\$ 973,949.94
<b>TOTAL</b>					<b>\$ 5,843,700.00</b>

**Alternative #4 - New Parallel SD in 15th Ave. (10-Yr, Grand Canal to Butler Drive)**

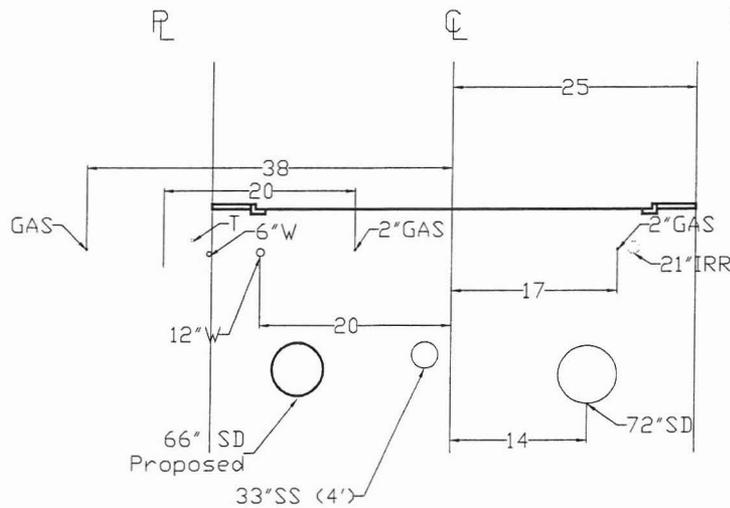
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15th Ave - Northern Ave to Glendale Ave.  
 Proposed 48" SD - 10 year Design  
 Inv @ Northern = 1176.0  
 Inv @ Glendale = 1152.0  
 Alternative #4

50' ROW



15th Ave - Glendale Ave. to Bethany Home  
 Proposed 66" SD - 10 year Design  
 Inv @ Glendale = 1152.0  
 Inv @ Bethany Home = 1132.0  
 Alternative #4

50' ROW



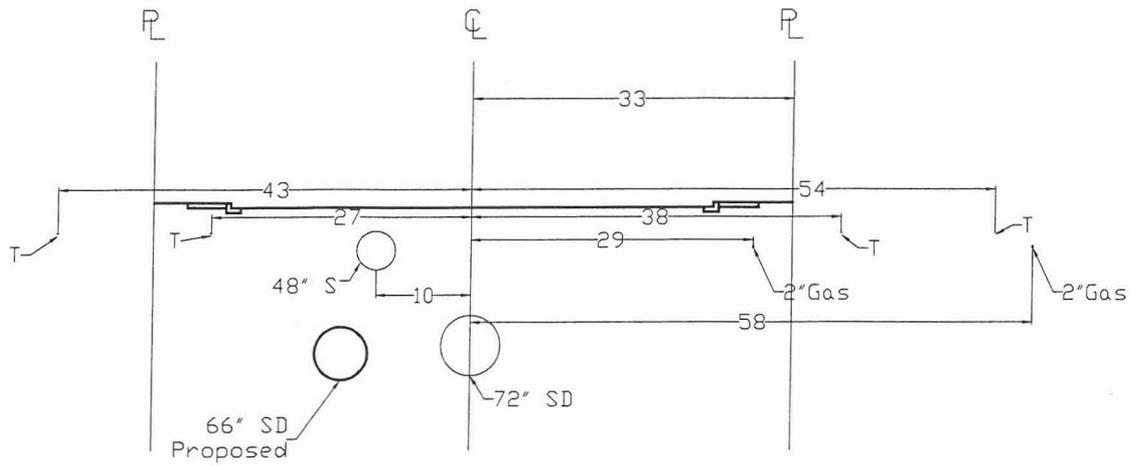
**FLOOD CONTROL DISTRICT  
 OF MARICOPA COUNTY**

**METRO PHOENIX  
 AREA DRAINAGE MASTER PLAN  
 FCD CONTRACT NO. FCD 2004C040**

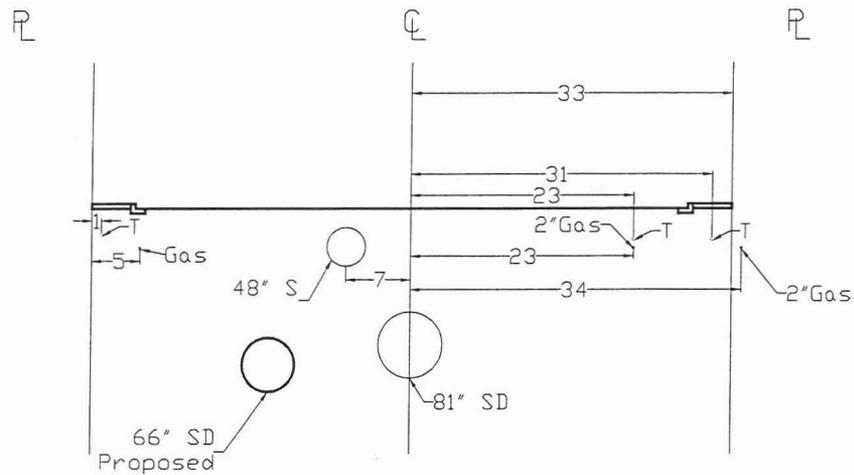
PRELIMINARY NOT FOR CONSTRUCTION	BY		DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
CHECKED	LAV	03/2007	
DRAWING NO.		METRO PHOENIX ADMP LEVEL II PLANS	SHEET OF 2 / 23



Engineering and Environmental Consultants, Inc.  
 3023 N. Central Avenue, Suite 600  
 Phoenix, Arizona 85012-2905  
 TEL: (602) 248-7702 FAX: (602) 248-7851



15th Ave - Bethany Home to Camelback Rd 66' ROW  
 Proposed 66" SD - 10 year Design  
 Inv @ Bethany Home = 1132.0  
 Inv @ Camelback = 1114.0  
 Alternative #4



15th Ave - Camelback Rd to Grand Canal 80' ROW  
 Proposed 66" SD - 10 year Design  
 Inv @ Camelback = 1114.0  
 Alternative #4

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N:\305008\CAVE CREEK

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	DATE
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
	 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>		
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 3 / 23

## Worksheet for S1 - 15th Ave - Butler to Northern

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00604	ft/ft
Normal Depth	4.02	ft
Diameter	4.02	ft ⇒ 48" PIPE
Discharge	113.00	ft <sup>3</sup> /s

### Results

Diameter	4.02	ft
Normal Depth	4.02	ft
Flow Area	12.68	ft <sup>2</sup>
Wetted Perimeter	12.62	ft
Top Width	0.00	ft
Critical Depth	3.21	ft
Percent Full	100.0	%
Critical Slope	0.00635	ft/ft
Velocity	8.91	ft/s
Velocity Head	1.23	ft
Specific Energy	5.25	ft
Froude Number	0.00	
Maximum Discharge	121.55	ft <sup>3</sup> /s
Discharge Full	113.00	ft <sup>3</sup> /s
Slope Full	0.00604	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 15th Ave - Northern to Glendale

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00455	ft/ft
Normal Depth	4.24	ft
Diameter	4.24	ft ⇒ 54" PIPE
Discharge	113.00	ft <sup>3</sup> /s

### Results

Diameter	4.24	ft
Normal Depth	4.24	ft
Flow Area	14.11	ft <sup>2</sup>
Wetted Perimeter	13.32	ft
Top Width	0.00	ft
Critical Depth	3.18	ft
Percent Full	100.0	%
Critical Slope	0.00548	ft/ft
Velocity	8.01	ft/s
Velocity Head	1.00	ft
Specific Energy	5.24	ft
Froude Number	0.00	
Maximum Discharge	121.55	ft <sup>3</sup> /s
Discharge Full	113.00	ft <sup>3</sup> /s
Slope Full	0.00455	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S3 - 15th Ave - Glendale to Bethany

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00379	ft/ft
Normal Depth	5.29	ft
Diameter	5.29	ft ⇒ 66" PIPE
Discharge	186.00	ft <sup>3</sup> /s

### Results

Diameter	5.29	ft
Normal Depth	5.29	ft
Flow Area	21.95	ft <sup>2</sup>
Wetted Perimeter	16.61	ft
Top Width	0.00	ft
Critical Depth	3.86	ft
Percent Full	100.0	%
Critical Slope	0.00487	ft/ft
Velocity	8.47	ft/s
Velocity Head	1.12	ft
Specific Energy	6.40	ft
Froude Number	0.00	
Maximum Discharge	200.06	ft <sup>3</sup> /s
Discharge Full	185.98	ft <sup>3</sup> /s
Slope Full	0.00379	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S4 - 15th Ave - Bethany to Camelback

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00341	ft/ft
Normal Depth	5.56	ft
Diameter	5.56	ft ⇒ 66" PIPE
Discharge	202.00	ft <sup>3</sup> /s

### Results

Diameter	5.56	ft
Normal Depth	5.56	ft
Flow Area	24.30	ft <sup>2</sup>
Wetted Perimeter	17.47	ft
Top Width	0.00	ft
Critical Depth	3.97	ft
Percent Full	100.0	%
Critical Slope	0.00463	ft/ft
Velocity	8.31	ft/s
Velocity Head	1.07	ft
Specific Energy	6.64	ft
Froude Number	0.00	
Maximum Discharge	217.30	ft <sup>3</sup> /s
Discharge Full	202.01	ft <sup>3</sup> /s
Slope Full	0.00341	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S5 - 15th Ave - Camelback to Grand Canal

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00441	ft/ft
Normal Depth	5.27	ft
Diameter	5.27	ft ⇒ 66" PIPE
Discharge	199.00	ft <sup>3</sup> /s

### Results

Diameter	5.27	ft
Normal Depth	5.27	ft
Flow Area	21.81	ft <sup>2</sup>
Wetted Perimeter	16.56	ft
Top Width	0.00	ft
Critical Depth	3.99	ft
Percent Full	100.0	%
Critical Slope	0.00519	ft/ft
Velocity	9.12	ft/s
Velocity Head	1.29	ft
Specific Energy	6.56	ft
Froude Number	0.00	
Maximum Discharge	214.04	ft <sup>3</sup> /s
Discharge Full	198.98	ft <sup>3</sup> /s
Slope Full	0.00441	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

# Project Summary Report

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Project Description	
Worksheet	L01 - Butler - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

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Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	109.00 cfs

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---

Results	
Depth	4.88 ft
Diameter	59 in ⇒ 60" PIPE
Flow Area	18.7 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	3.00 ft
Percent Full	100.0 %
Critical Slope	0.004108 ft/ft
Velocity	5.83 ft/s
Velocity Head	0.53 ft
Specific Energy	5.41 ft
Froude Number	0.00
Maximum Discharge	117.25 cfs
Discharge Full	109.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Butler Lateral from 17th to 15th Ave

# Project Summary Report

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Project Description	
Worksheet	L02 - Northern - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

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Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	72.00 cfs

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---

Results	
Depth	4.17 ft
Diameter	50 in ⇒ 54" PIPE
Flow Area	13.7 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.53 ft
Percent Full	100.0 %
Critical Slope	0.004278 ft/ft
Velocity	5.26 ft/s
Velocity Head	0.43 ft
Specific Energy	4.60 ft
Froude Number	0.00
Maximum Discharge	77.45 cfs
Discharge Full	72.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Northern Lateral from 17th to 15th Ave

# Project Summary Report

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Project Description	
Worksheet	L03 - Northern - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	14.00 cfs

---

---

Results	
Depth	2.26 ft
Diameter	27 in ⇒ 30" PIPE
Flow Area	4.0 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.30 ft
Percent Full	100.0 %
Critical Slope	0.005046 ft/ft
Velocity	3.49 ft/s
Velocity Head	0.19 ft
Specific Energy	2.45 ft
Froude Number	0.00
Maximum Discharge	15.06 cfs
Discharge Full	14.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Northern Lateral from 13th to 15th Ave

11/23

# Project Summary Report

---

Project Description	
Worksheet	L04 - Orangewood - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	33.00 cfs

---

---

Results	
Depth	3.12 ft
Diameter	37 in ⇒ 42" PIPE
Flow Area	7.6 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.84 ft
Percent Full	100.0 %
Critical Slope	0.004624 ft/ft
Velocity	4.33 ft/s
Velocity Head	0.29 ft
Specific Energy	3.41 ft
Froude Number	0.00
Maximum Discharge	35.50 cfs
Discharge Full	33.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Orangewood Lateral from 17th to 15th Ave

# Project Summary Report

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Project Description	
Worksheet	L05 - Vista Ave - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	21.00 cfs

---

---

Results	
Depth	2.63 ft
Diameter	32 in ⇒ 36" PIPE
Flow Area	5.4 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.53 ft
Percent Full	100.0 %
Critical Slope	0.004841 ft/ft
Velocity	3.87 ft/s
Velocity Head	0.23 ft
Specific Energy	2.86 ft
Froude Number	0.00
Maximum Discharge	22.59 cfs
Discharge Full	21.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Vista Lateral from 13th to 15th Ave

13 | 23

# Project Summary Report

---

Project Description	
Worksheet	L06 - Glendale Ave - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	33.00 cfs

---

---

Results	
Depth	3.12 ft
Diameter	37 in $\Rightarrow$ 42" PIPE
Flow Area	7.6 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.84 ft
Percent Full	100.0 %
Critical Slope	0.004624 ft/ft
Velocity	4.33 ft/s
Velocity Head	0.29 ft
Specific Energy	3.41 ft
Froude Number	0.00
Maximum Discharge	35.50 cfs
Discharge Full	33.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Glendale Lateral from 17th to 15th Ave

14/23

# Project Summary Report

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Project Description	
Worksheet	L07 - Bethany Home - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	52.00 cfs

---

---

Results	
Depth	3.70 ft
Diameter	44 in ⇒ 48" PIPE
Flow Area	10.7 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.22 ft
Percent Full	100.0 %
Critical Slope	0.004418 ft/ft
Velocity	4.85 ft/s
Velocity Head	0.37 ft
Specific Energy	4.06 ft
Froude Number	0.00
Maximum Discharge	55.94 cfs
Discharge Full	52.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Bethany Home Lateral from 17th to 15th Ave

## Project Summary Report

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Project Description	
Worksheet	L08 - Bethany Home - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

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---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	15.00 cfs

---

---

Results	
Depth	2.32 ft
Diameter	28 in ⇒ 30" PIPE
Flow Area	4.2 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.34 ft
Percent Full	100.0 %
Critical Slope	0.005011 ft/ft
Velocity	3.55 ft/s
Velocity Head	0.20 ft
Specific Energy	2.51 ft
Froude Number	0.00
Maximum Discharge	16.14 cfs
Discharge Full	15.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Bethany Home Lateral from 13th to 15th Ave

# Project Summary Report

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Project Description	
Worksheet	L09 - Missouri - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	52.00 cfs

---

---

Results	
Depth	3.70 ft
Diameter	44 in ⇒ 48" PIPE
Flow Area	10.7 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	2.22 ft
Percent Full	100.0 %
Critical Slope	0.004418 ft/ft
Velocity	4.85 ft/s
Velocity Head	0.37 ft
Specific Energy	4.06 ft
Froude Number	0.00
Maximum Discharge	55.94 cfs
Discharge Full	52.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Missouri Lateral from 17th to 15th Ave

## Project Summary Report

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Project Description	
Worksheet	L10 - Missouri - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	38.00 cfs

---

---

Results	
Depth	3.29 ft
Diameter	39 in ⇒ 42" PIPE
Flow Area	8.5 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.95 ft
Percent Full	100.0 %
Critical Slope	0.004561 ft/ft
Velocity	4.48 ft/s
Velocity Head	0.31 ft
Specific Energy	3.60 ft
Froude Number	0.00
Maximum Discharge	40.88 cfs
Discharge Full	38.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Missouri Lateral from 13th to 15th Ave

# Project Summary Report

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Project Description	
Worksheet	L11 - Camelback - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

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Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	38.00 cfs

---

---

Results	
Depth	3.29 ft
Diameter	39 in ⇒ 42" PIPE
Flow Area	8.5 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.95 ft
Percent Full	100.0 %
Critical Slope	0.004561 ft/ft
Velocity	4.48 ft/s
Velocity Head	0.31 ft
Specific Energy	3.60 ft
Froude Number	0.00
Maximum Discharge	40.88 cfs
Discharge Full	38.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

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Notes: Camelback Lateral from 13th to 15th Ave

# Project Summary Report

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Project Description	
Worksheet	Existing L01 - Maryland - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

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Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Diameter	42 in

---

---

Results	
Depth	3.50 ft
Discharge	44.99 cfs
Flow Area	9.6 ft <sup>2</sup>
Wetted Perimeter	11.00 ft
Top Width	0.00 ft
Critical Depth	2.09 ft
Percent Full	100.0 %
Critical Slope	0.004483 ft/ft
Velocity	4.68 ft/s
Velocity Head	0.34 ft
Specific Energy	3.84 ft
Froude Number	0.00
Maximum Discharge	48.40 cfs
Discharge Full	44.99 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

# Project Summary Report

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Project Description	
Worksheet	Existing L02 - Maryland - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Diameter	36 in

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---

Results	
Depth	3.00 ft
Discharge	29.83 cfs
Flow Area	7.1 ft <sup>2</sup>
Wetted Perimeter	9.42 ft
Top Width	0.00 ft
Critical Depth	1.77 ft
Percent Full	100.0 %
Critical Slope	0.004673 ft/ft
Velocity	4.22 ft/s
Velocity Head	0.28 ft
Specific Energy	3.28 ft
Froude Number	0.00
Maximum Discharge	32.08 cfs
Discharge Full	29.83 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

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# Project Summary Report

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Project Description	
Worksheet	Existing L03 - Missouri - 17th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

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Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Diameter	36 in

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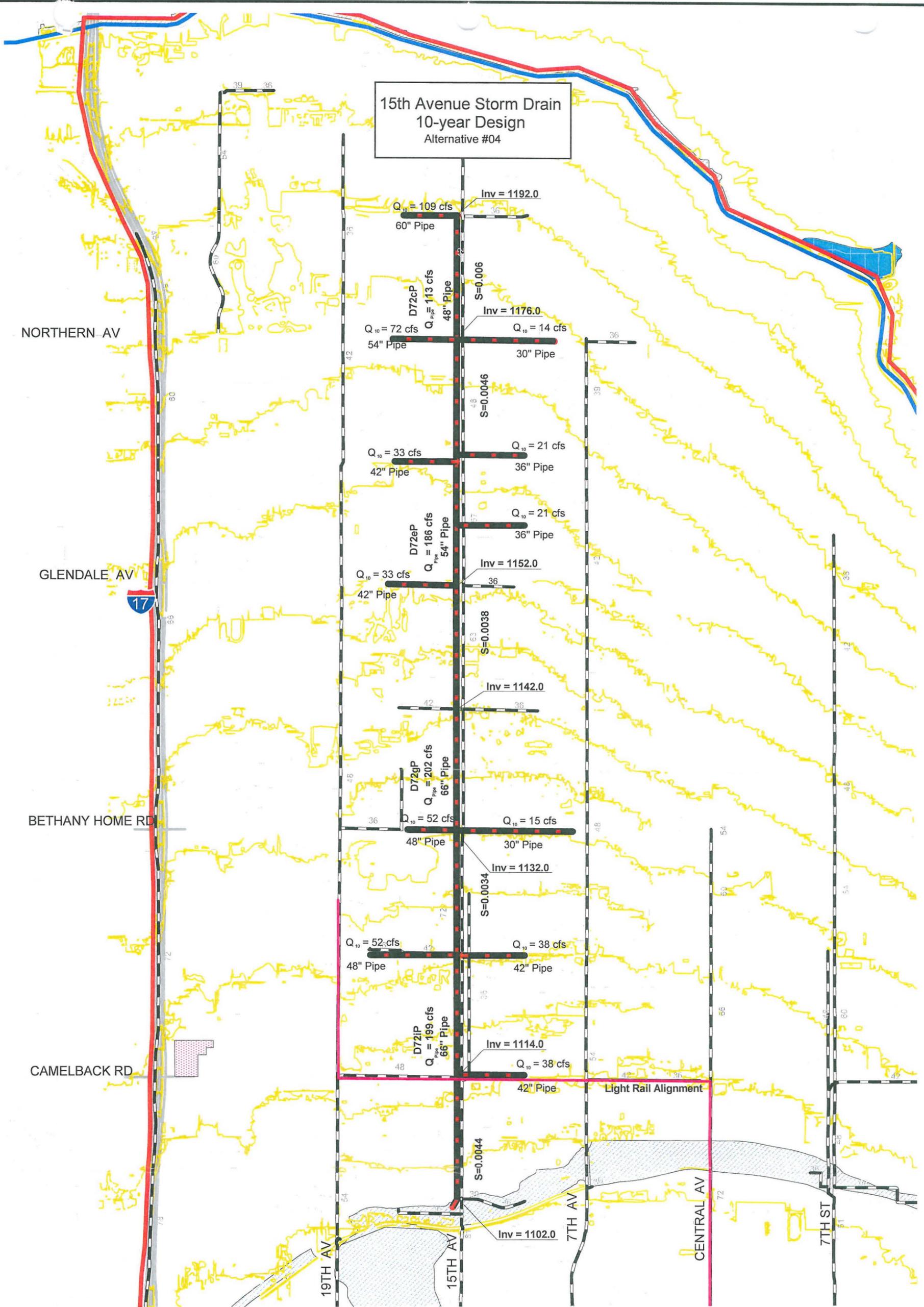
Results	
Depth	3.00 ft
Discharge	29.83 cfs
Flow Area	7.1 ft <sup>2</sup>
Wetted Perimeter	9.42 ft
Top Width	0.00 ft
Critical Depth	1.77 ft
Percent Full	100.0 %
Critical Slope	0.004673 ft/ft
Velocity	4.22 ft/s
Velocity Head	0.28 ft
Specific Energy	3.28 ft
Froude Number	0.00
Maximum Discharge	32.08 cfs
Discharge Full	29.83 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

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Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" SD in 15th Ave, Butler to Northern	LF	\$637.14	2640	\$ 1,682,043.26
2	48" SD in 15th Ave, Northern to Glendale	LF	\$637.14	5280	\$ 3,364,086.53
3	54" SD in 15th Ave, Glendale to Bethany Home	LF	\$698.29	5280	\$ 3,686,988.10
4	66" SD in 15th Ave, Bethany Home to Camelback	LF	\$819.44	5280	\$ 4,326,657.98
5	66" SD in 15th Ave, Camelback to Grand Canal	LF	\$819.44	3300	\$ 2,704,161.24
6	60" SD Lateral in Butler, 17th Ave to 15th Ave	LF	\$759.41	1170	\$ 888,508.76
7	54" SD Lateral in Northern, 17th Ave to 15th Ave	LF	\$698.29	1530	\$ 1,068,388.60
8	30" SD Lateral in Northern, 9th Ave to 15th Ave	LF	\$448.81	1950	\$ 875,185.74
9	42" SD Lateral in Orangewood Rd., 17th Ave to 15th Ave	LF	\$578.17	1470	\$ 849,914.60
10	36" SD Lateral in Vista Ave., 11th Ave to 15th Ave	LF	\$506.89	1300	\$ 658,961.16
11	36" SD Lateral in Myrtle Ave., 11th Ave to 15th Ave	LF	\$506.89	1300	\$ 658,961.16
12	42" SD Lateral in Glendale Ave., 17th Ave to 15th Ave	LF	\$578.17	1600	\$ 925,077.12
13	48" SD Lateral in Bethany Home, 17th Ave to 15th Ave	LF	\$637.14	1200	\$ 764,565.12
14	30" SD Lateral in Bethany Home, 8th Ave to 15th Ave	LF	\$448.81	2500	\$ 1,122,033.00
15	48" SD Lateral in Missouri Ave., 18th Ave to 15th Ave	LF	\$637.14	1990	\$ 1,267,903.82
16	42" SD Lateral in Missouri Ave., 11th Ave to 15th Ave	LF	\$578.17	1320	\$ 763,188.62
17	42" SD Lateral in Camelback Ave., 11th Ave to 15th Ave	LF	\$578.17	1440	\$ 832,569.41
18	Utility Relocation	LM	\$50,000.00	4.1	\$ 205,000.00
Sub Total					\$ 26,644,194
Contingencies (20%)					\$ 5,328,838.85
<b>TOTAL</b>					<b>\$ 31,973,000</b>

23/23

15th Avenue Storm Drain  
10-year Design  
Alternative #04



Metro Phoenix ADMP - Level II Analysis  
Old Cave Creek Floodplain  
Alternative #4

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- Future Detention Basins (Planned with 24th Ave. and Camelback Rd. DCR)

- Pipe Dimensions (inches)
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway



Scale: 1" = 2,000'

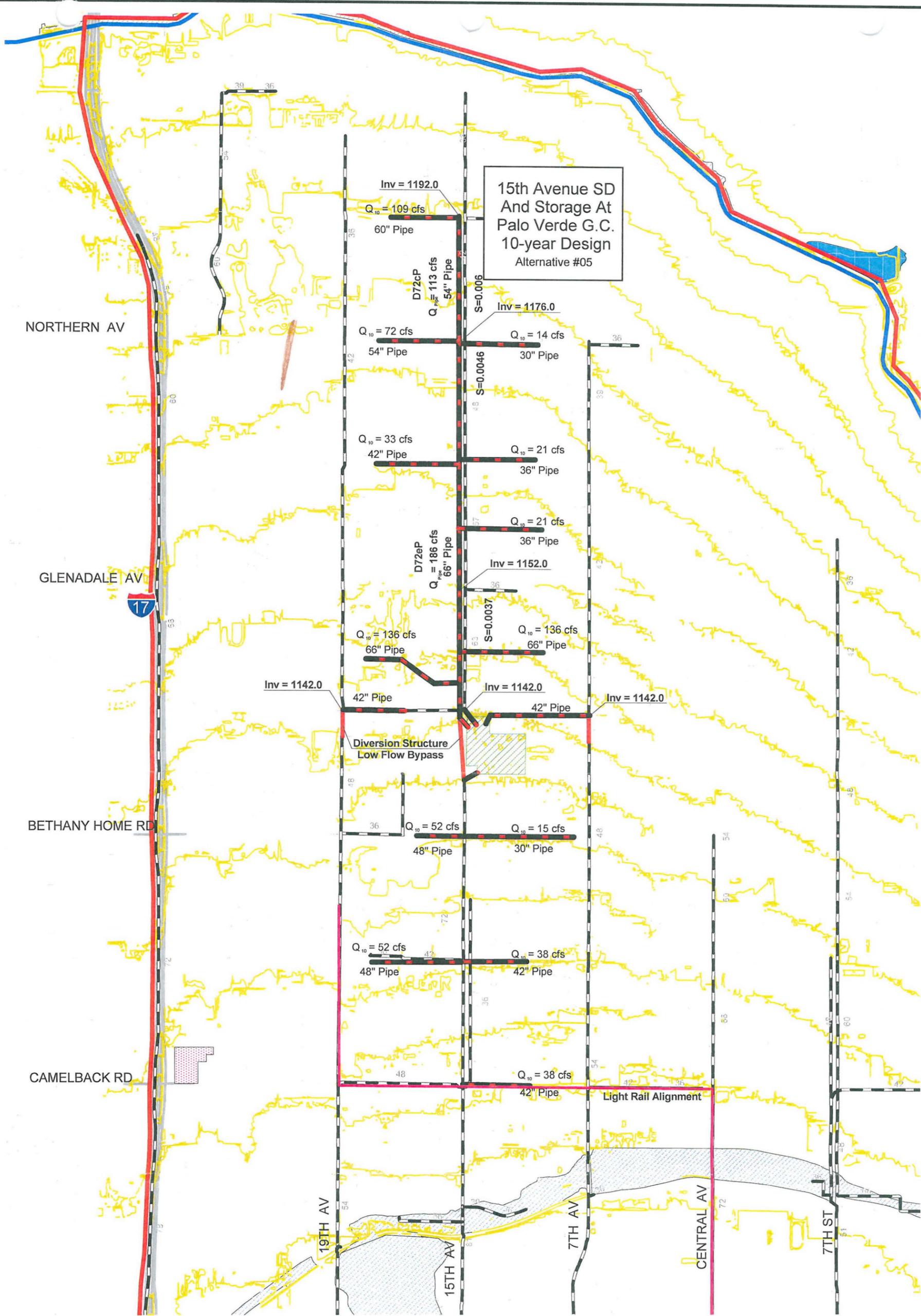


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Phoenix, Arizona 85012

# Alternative #5 - Storage in Palo Verde Golf Course (10-Yr)

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Metro Phoenix ADMP - Level II Analysis  
 Old Cave Creek Floodplain  
 Alternative #5

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- Future Detention Basins (Planned with 24th Ave. and Camelback Rd. DCR)

- Pipe Dimensions (inches)
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

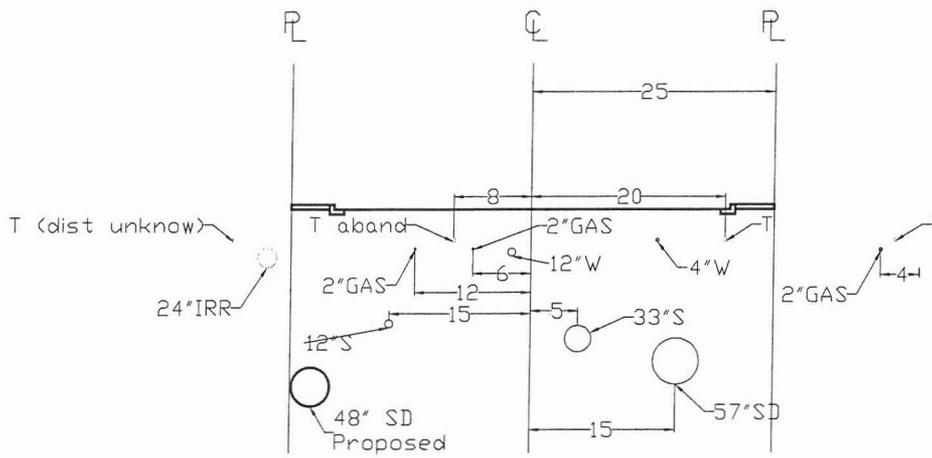


Scale: 1" = 2,000'



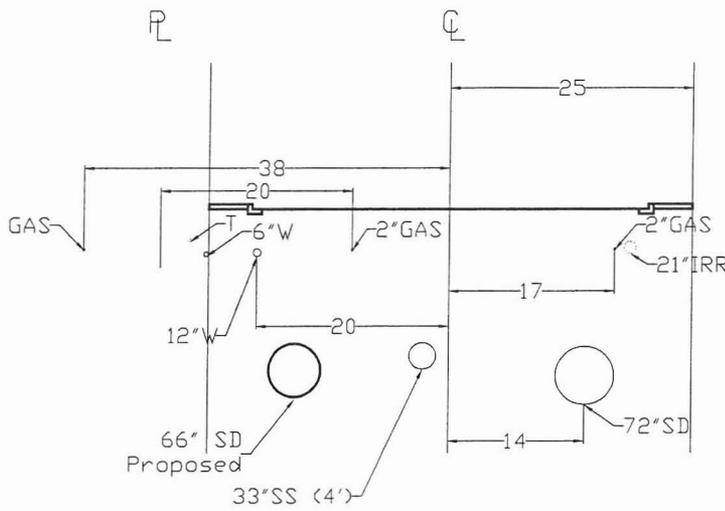
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 Phoenix, Arizona 85012

1/13



15th Ave - Northern Ave to Glendale Ave.  
 Proposed 48" SD - 10 year Design  
 Inv @ Northern = 1176.0  
 Inv @ Glendale = 1152.0  
 Alternative #5

50' ROW



15th Ave - Glendale Ave. to Maryland  
 Proposed 66" SD - 10 year Design  
 Inv @ Glendale = 1152.0  
 Alternative #5

50' ROW

N:\305008\CAVE CREEK X-SECTIONS.DWG, 5/22/2007 8:32:39 AM, \phxsr\01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
 Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851			
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 11

2/13

## Worksheet for S01- Butler to Northern

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00606	ft/ft
Normal Depth	4.02	ft
Diameter	4.02	ft
Discharge	113.00	ft <sup>3</sup> /s

### Results

Diameter	4.02	ft
Normal Depth	4.02	ft
Flow Area	12.66	ft <sup>2</sup>
Wetted Perimeter	12.62	ft
Top Width	0.00	ft
Critical Depth	3.21	ft
Percent Full	100.0	%
Critical Slope	0.00636	ft/ft
Velocity	8.92	ft/s
Velocity Head	1.24	ft
Specific Energy	5.25	ft
Froude Number	0.00	
Maximum Discharge	121.54	ft <sup>3</sup> /s
Discharge Full	112.99	ft <sup>3</sup> /s
Slope Full	0.00606	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S02- Northern to Glendale

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00455	ft/ft
Normal Depth	4.24	ft
Diameter	4.24	ft
Discharge	113.00	ft <sup>3</sup> /s

### Results

Diameter	4.24	ft
Normal Depth	4.24	ft
Flow Area	14.11	ft <sup>2</sup>
Wetted Perimeter	13.32	ft
Top Width	0.00	ft
Critical Depth	3.18	ft
Percent Full	100.0	%
Critical Slope	0.00548	ft/ft
Velocity	8.01	ft/s
Velocity Head	1.00	ft
Specific Energy	5.24	ft
Froude Number	0.00	
Maximum Discharge	121.55	ft <sup>3</sup> /s
Discharge Full	113.00	ft <sup>3</sup> /s
Slope Full	0.00455	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S03- Glendale to Maryland

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00370	ft/ft
Normal Depth	5.31	ft
Diameter	5.31	ft
Discharge	186.00	ft <sup>3</sup> /s

### Results

Diameter	5.31	ft
Normal Depth	5.31	ft
Flow Area	22.14	ft <sup>2</sup>
Wetted Perimeter	16.68	ft
Top Width	0.00	ft
Critical Depth	3.85	ft
Percent Full	100.0	%
Critical Slope	0.00482	ft/ft
Velocity	8.40	ft/s
Velocity Head	1.10	ft
Specific Energy	6.41	ft
Froude Number	0.00	
Maximum Discharge	200.08	ft <sup>3</sup> /s
Discharge Full	186.00	ft <sup>3</sup> /s
Slope Full	0.00370	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for L01 - Tuckey Ln - 19th Ave to 15th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	5.30	ft
Diameter	5.30	ft

### Results

Discharge	136.00	ft <sup>3</sup> /s
Flow Area	22.06	ft <sup>2</sup>
Wetted Perimeter	16.65	ft
Top Width	0.00	ft
Critical Depth	3.28	ft
Percent Full	100.0	%
Critical Slope	0.00402	ft/ft
Velocity	6.17	ft/s
Velocity Head	0.59	ft
Specific Energy	5.89	ft
Froude Number	0.00	
Maximum Discharge	146.30	ft <sup>3</sup> /s
Discharge Full	136.00	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

## Worksheet for L02 - Ocotillo Rd - 7th Ave to 15th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	5.30	ft
Diameter	5.30	ft

### Results

Discharge	136.00	ft <sup>3</sup> /s
Flow Area	22.06	ft <sup>2</sup>
Wetted Perimeter	16.65	ft
Top Width	0.00	ft
Critical Depth	3.28	ft
Percent Full	100.0	%
Critical Slope	0.00402	ft/ft
Velocity	6.17	ft/s
Velocity Head	0.59	ft
Specific Energy	5.89	ft
Froude Number	0.00	
Maximum Discharge	146.30	ft <sup>3</sup> /s
Discharge Full	136.00	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

## Project Summary Report

---

Project Description	
Worksheet	L03 - Bethany Home - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	15.00 cfs

---

---

Results	
Depth	2.32 ft
Diameter	28 in
Flow Area	4.2 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.34 ft
Percent Full	100.0 %
Critical Slope	0.005011 ft/ft
Velocity	3.55 ft/s
Velocity Head	0.20 ft
Specific Energy	2.51 ft
Froude Number	0.00
Maximum Discharge	16.14 cfs
Discharge Full	15.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Bethany Home Lateral from 13th to 15th Ave

## Project Summary Report

---

Project Description	
Worksheet	L04 - Missouri - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	38.00 cfs

---

---

Results	
Depth	3.29 ft
Diameter	39 in
Flow Area	8.5 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.95 ft
Percent Full	100.0 %
Critical Slope	0.004561 ft/ft
Velocity	4.48 ft/s
Velocity Head	0.31 ft
Specific Energy	3.60 ft
Froude Number	0.00
Maximum Discharge	40.88 cfs
Discharge Full	38.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Missouri Lateral from 13th to 15th Ave

## Project Summary Report

---

Project Description	
Worksheet	L05 - Camelback - 13th Ave to 15th Ave
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

---

---

Input Data	
Mannings Coefficient	0.013
Slope	0.002000 ft/ft
Discharge	38.00 cfs

---

---

Results	
Depth	3.29 ft
Diameter	39 in
Flow Area	8.5 ft <sup>2</sup>
Wetted Perimeter	12.57 ft
Top Width	0.00 ft
Critical Depth	1.95 ft
Percent Full	100.0 %
Critical Slope	0.004561 ft/ft
Velocity	4.48 ft/s
Velocity Head	0.31 ft
Specific Energy	3.60 ft
Froude Number	0.00
Maximum Discharge	40.88 cfs
Discharge Full	38.00 cfs
Slope Full	0.002000 ft/ft
Flow Type	N/A

---

Notes: Camelback Lateral from 13th to 15th Ave

# PALO VERDE (S72G)

ELEV AREA (sq. ft.) VOLUME

$$V=H(A1+A2+(A1*A2)^{(1/2)})/3$$

1155	1032934.09	
1154	952767.63	992581.0443
1153	847720.82	899733.0564
1152	772356.96	809746.5796
1151	672249.72	721724.5481
1150	516611.99	592725.5973
1149	347215.91	429118.6079
1148	316658.52	331819.9427
1147	288184.45	302309.7174
1146	231205.35	259172.4207
1145	125091.02	175453.4067
1144	62604.6	92063.36719
1143	51525.15	56975.03223
1142	48460.83	49985.16202

Cut = 318374 cu.yds Fill = 436 cu.yds  
Net = 317938 cu.yds CUT

TOTAL 5713408.482 cu. ft.

Elev [ft]	Area [sq. ft.]	Volume [cu. ft.]	Accumulative Volume [cu. ft.]	Accumulative Volume [acre-ft]
1142	48460.8	0	0	0.0
1143	51525.2	49985	49985	1.1
1144	62604.6	56975	106960	2.5
1145	125091.0	92063	199024	4.6
1146	231205.4	175453	374477	8.6
1147	288184.5	259172	633649	14.5
1148	316658.5	302310	935959	21.5
1149	347215.9	331820	1267779	29.1
1150	516612.0	429119	1696898	39.0
1151	772357.0	640213	2337111	53.7
1152	847720.8	809747	3146858	72.2
1153	847720.8	847721	3994579	91.7
1154	952767.6	899733	4894312	112.4
1155	1032934.1	992581	5886893	135.1

peak Q = 49 cfs

peak stage =

time to peak =

peak storage =

Metro Phoenix ADMP  
 Alternative 5  
 Storage at Palo Verde Golf Course

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	54" SD in 15th Avenue, Butler to Northern Ave	LF	\$698.29	2640	\$ 1,843,494.05
2	66" SD in 15th Avenue, Northern Ave to Glendale Ave	LF	\$819.44	5280	\$ 4,326,657.98
3	66" SD in 15th Avenue, Glendale Ave to Maryland	LF	\$819.44	2640	\$ 2,163,328.99
4	60" SD Lateral in Butler, 17th Ave to 15th Ave	LF	\$759.41	1170	\$ 888,508.76
5	54" SD Lateral in Northern, 17th Ave to 15th Ave	LF	\$698.29	1530	\$ 1,068,388.60
6	30" SD Lateral in Northern, 9th Ave to 15th Ave	LF	\$448.81	1950	\$ 875,185.74
7	42" SD Lateral in Orangewood, 17th Ave to 15th Ave	LF	\$578.17	1470	\$ 849,914.60
8	36" SD Lateral in Vista, 11th Ave to 15th Ave	LF	\$506.89	1300	\$ 658,961.16
9	36" SD Lateral in Myrtle, 11th Ave to 15th Ave	LF	\$506.89	1300	\$ 658,961.16
10	66" SD Lateral in Ocotillo, 11th Ave to 15th Ave	LF	\$819.44	1850	\$ 1,515,969.18
11	66" SD Lateral in McLellan, 17th Ave to 15th Ave	LF	\$819.44	2300	\$ 1,884,718.44
12	42" SD, Connect existing Pipes between 19th and 17th Avenue	LF	\$578.17	1400	\$ 809,442.48
13	42" SD, Connect existing 7th Avenue Storm Drain to Golf Course	LF	\$578.17	2200	\$ 1,271,981.04
14	48" SD Lateral in Bethany Home, 17th Ave to 15th Ave	LF	\$637.14	1200	\$ 764,565.12
15	30" SD Lateral in Bethany Home, 8th Ave to 15th Ave	LF	\$448.81	2500	\$ 1,122,033.00
16	48" SD Lateral in Missouri Ave., 18th Ave to 15th Ave	LF	\$637.14	1990	\$ 1,267,903.82
17	42" SD Lateral in Missouri Ave., 11th Ave to 15th Ave	LF	\$578.17	1320	\$ 763,188.62
18	42" SD Lateral in Camelback Rd., 11th Ave to 15th Ave	LF	\$578.17	1440	\$ 832,569.41
19	42" SD from Maryland Ave to Lake (Palo Verde Golf Course)	LF	\$414.48	160	\$ 66,316.80
20	10' x 3' SD in 15th Ave from Maryland to Junction Structure #2	LF	\$1,505.29	140	\$ 210,740.38
21	48" Culvert in Palo Verde Golf Course	LF	\$473.44	400	\$ 189,377.76
22	60" Culvert in Palo Verde Golf Course	LF	\$594.40	290	\$ 172,374.84
23	72" SD from 15th Ave to Lake (Palo Verde Golf Course)	LF	\$711.04	560	\$ 398,184.86
24	Headwall, for 42" Pipe	EA	\$2,250.00	1	\$ 2,250.00
25	Headwall, for 48" Pipe	EA	\$2,500.00	4	\$ 10,000.00
26	Headwall for 60" Pipe	EA	\$2,800.00	1	\$ 2,800.00
27	Headwall for 2-72" Pipes	EA	\$5,000.00	1	\$ 5,000.00
28	Junction Structure #1, Intersection of 15th Ave and Maryland	EA	\$15,000.00	1	\$ 15,000.00
29	Junction Structure #2, 15th Ave. south of Maryland	EA	\$30,000.00	1	\$ 30,000.00
30	Excavation and Haul (18 mile round trip)	CY	\$13.00	318000	\$ 4,134,000.00
31	Retaining Wall, Height = 12 ft, Length = 320 ft, ADOT Det. B-18.10	SF	\$62.85	3840	\$ 241,344.00
32	Reconstruct Golf Course (9 holes, 27 acres)	LS	\$2,500,000.00	1	\$ 2,500,000.00
33	Utility Relocation	LM	\$50,000.00	2	\$ 100,000.00
Sub Total					\$ 31,643,160.80
Contingencies (20%)					\$ 6,328,632.16
<b>TOTAL</b>					<b>\$ 37,971,800.00</b>

12/13



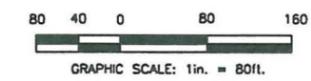
# FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

## METRO PHOENIX ADMP ALTERNATIVE 5 STORAGE AT PALO VERDE GOLF COURSE



### LEGEND

- EXISTING CONTOURS
- PROPOSED 1' CONTOURS
- PROPOSED 5' CONTOURS
- ROADWAY CENTERLINE
- NEW STORM DRAIN PIPE & SIZE
- EXISTING STORM DRAIN PIPE & SIZE
- NEW LOW FLOW ORIFICE
- NEW MANHOLE
- NEW HEADWALL
- NEW JUNCTION STRUCTURE
- NEW BOX CULVERT & SIZE
- STORAGE BASIN FOR INTERMEDIATE FLOWS
- DIRECTION OF FLOW

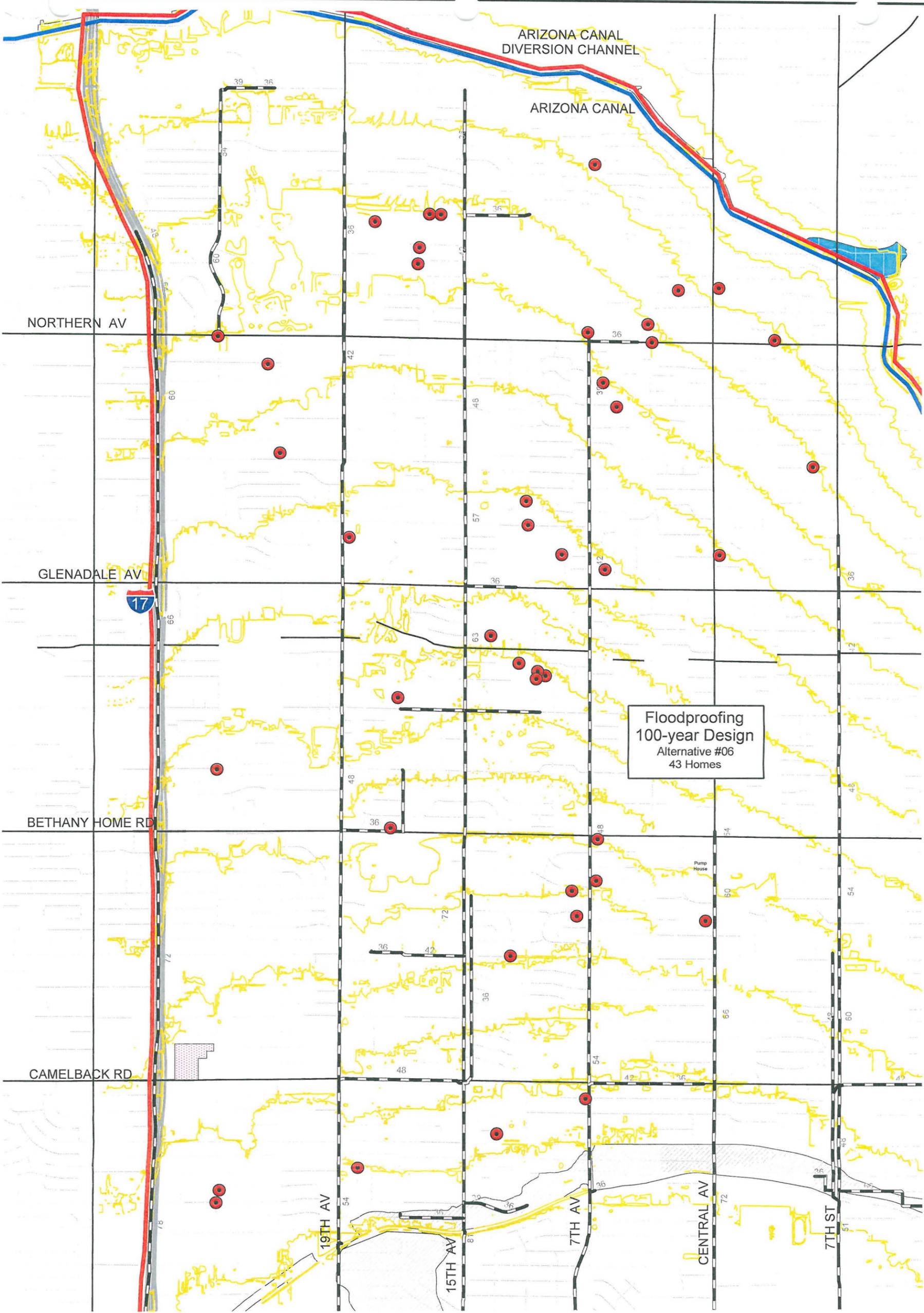


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**Alternative #6 – Floodproofing in Old Cave Creek**

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<b>Plan View Exhibit</b>	<b>1</b>
<b>Cost Estimate</b>	<b>2</b>



Floodproofing  
100-year Design  
Alternative #06  
43 Homes

**Metro Phoenix ADMP - Level II Analysis**  
**Old Cave Creek Floodplain**  
**Alternative #6**

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- Future Detention Basins (Planned with 24th Ave. and Camelback Rd. DCR)

- Pipe Dimensions (inches)**
- Existing Storm Drain
- Location of Homes That Experience Flooding
- FEMA Flood Hazard Boundaries**
- Floodplain
- Floodway



Scale: 1" = 2,000'



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Phoenix, Arizona 85012

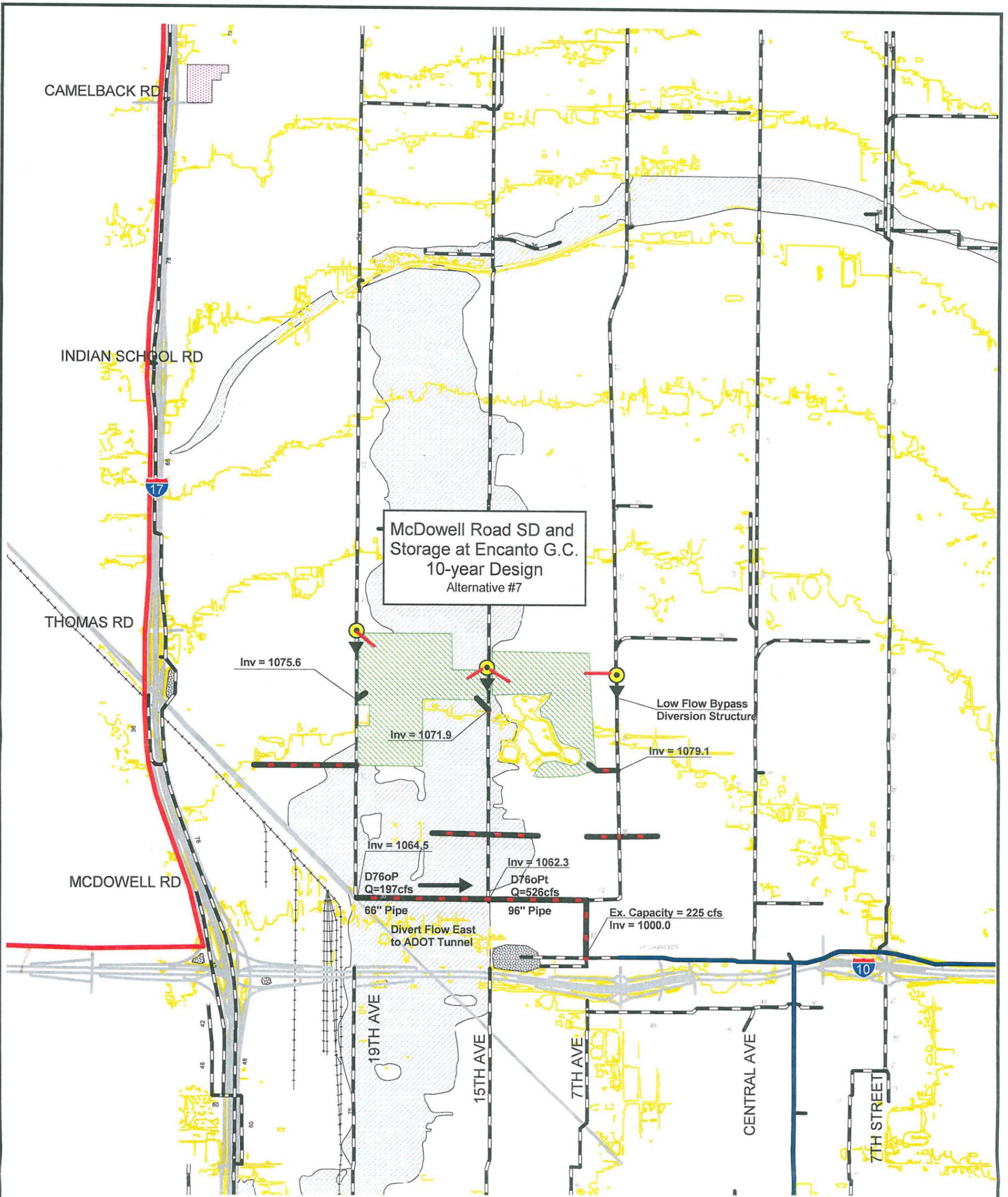
1/2

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Floodproof Home - Raise Finish Floor Elevation	EA	\$150,000.00	43	\$ 6,450,000.00
2	Move Residents and Provide Temporary Housing	EA	\$25,000.00	43	\$ 1,075,000.00
	Sub Total				\$ 7,525,000.00
	Contingencies (20%)				\$ 1,505,000.00
	<b>TOTAL</b>				\$ <b>9,030,000.00</b>

# Alternative #7 - Storage in Encanto Municipal Golf Course (10-Yr)

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Hydraulic Calculations for Proposed Storage	5-7
Cost Estimate	8
Golf Course Exhibit	9



Metro Phoenix ADMP - Level II Analysis

Cave Creek Floodplain ( Grand Canal to I-10)  
Alternative #7

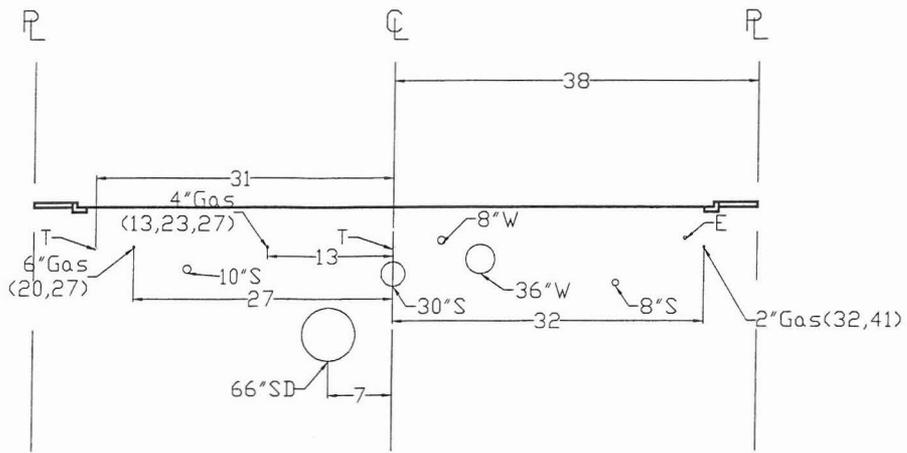
- |                      |                                       |                                      |                              |
|----------------------|---------------------------------------|--------------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel                       | Pipe Dimensions (inches)             | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel                          | Existing Storm Drain                 | Floodplain                   |
| Interstate / Highway | Retention Basins                      | Future Storm Drain (COP 5-year Plan) | Floodway                     |
| Local Roads          | Proposed Retention Basins             | Proposed Storm Drain (Metro ADMP)    |                              |
| Railroad             | Proposed Low Flow Bypass (Metro ADMP) |                                      |                              |

Scale: 1" = 2,000'  
C.I. = 10'



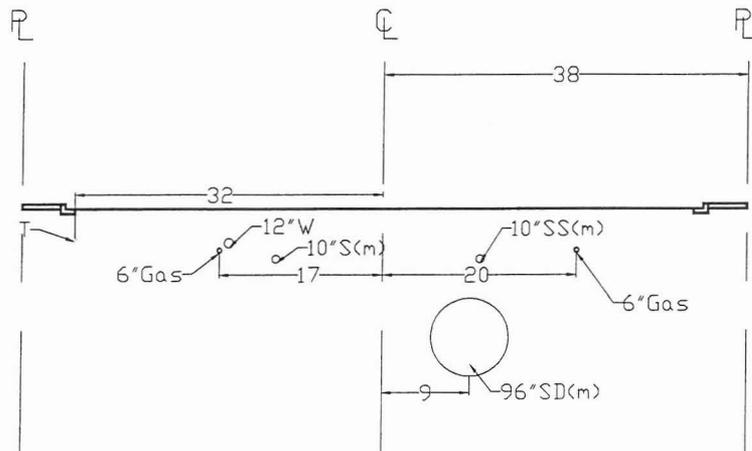
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Phoenix, Arizona 85012

6/1



McDowell Rd - 19th Ave to 15th Ave  
Proposed 66" Crossing

75' ROW



McDowell - 15th Ave to 7th Ave  
Proposed 96"

75' ROW

X-SECTIONS.DWG, 8/13/2007 7:29:40 AM, \phsrs\011HP LaserJet 4050



**FLOOD CONTROL DISTRICT  
OF MARICOPA COUNTY**

**METRO PHOENIX  
AREA DRAINAGE MASTER PLAN  
FCD CONTRACT NO. FCD 2004C040**

PRELIMINARY NOT FOR CONSTRUCTION	BY		DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
DRAWING NO.		METRO PHOENIX ADMP LEVEL II PLANS	SHEET OF <b>219</b>



Engineering and Environmental Consultants, Inc.  
3003 N. Central Avenue, Suite 600  
Phoenix, Arizona 85012-2905  
TEL: (602) 248-7702 FAX: (602) 248-7851

## Worksheet for McDowell - 19th Ave to 15th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00400	ft/ft
Normal Depth	5.35	ft
Diameter	5.35	ft
Discharge	197.00	ft <sup>3</sup> /s

### Results

Diameter	5.35	ft
Normal Depth	5.35	ft
Flow Area	22.46	ft <sup>2</sup>
Wetted Perimeter	16.80	ft
Top Width	0.00	ft
Critical Depth	3.96	ft
Percent Full	100.0	%
Critical Slope	0.00496	ft/ft
Velocity	8.77	ft/s
Velocity Head	1.20	ft
Specific Energy	6.54	ft
Froude Number	0.00	
Maximum Discharge	211.91	ft <sup>3</sup> /s
Discharge Full	197.00	ft <sup>3</sup> /s
Slope Full	0.00400	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for McDowell - 15th Ave to North Tunnel

### Project Description

Friction Method                      Manning Formula  
Solve For                              Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00400	ft/ft
Normal Depth	7.73	ft
Diameter	7.73	ft
Discharge	526.00	ft <sup>3</sup> /s

### Results

Diameter	7.73	ft
Normal Depth	7.73	ft
Flow Area	46.91	ft <sup>2</sup>
Wetted Perimeter	24.28	ft
Top Width	0.00	ft
Critical Depth	5.89	ft
Percent Full	100.0	%
Critical Slope	0.00463	ft/ft
Velocity	11.21	ft/s
Velocity Head	1.95	ft
Specific Energy	9.68	ft
Froude Number	0.00	
Maximum Discharge	565.82	ft <sup>3</sup> /s
Discharge Full	526.00	ft <sup>3</sup> /s
Slope Full	0.00400	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Encanto (\$RBZ-3)

Discharge

ELEV	Storage (acre-ft)	Total Storage (acre-ft)
1075	0.0	0.0
1076	2.1	2.1
1077	6.8	8.9
1078	12.9	21.8
1079	18.9	40.7
1080	24.2	64.9
1081	28.4	93.3
1082	32.5	125.8
1083	47.6	173.4
1084	63.9	237.3
1085	70.4	307.7
1086	77.2	384.9
1087	83.0	467.8

Zorific

Zweir

## Rating Table for Circular Orifice - 1

### Project Description

Solve For Discharge

### Input Data

Headwater Elevation	10.00 ft
Centroid Elevation	0.75 ft
Tailwater Elevation	1.00 ft
Discharge Coefficient	0.67
Diameter	1.50 ft

Headwater Elevation (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)
--------------------------	--------------------------------	-----------------

0.00			
1.00			
2.00	9.50	19.0	5.37
3.00	13.43	26.8	7.60
4.00	16.45	32.9	9.31
5.00	19.00	38.0	10.75
6.00	21.24	42.4	12.02
7.00	23.26	46.5	13.16
8.00	25.13	50.2	14.22
9.00	26.86	53.8	15.20
10.00	28.49	57.0	16.12
11.00	30.03	60.0	17.00
12.00	31.50	63.0	17.83
13.00	32.90	65.8	18.62
14.00	34.24	68.5	19.38
15.00	35.54	71.0	20.11

6/9

Site Volume Table: Unadjusted

Cut	Fill	Net	
cu.yds	cu.yds	cu.yds	Method

=====

Site: Encanto

Stratum: encanto	eg-encanto	encanto-proposed contour	
1430585	388	1430197 (C)	Composite

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Reconstruct Golf Course	EA	\$6,000,000.00	1	\$ 6,000,000.00
2	Excavation and Haul (12 mile Round Trip)	CY	\$12.00	1,430,000.00	\$ 17,160,000.00
3	66" Connection to Existing 7th Ave SD	LF	\$819.00	500	\$ 409,500.00
4	84" Connection to Existing 15th Ave SD	LF	\$997.19	100	\$ 99,719.40
5	72" Connection to Existing 19th Ave SD	LF	\$878.70	100	\$ 87,869.76
6	66" Outlet SD to 7th Ave SD	LF	\$819.00	500	\$ 409,500.00
7	84" Outlet SD to 15th Ave SD	LF	\$997.19	100	\$ 99,719.40
8	66" Outlet SD to 19th Ave SD	LF	\$819.44	100	\$ 81,944.28
9	Interior Basin Drainage, 24" Pipe	LF	\$120.00	1000	\$ 120,000.00
10	Interior Basin Drainage, 42" Pipe	LF	\$240.00	400	\$ 96,000.00
11	Interior Basin Drainage, 48" Pipe	LF	\$280.00	1800	\$ 504,000.00
12	Interior Basin Drainage, 60" Pipe	LF	\$360.00	1000	\$ 360,000.00
13	Interior Basin Drainage, 72" Pipe	LF	\$440.00	1000	\$ 440,000.00
14	36" Laterals Collect 10-year flow south of Encanto	LF	\$506.89	5500	\$ 2,787,912.60
15	66" SD McDowell Road - 19th to 15th Ave	LF	\$819.44	2640	\$ 2,163,328.99
16	96" SD McDowell Road 15th Ave to North Tunnel	LF	\$1,115.70	3640	\$ 4,061,161.10
Sub Total					\$ 34,880,655.54
<i>Contingencies (20%)</i>					\$ 6,976,131.11
<b>TOTAL</b>					<b>\$ 41,856,800.00</b>

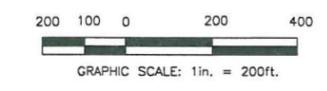


**FLOOD CONTROL DISTRICT  
OF MARICOPA COUNTY**  
METRO PHOENIX ADMP  
ALTERNATIVE 7  
STORAGE AT  
ENCANTO GOLF COURSE



**LEGEND**

- EXISTING CONTOURS
- PROPOSED 1' CONTOURS
- PROPOSED 5' CONTOURS
- ROADWAY CENTERLINE
- 72" NEW STORM DRAIN PIPE & SIZE
- 72" EXISTING STORM DRAIN PIPE & SIZE
- NEW LOW FLOW ORIFICE
- NEW MANHOLE
- NEW HEADWALL
- NEW JUNCTION STRUCTURE
- 10'x3' NEW BOX CULVERT & SIZE
- STORAGE BASIN FOR INTERMEDIATE FLOWS
- DIRECTION OF FLOW

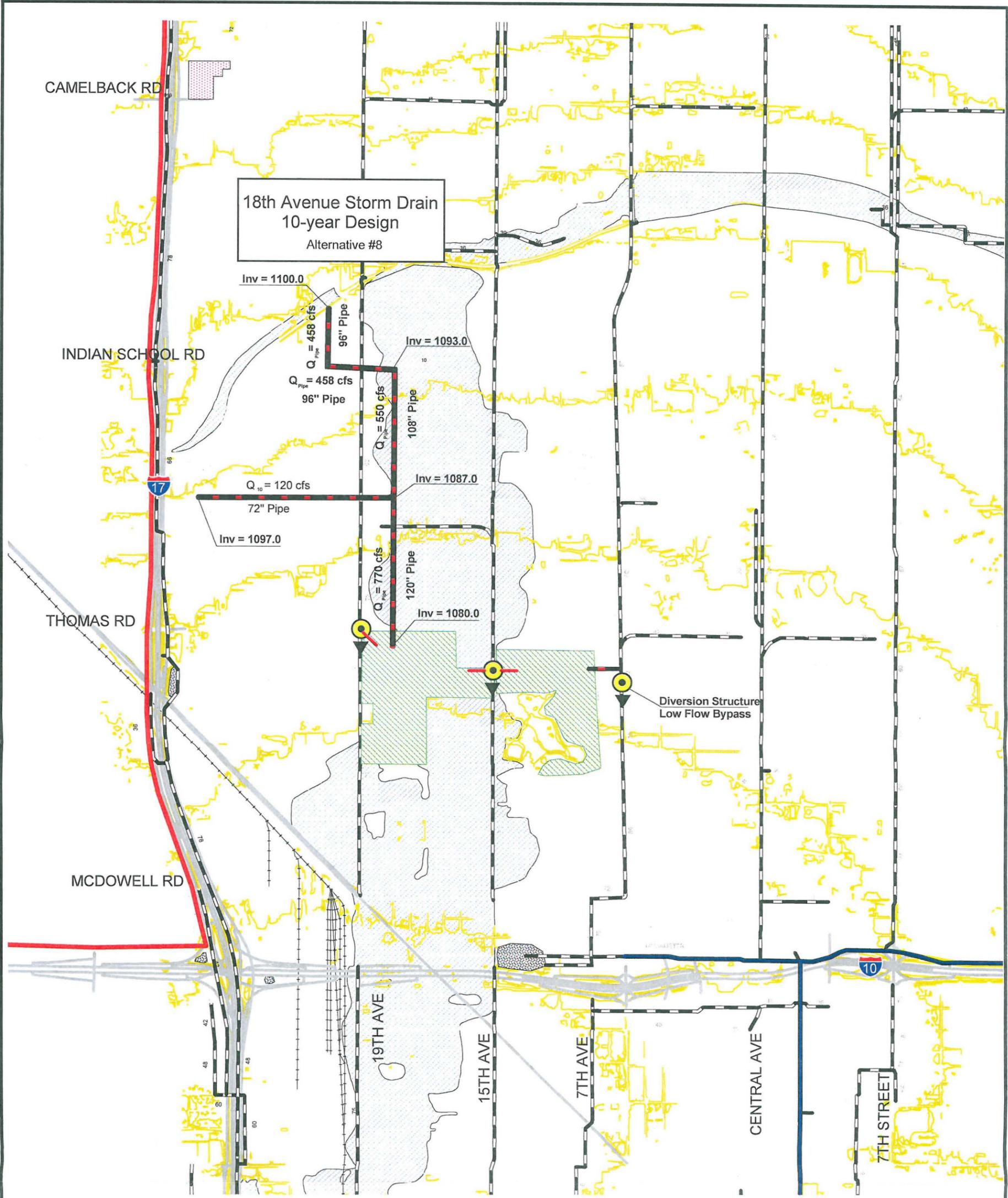


**Alternative #8 - New Storm Drain in 18th Avenue (10-year,  
Encanto G.C. to Grand Canal)**

**Table of Contents**

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Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-7
Cost Estimate	8

**ALTERNATIVE #8**  
**New Storm Drain in 18th Avenue (10-year, Encanto G.C. to Grand Canal)**



Metro Phoenix ADMP - Level II Analysis

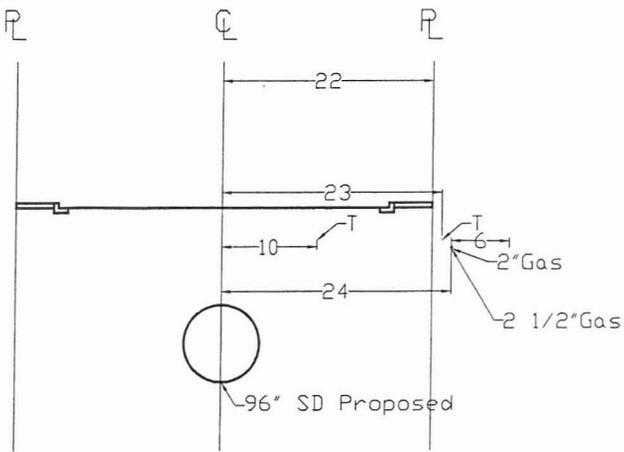
Cave Creek Floodplain ( Grand Canal to I-10)  
Alternative #8

- |                      |                           |                                       |                              |
|----------------------|---------------------------|---------------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel           | Pipe Dimensions (inches)              | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel              | Existing Storm Drain                  | Floodplain                   |
| Interstate / Highway | Retention Basins          | Future Storm Drain (COP 5-year Plan)  | Floodway                     |
| Local Roads          | Proposed Retention Basins | Proposed Storm Drain (Metro ADMP)     |                              |
| Railroad             |                           | Proposed Low Flow Bypass (Metro ADMP) |                              |

Scale: 1" = 2,000'  
C.I. = 10'



Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



18th Ave - Indian School Rd to Thomas Rd  
 Proposed 120" SD - 10 year Design  
 Alternative #8

44' ROW

N:\305008\CAVE CREEK X-SECTIONS.DWG, 8/7/2007 4:03:58 PM, \phtsr\01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	CHECKED	LAV	03/2007
		 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS	SHEET OF 2 / 8	

## Worksheet for S1 - 20th Ave SD - Grand Canal to Indian School

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00270	ft/ft
Normal Depth	7.90	ft
Diameter	7.90	ft ⇒ 96" Pipe
Discharge	458.00	ft <sup>3</sup> /s

### Results

Diameter	7.90	ft
Normal Depth	7.90	ft
Flow Area	49.00	ft <sup>2</sup>
Wetted Perimeter	24.81	ft
Top Width	0.00	ft
Critical Depth	5.47	ft
Percent Full	100.0	%
Critical Slope	0.00396	ft/ft
Velocity	9.35	ft/s
Velocity Head	1.36	ft
Specific Energy	9.26	ft
Froude Number	0.00	
Maximum Discharge	492.69	ft <sup>3</sup> /s
Discharge Full	458.01	ft <sup>3</sup> /s
Slope Full	0.00270	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 20th Ave SD - 20th Ave to 18th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                              Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00270    ft/ft  
Normal Depth                              7.90    ft  
Diameter                                      7.90    ft  
Discharge                                    458.00    ft<sup>3</sup>/s

⇒ 96" PIPE

### Results

Diameter                                      7.90    ft  
Normal Depth                              7.90    ft  
Flow Area                                    49.00    ft<sup>2</sup>  
Wetted Perimeter                          24.81    ft  
Top Width                                    0.00    ft  
Critical Depth                              5.47    ft  
Percent Full                                100.0    %  
Critical Slope                              0.00396    ft/ft  
Velocity                                      9.35    ft/s  
Velocity Head                              1.36    ft  
Specific Energy                              9.26    ft  
Froude Number                              0.00  
Maximum Discharge                        492.69    ft<sup>3</sup>/s  
Discharge Full                              458.01    ft<sup>3</sup>/s  
Slope Full                                    0.00270    ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                          0.00    ft  
Length                                      0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise            0.00    %  
Normal Depth Over Rise                 100.00    %

## Worksheet for S3 - 18th Ave SD - Indian School to Osborn

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00240 ft/ft
Normal Depth	8.65 ft
Diameter	8.65 ft
Discharge	550.00 ft <sup>3</sup> /s

⇒ 108" PIPE

### Results

Diameter	8.65 ft
Normal Depth	8.65 ft
Flow Area	58.74 ft <sup>2</sup>
Wetted Perimeter	27.17 ft
Top Width	0.00 ft
Critical Depth	5.86 ft
Percent Full	100.0 %
Critical Slope	0.00374 ft/ft
Velocity	9.36 ft/s
Velocity Head	1.36 ft
Specific Energy	10.01 ft
Froude Number	0.00
Maximum Discharge	591.65 ft <sup>3</sup> /s
Discharge Full	550.01 ft <sup>3</sup> /s
Slope Full	0.00240 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

## Worksheet for S4 - 18th Ave SD - Osborn to Encanto Golf Course

### Project Description

Friction Method                      Manning Formula  
 Solve For                              Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00260	ft/ft
Normal Depth	9.67	ft
Diameter	9.67	ft ⇒ 120" PIPE
Discharge	770.00	ft³/s

### Results

Diameter	9.67	ft
Normal Depth	9.67	ft
Flow Area	73.37	ft²
Wetted Perimeter	30.36	ft
Top Width	0.00	ft
Critical Depth	6.75	ft
Percent Full	100.0	%
Critical Slope	0.00374	ft/ft
Velocity	10.49	ft/s
Velocity Head	1.71	ft
Specific Energy	11.38	ft
Froude Number	0.00	
Maximum Discharge	828.34	ft³/s
Discharge Full	770.05	ft³/s
Slope Full	0.00260	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for L1 - Osborn - 23rd Ave to 18th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	4.85	ft
Diameter	4.85	ft ⇒ 60" PIPE
Discharge	120.00	ft <sup>3</sup> /s

### Results

Diameter	4.85	ft
Normal Depth	4.85	ft
Flow Area	18.47	ft <sup>2</sup>
Wetted Perimeter	15.23	ft
Top Width	0.00	ft
Critical Depth	3.16	ft
Percent Full	100.0	%
Critical Slope	0.00434	ft/ft
Velocity	6.50	ft/s
Velocity Head	0.66	ft
Specific Energy	5.51	ft
Froude Number	0.00	
Maximum Discharge	129.10	ft <sup>3</sup> /s
Discharge Full	120.01	ft <sup>3</sup> /s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

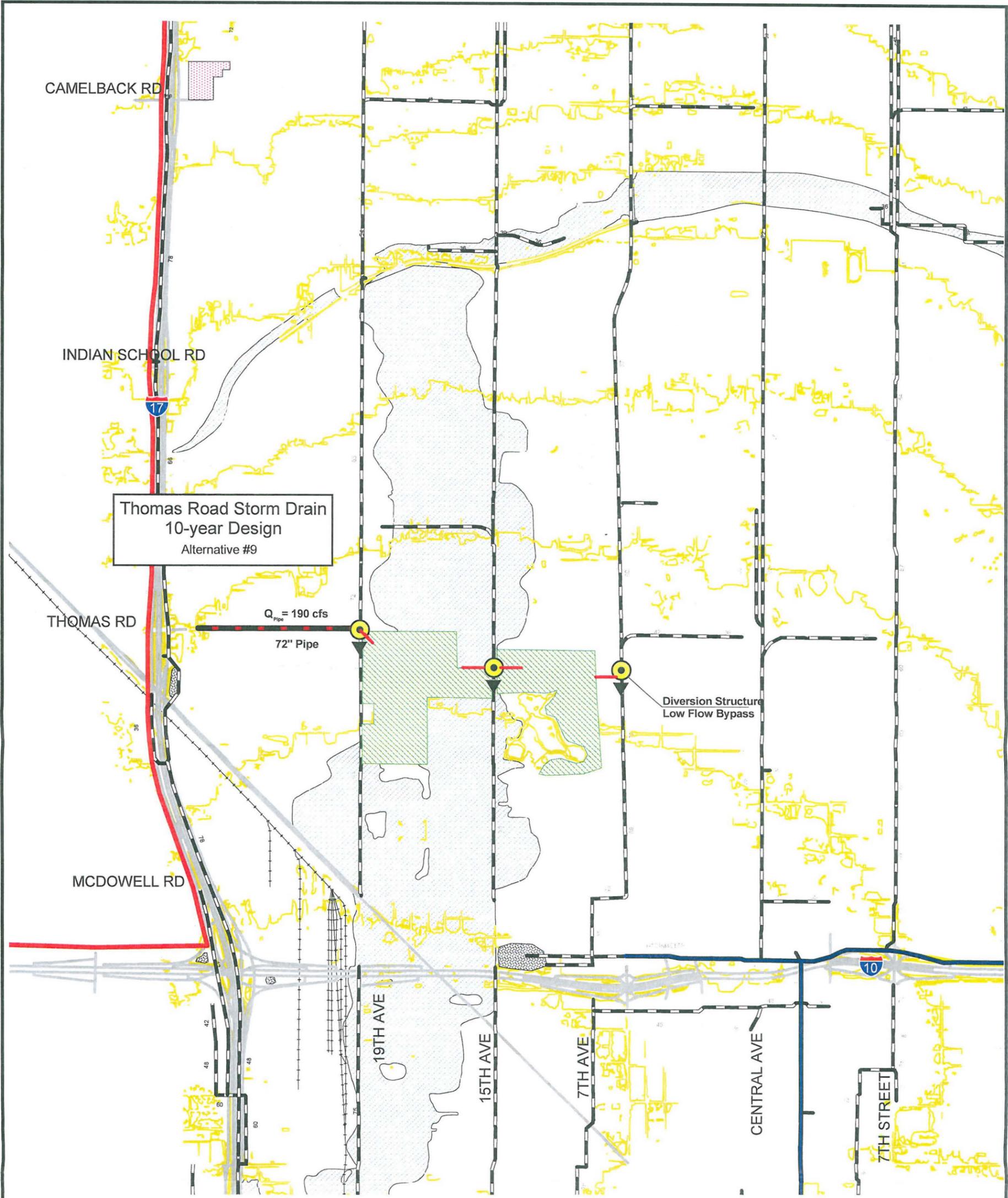
Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	96" SD in 20th Ave., Grand Canal to Indian School	LF	\$1,115.70	1300	\$ 1,450,414.68
2	96" SD in Indian School Rd., 20th Ave to 18th Ave	LF	\$1,115.70	1300	\$ 1,450,414.68
3	108" SD in 18th Ave., Indian School to Osborn	LF	\$1,260.61	2640	\$ 3,328,018.85
4	120" SD in 18th Ave., Osborn to Encanto Golf Course	LF	\$1,405.81	2700	\$ 3,795,695.64
5	72" SD Lateral In Osborn Rd., 24th Ave to 18th Ave	LF	\$878.70	3900	\$ 3,426,920.64
6	Utility Relocation	LM	\$50,000.00	1.5	\$ 75,000.00
	Sub Total				\$ 13,526,464.49
	Contingencies (20%)				\$ 2,705,292.90
	<b>TOTAL</b>				\$ <b>16,231,800.00</b>

**Alternative #9 - New Storm Drain in Thomas Road (10-year,  
24th Ave. to 18th Ave)**

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	<u>Page</u>
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<b>Hydraulic Calculations for Proposed Storm Drains</b>	<b>3</b>
<b>Cost Estimate</b>	<b>4</b>

**ALTERNATIVE #9**  
**New Storm Drain in Thomas Road (10-year, 24th Ave. to 18th Ave)**



Thomas Road Storm Drain  
10-year Design  
Alternative #9

$Q_{pipe} = 190 \text{ cfs}$   
72" Pipe

Diversion Structure  
Low Flow Bypass

Metro Phoenix ADMP - Level II Analysis

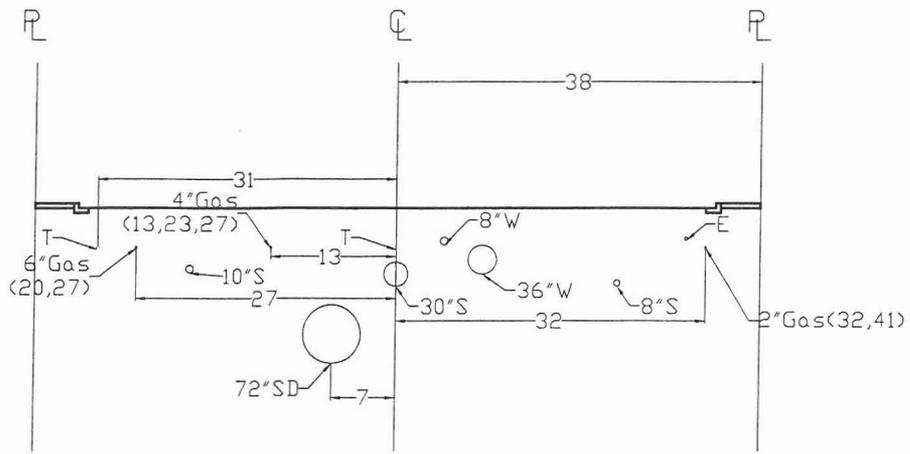
Cave Creek Floodplain ( Grand Canal to I-10)  
Alternative #9

- |                      |                           |                                       |                              |
|----------------------|---------------------------|---------------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel           | Pipe Dimensions (inches)              | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel              | Existing Storm Drain                  | Floodplain                   |
| Interstate / Highway | Retention Basins          | Future Storm Drain (COP 5-year Plan)  | Floodway                     |
| Local Roads          | Proposed Retention Basins | Proposed Storm Drain (Metro ADMP)     |                              |
| Railroad             |                           | Proposed Low Flow Bypass (Metro ADMP) |                              |

Scale: 1" = 2,000'  
C.I. = 10'



Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



Thomas Rd - 19th Ave to 15th Ave  
Proposed 72" Crossing

75' ROW

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 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF <b>2/4</b>

## Worksheet for S1 - Thomas - 24th to Encanto Golf Course

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00200 ft/ft
Normal Depth	6.01 ft
Diameter	6.01 ft
Discharge	190.00 ft <sup>3</sup> /s

### Results

Diameter	6.01 ft
Normal Depth	6.01 ft
Flow Area	28.34 ft <sup>2</sup>
Wetted Perimeter	18.87 ft
Top Width	0.00 ft
Critical Depth	3.76 ft
Percent Full	100.0 %
Critical Slope	0.00389 ft/ft
Velocity	6.70 ft/s
Velocity Head	0.70 ft
Specific Energy	6.71 ft
Froude Number	0.00
Maximum Discharge	204.40 ft <sup>3</sup> /s
Discharge Full	190.01 ft <sup>3</sup> /s
Slope Full	0.00200 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	72" SD in Thomas Rd., 24th Ave to Encanto Golf Course	LF	\$819.44	3900	\$ 3,195,826.92
2	Utility Relocation	LM	\$50,000.00	0.7	\$ 35,000.00
	Sub Total				\$ 3,230,826.92
	Contingencies (20%)				\$ 646,165.38
	<b>TOTAL</b>				<b>\$ 3,877,000.00</b>

4/4

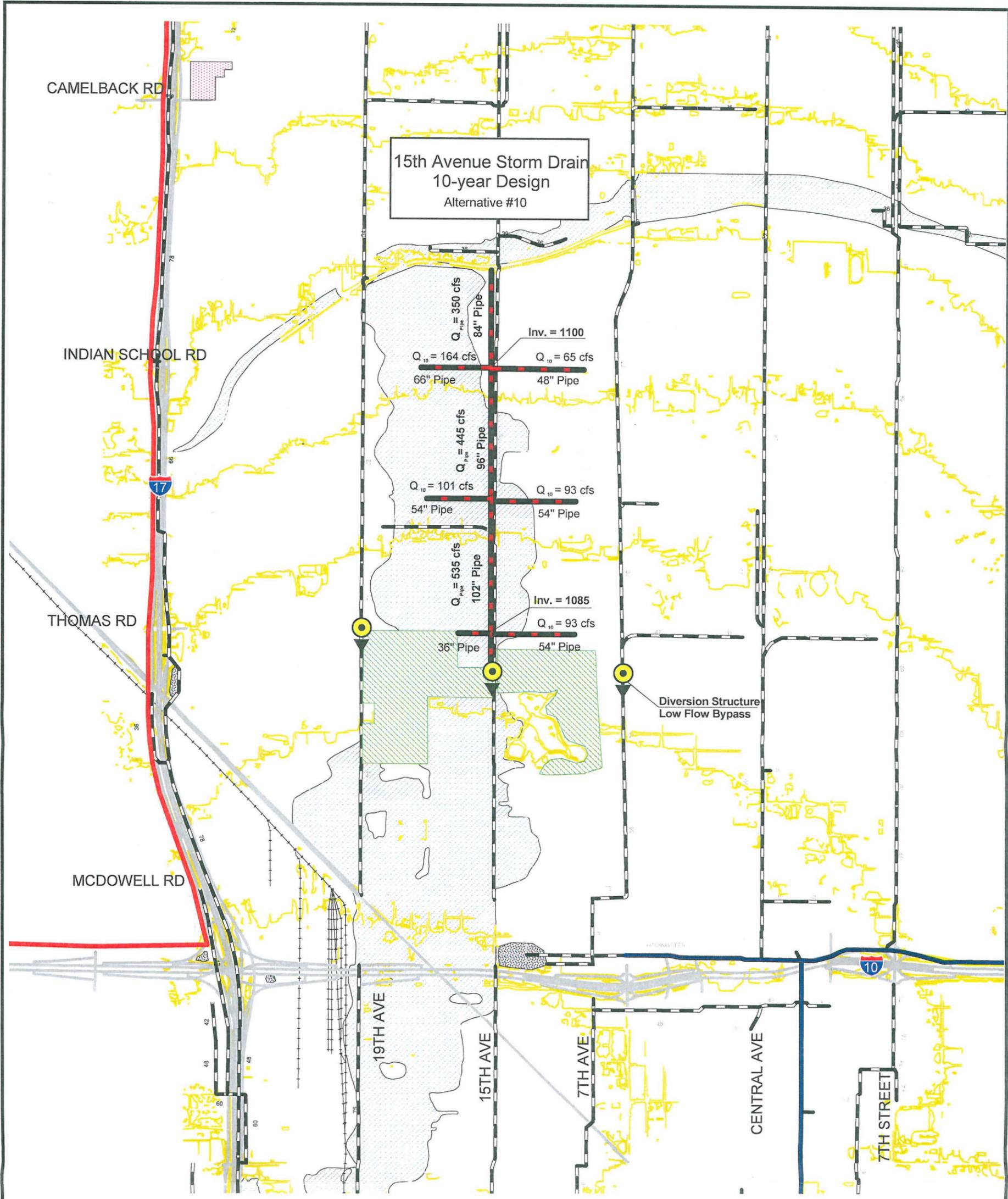
**Alternative #10 - New Parallel Storm Drain in 15th Avenue  
(10-year, Encanto G.C. to Grand Canal)**

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	<u>Page</u>
<b>Plan View Exhibit</b>	<b>1</b>
<b>Cross Sections</b>	<b>2</b>
<b>Hydraulic Calculations for Proposed Storm Drains</b>	<b>3-5</b>
<b>Cost Estimate</b>	<b>6</b>

**ALTERNATIVE #10**

**New Parallel Storm Drain in 15th Avenue (10-year, Encanto G.C. to Grand Canal)**



Metro Phoenix ADMP - Level II Analysis

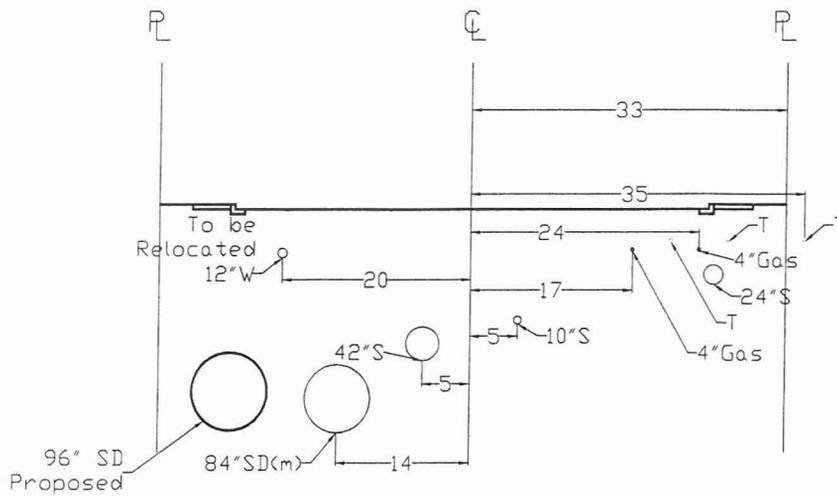
Cave Creek Floodplain ( Grand Canal to Encanto)  
Alternative #10

- |                      |                           |                                       |                              |
|----------------------|---------------------------|---------------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel           | Pipe Dimensions (inches)              | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel              | Existing Storm Drain                  | Floodplain                   |
| Interstate / Highway | Retention Basins          | Future Storm Drain (COP 5-year Plan)  | Floodway                     |
| Local Roads          | Proposed Retention Basins | Proposed Storm Drain (Metro ADMP)     |                              |
| Railroad             |                           | Proposed Low Flow Bypass (Metro ADMP) |                              |

Scale: 1" = 2,000'  
C.I. = 10'

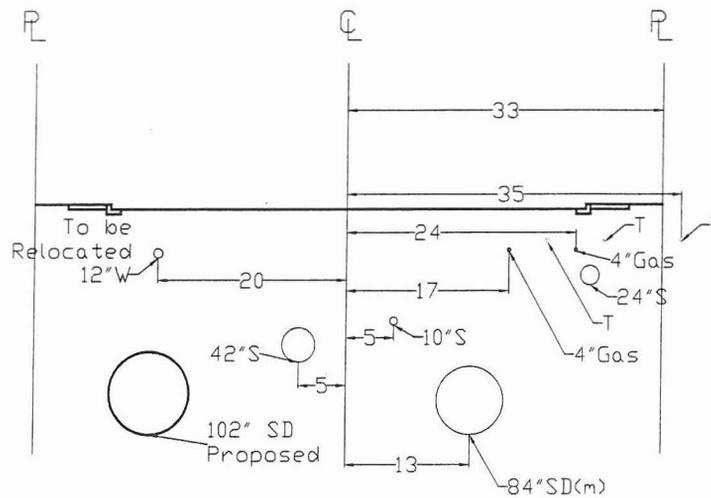


Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



15th Ave - Indian School Rd to Flower St  
 Proposed 96" SD - 10 year Design  
 Inv @ Indian School = 1100.0  
 Alternative #10

66' ROW



15th Ave - Flower St to Thomas Rd  
 Proposed 102" SD - 10 year Design  
 Inv @ Thomas = 1085.0  
 Alternative #10

66' ROW

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 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	BY		DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
 Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602)248-7752 FAX: (602)248-7851			
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 6

## Worksheet for S1 - 15th Ave - Grand Canal to Indian School

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00350	ft/ft
Normal Depth	6.80	ft
Diameter	6.80	ft
Discharge	350.00	ft <sup>3</sup> /s

### Results

Diameter	6.80	ft
Normal Depth	6.80	ft
Flow Area	36.33	ft <sup>2</sup>
Wetted Perimeter	21.37	ft
Top Width	0.00	ft
Critical Depth	4.97	ft
Percent Full	100.0	%
Critical Slope	0.00448	ft/ft
Velocity	9.63	ft/s
Velocity Head	1.44	ft
Specific Energy	8.24	ft
Froude Number	0.00	
Maximum Discharge	376.52	ft <sup>3</sup> /s
Discharge Full	350.02	ft <sup>3</sup> /s
Slope Full	0.00350	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 15th Ave - Indian School to Osborn

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	7.66	ft
Diameter	7.66	ft
Discharge	445.00	ft <sup>3</sup> /s

### Results

Diameter	7.66	ft
Normal Depth	7.66	ft
Flow Area	46.09	ft <sup>2</sup>
Wetted Perimeter	24.07	ft
Top Width	0.00	ft
Critical Depth	5.44	ft
Percent Full	100.0	%
Critical Slope	0.00413	ft/ft
Velocity	9.65	ft/s
Velocity Head	1.45	ft
Specific Energy	9.11	ft
Froude Number	0.00	
Maximum Discharge	478.69	ft <sup>3</sup> /s
Discharge Full	445.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S3 - 15th Ave - Osborn to Encanto Golf Course

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	8.21	ft
Diameter	8.21	ft
Discharge	535.00	ft <sup>3</sup> /s

### Results

Diameter	8.21	ft
Normal Depth	8.21	ft
Flow Area	52.92	ft <sup>2</sup>
Wetted Perimeter	25.79	ft
Top Width	0.00	ft
Critical Depth	5.86	ft
Percent Full	100.0	%
Critical Slope	0.00407	ft/ft
Velocity	10.11	ft/s
Velocity Head	1.59	ft
Specific Energy	9.80	ft
Froude Number	0.00	
Maximum Discharge	575.51	ft <sup>3</sup> /s
Discharge Full	535.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

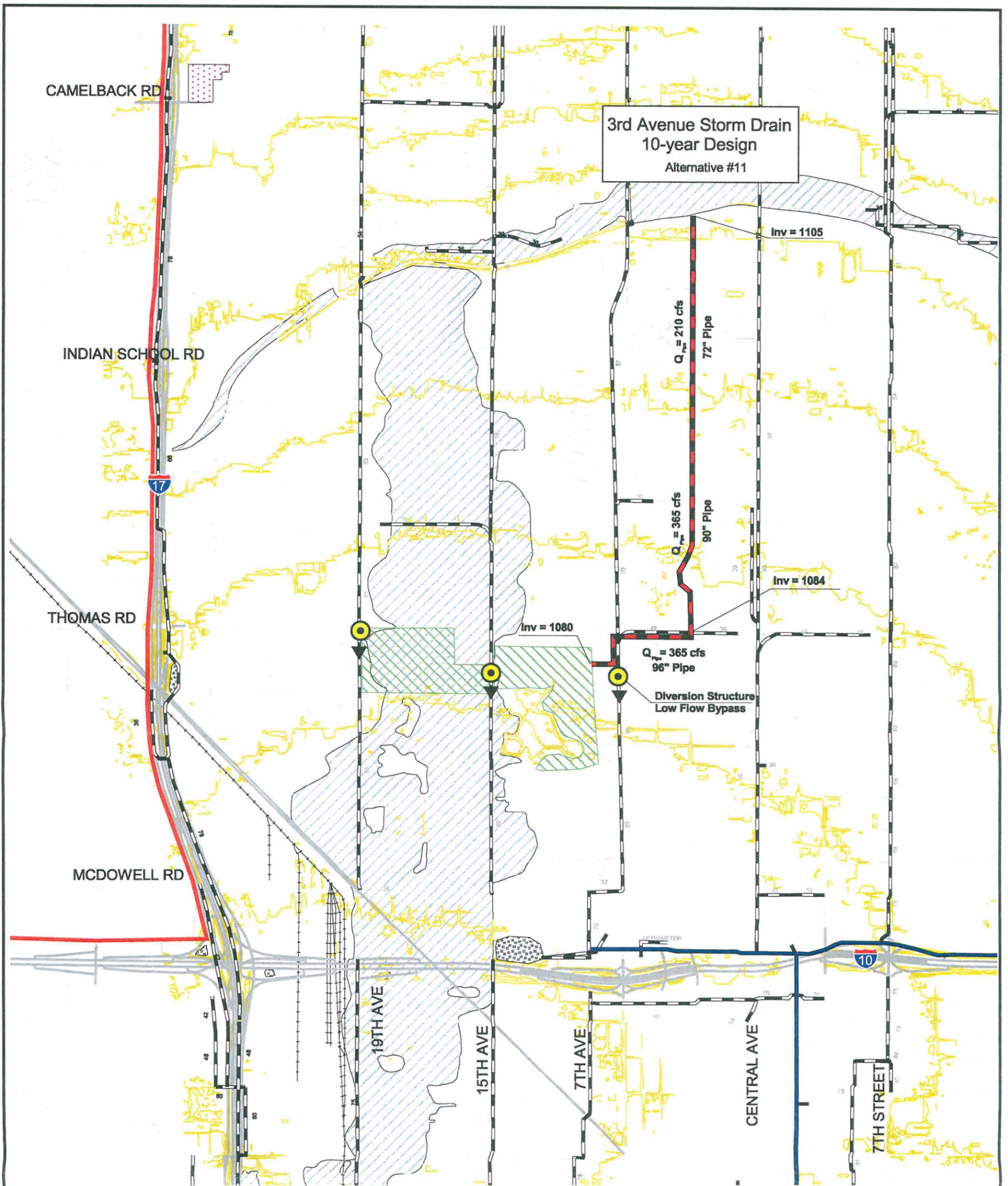
Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	84" SD in 15th Ave., Grand Canal to Indian School	LF	\$997.19	2200	\$ 2,193,826.80
2	96" SD in 15th Ave., Indian School to Osborn	LF	\$1,115.70	2640	\$ 2,945,457.50
3	102" SD in 15th Ave., Osborn to Encanto Golf Course	LF	\$1,188.16	3500	\$ 4,158,554.40
4	66" SD Lateral in Indian School Rd., 18th Ave to 15th Ave	LF	\$819.44	1800	\$ 1,474,997.04
5	48" SD Lateral in Indian School Rd., 11th Ave to 15th Ave	LF	\$637.14	1400	\$ 891,992.64
6	54" SD Lateral in Osborn Rd., 18th Ave to 15th Ave	LF	\$698.29	1800	\$ 1,256,927.76
7	54" SD Lateral in Osborn Rd., 11th Ave to 15th Ave	LF	\$698.29	1400	\$ 977,610.48
8	36" SD Lateral in Thomas Rd., 18th Ave to 15th Ave	LF	\$506.89	800	\$ 405,514.56
9	54" SD Lateral in Thomas Rd., 8th Ave to 15th Ave	LF	\$698.29	2200	\$ 1,536,245.04
10	Utility Relocation (includes relocation of 12" waterline)	LS	\$2,200,000.00	1	\$ 2,200,000.00
Sub Total					\$ 18,041,126.22
<i>Contingencies (20%)</i>					\$ 3,608,225.24
<b>TOTAL</b>					<b>\$ 21,649,400.00</b>

9/9

**Alternative #11 - New Storm Drain in 3rd Avenue (10-year,  
Encanto to Grand Canal)**

**Table of Contents**

	<u>Page</u>
Plan View Exhibit	1
Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-5
Cost Estimate	6



Metro Phoenix ADMP - Level II Analysis

Cave Creek Floodplain ( Grand Canal to Encanto)  
Alternative #11

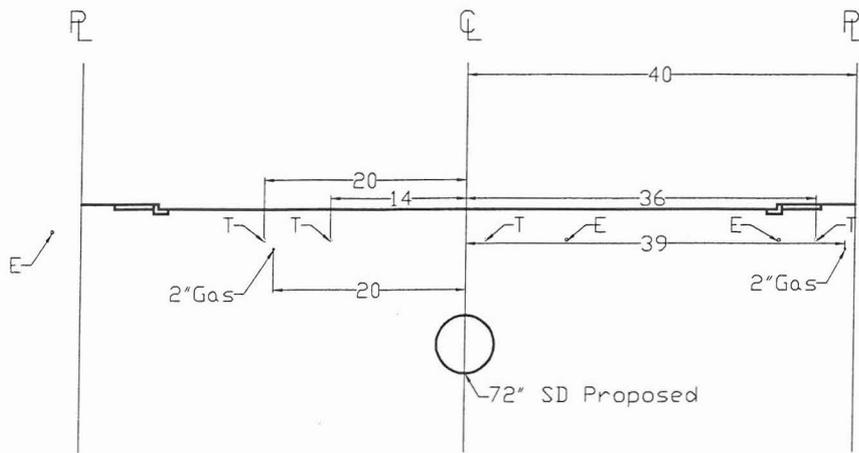
- |                      |                           |                                       |                              |
|----------------------|---------------------------|---------------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel           | Pipe Dimensions (Inches)              | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel              | Existing Storm Drain                  | Floodplain                   |
| Interstate / Highway | Retention Basins          | Future Storm Drain (COP 5-year Plan)  | Floodway                     |
| Local Roads          | Proposed Retention Basins | Proposed Storm Drain (Metro ADMP)     |                              |
| Railroad             |                           | Proposed Low Flow Bypass (Metro ADMP) |                              |

Scale: 1" = 2,000'  
C.I. = 10'



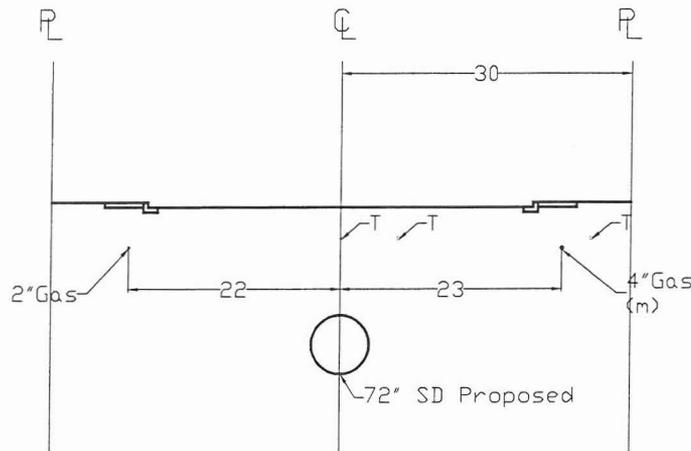
Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

9/1



3rd Ave - Grand Canal to Thomas Rd  
 Proposed 72" SD - 10 year Design  
 Inv. @ Grand Canal = 1105  
 Alternative #11

80' ROW



3rd Ave - Thomas Rd to McDowell Rd  
 Proposed 72" SD - 10 year Design  
 Inv. @ Thomas = 1084  
 Inv. @ Encanto = 1080  
 Alternative #11

60' ROW

N:\305008\CAVE CREEK V-SECTIONS.DWG, 5/22/2007 11:26:08 AM, \pchsav01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT        OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX        AREA DRAINAGE MASTER PLAN        FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	DATE
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
	 <small>Engineering and Environmental Consultants, Inc.          3003 N. Central Avenue, Suite 600          Phoenix, Arizona 85012-2905          TEL: (602)248-7702 FAX: (602)248-7851</small>		
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS	SHEET OF 2 / 6	

## Worksheet for S1 - 3rd Ave - Grand Canal to Indian School

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00350	ft/ft
Normal Depth	5.62	ft
Diameter	5.62	ft
Discharge	210.00	ft <sup>3</sup> /s

### Results

Diameter	5.62	ft
Normal Depth	5.62	ft
Flow Area	24.77	ft <sup>2</sup>
Wetted Perimeter	17.64	ft
Top Width	0.00	ft
Critical Depth	4.04	ft
Percent Full	100.0	%
Critical Slope	0.00466	ft/ft
Velocity	8.48	ft/s
Velocity Head	1.12	ft
Specific Energy	6.73	ft
Froude Number	0.00	
Maximum Discharge	225.92	ft <sup>3</sup> /s
Discharge Full	210.02	ft <sup>3</sup> /s
Slope Full	0.00350	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 3rd Ave - Indian School to Thomas

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	7.36	ft
Diameter	7.36	ft
Discharge	365.00	ft <sup>3</sup> /s

### Results

Diameter	7.36	ft
Normal Depth	7.36	ft
Flow Area	42.54	ft <sup>2</sup>
Wetted Perimeter	23.12	ft
Top Width	0.00	ft
Critical Depth	4.97	ft
Percent Full	100.0	%
Critical Slope	0.00393	ft/ft
Velocity	8.58	ft/s
Velocity Head	1.14	ft
Specific Energy	8.50	ft
Froude Number	0.00	
Maximum Discharge	392.63	ft <sup>3</sup> /s
Discharge Full	365.00	ft <sup>3</sup> /s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S3 - Thomas - 3rd Ave to Encanto Golf Course

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	7.67	ft
Diameter	7.67	ft
Discharge	365.00	ft <sup>3</sup> /s

### Results

Diameter	7.67	ft
Normal Depth	7.67	ft
Flow Area	46.25	ft <sup>2</sup>
Wetted Perimeter	24.11	ft
Top Width	0.00	ft
Critical Depth	4.91	ft
Percent Full	100.0	%
Critical Slope	0.00366	ft/ft
Velocity	7.89	ft/s
Velocity Head	0.97	ft
Specific Energy	8.64	ft
Froude Number	0.00	
Maximum Discharge	392.63	ft <sup>3</sup> /s
Discharge Full	365.00	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

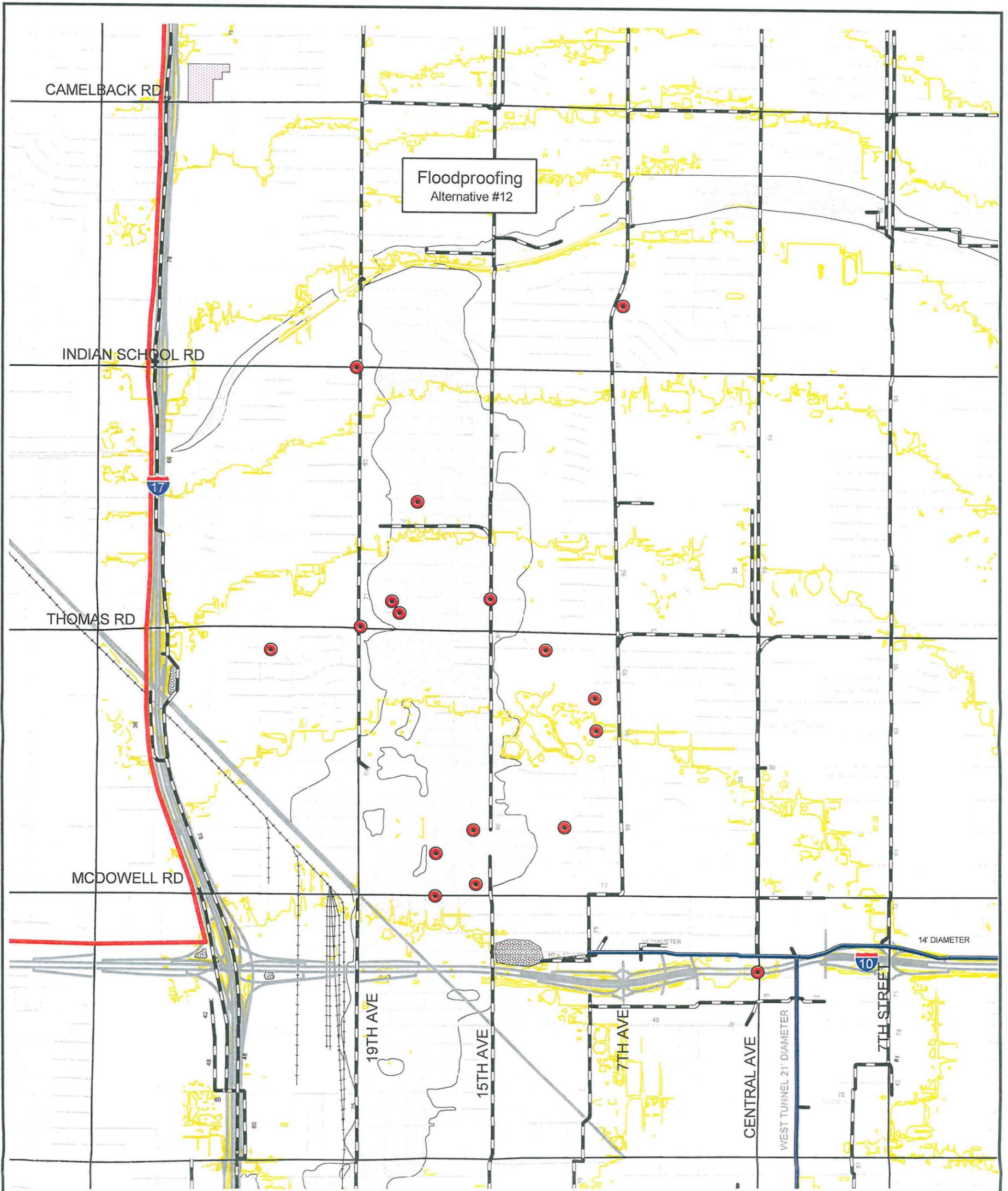
Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Floodproof Home - Raise Finish Floor Elevation	EA	\$150,000.00	20	\$ 3,000,000.00
2	Move Residents and Provide Temporary Housing	EA	\$25,000.00	20	\$ 500,000.00
					\$ -
	Sub Total				\$ 3,500,000.00
	Contingencies (20%)				\$ 700,000.00
	<b>TOTAL</b>				\$ 4,200,000.00

9/9

# Alternative #12 – Floodproofing Cave Creek Floodplain

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Cost Estimate	2



**Metro Phoenix ADMP - Level II Analysis**

**Cave Creek Floodplain (Grand Canal to I-10)  
Alternative #12**

- |                      |                           |                                      |                              |
|----------------------|---------------------------|--------------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel           | Pipe Dimensions (inches)             | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel              | Existing Storm Drain                 | Floodplain                   |
| Interstate / Highway | Retention Basins          | Future Storm Drain (COP 5-year Plan) | Floodway                     |
| Local Roads          | Proposed Retention Basins | Proposed Storm Drain (Metro ADMP)    |                              |
| Railroad             |                           |                                      |                              |



Scale: 1" = 2,000'  
C.I. = 10'



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Phoenix, Arizona 85012

2/2

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Floodproof Home - Raise Finish Floor Elevation	EA	\$150,000.00	20	\$ 3,000,000.00
2	Move Residents and Provide Temporary Housing	EA	\$25,000.00	20	\$ 500,000.00
					\$ -
	Sub Total				\$ 3,500,000.00
	Contingencies (20%)				\$ 700,000.00
	<b>TOTAL</b>				\$ 4,200,000.00

# Alternative #13 - Buyout, Demolish and Resale Lots within the Floodplain

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Average Cost per Home Worksheets	2-24
Cost Estimate	25-26

**ALTERNATIVE #13**  
**Buyout, Demolish and Resale Lots within the Floodplain**

### Grand Canal Alternative #13

- Study Area Boundary
- Major Streets
- Interstate
- Freeways
- Local Roads
- Railroad
- Index Contours
- Arizona Canal Diversion Channel
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway



Scale: 1" = 2,000'  
C.I. = 10'



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Buy-out, Demolish,  
And Resale Lots  
Alternative #13  
407 Parcels

Grand Canal

Historic District  
Pierson Place

Group 5  
35 Parcels

Group 6  
63 Parcels

Group 7  
26 Parcels

Group 8  
25 Parcels

Group 9  
41 Parcels

Group 1  
10 Parcels

Group 2  
86 Parcels

Group 3  
121 Parcels

Bethany Home Rd  
Camelback Rd  
Indian School Rd  
Thomas Rd  
27th Ave  
19th Ave  
18th Ave  
7th Ave  
Central Ave  
7th St  
12th St  
16th St  
24th St

51

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**3807 N 23rd Dr, Phoenix, AZ 85015**  
**ZESTIMATE™: \$300,374**

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**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

**Owner Facts**

<b>Residence:</b>	Multi family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	--
<b>Sq ft:</b>	2,800
<b>Lot size:</b>	8,208 sq ft / 0.19 acres
<b>Year built:</b>	1980
<b>Year updated:</b>	1980
<b># Stories:</b>	1
<b># Units:</b>	3
<b>Total rooms:</b>	--

2/26

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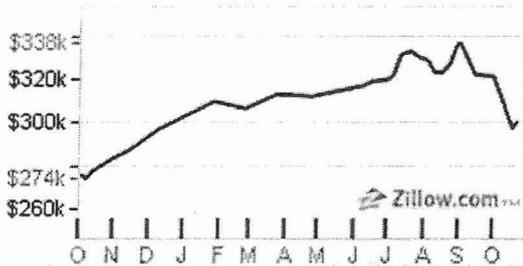


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### Sale History & Tax Info

### Comparable Homes

#### How this home stacks up

1. [2206 W Heatherbrae Dr](#)  
Sold 07/11/2006: \$235,000
2. [2210 W Heatherbrae Dr](#)  
Sold 07/12/2006: \$235,000
3. [2202 W Heatherbrae Dr](#)  
Sold 06/16/2006: \$235,000
4. [2205 W Glenrosa Ave](#)  
Sold 07/11/2006: \$235,000

3/26



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**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Multi family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	--
<b>Sq ft:</b>	3,033
<b>Lot size:</b>	11,518 sq ft / 0.26 acres
<b>Year built:</b>	1963
<b>Year updated:</b>	1963
<b># Stories:</b>	1
<b># Units:</b>	4
<b>Total rooms:</b>	--

4/26

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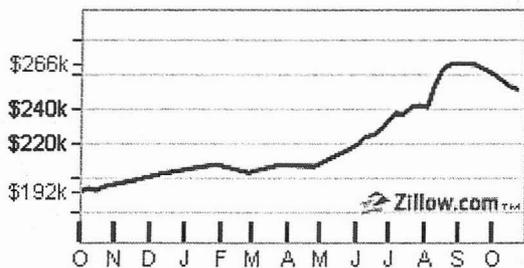


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**Sale History & Tax Info**

**Comparable Homes**

**How this home stacks up**

1. [2210 W Heatherbrae Dr](#)  
Sold 07/12/2006: \$235,000
2. [2206 W Heatherbrae Dr](#)  
Sold 07/11/2006: \$235,000
3. [2202 W Heatherbrae Dr](#)  
Sold 06/16/2006: \$235,000
4. [2205 W Glenrosa Ave](#)  
Sold 07/11/2006: \$235,000

5/26



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**ZESTIMATE™: \$208,691**

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**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Single family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	1.0
<b>Sq ft:</b>	1,540
<b>Lot size:</b>	7,410 sq ft / 0.17 acres
<b>Year built:</b>	1949
<b>Year updated:</b>	--
<b># Stories:</b>	1
<b>Total rooms:</b>	6

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6/26

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**Zestimate: \$208,691**

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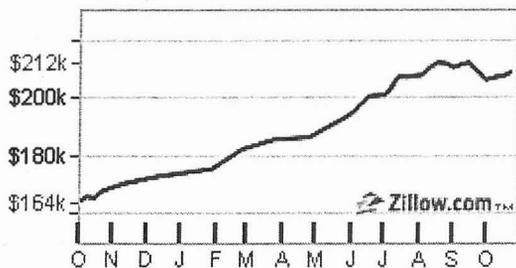


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**Sale History & Tax Info**

**Comparable Homes**

**How this home stacks up**

1. 4317 N 17th Ave  
Sold 08/30/2006: \$220,000
2. 4521 N 17th Dr  
Sold 09/29/2006: \$189,000
3. 1705 W Montecito Ave  
Sold 07/24/2006: \$205,000
4. 1506 W Roma Ave  
Sold 12/22/2005: \$197,000

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7/26



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**ZESTIMATE™: \$246,989**

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**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Single family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	2.0
<b>Sq ft:</b>	1,654
<b>Lot size:</b>	8,708 sq ft / 0.20 acres
<b>Year built:</b>	1952
<b>Year updated:</b>	--
<b># Stories:</b>	1
<b>Total rooms:</b>	5

**Are you the owner?**

8/26

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**Zestimate: \$246,989**

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BED/BATH

3Bd 2Ba

SQ. FT.

2200

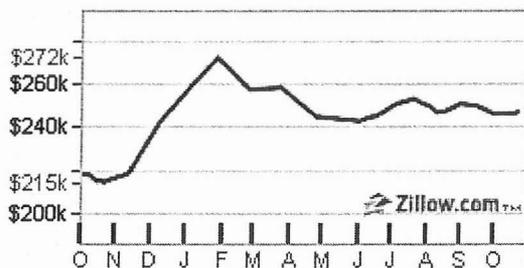
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**Sale History & Tax Info**

**Sale History & Tax Info**

Sale History

No sale history is available for this home

**2006 Property Tax**

\$941

**Assessed value bldgs:**

\$9,040

**Assessed value land:**

+ \$2,260

**Total assessed value:**

= \$11,300

**Comparable Homes**

**How this home stacks up**

9/26

1. <sup>1</sup> 1108 W Campbell Ave  
Sold 01/10/2006: \$267,500
2. <sup>2</sup> 915 W Campbell Ave  
Sold 06/05/2006: \$243,000
3. <sup>3</sup> 4530 N 12th Ave  
Sold 12/23/2005: \$238,900
4. <sup>4</sup> 1344 W Sells Dr  
Sold 05/03/2006: \$249,900

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**333 W Hazelwood St, Phoenix, AZ 85013**  
**ZESTIMATE™: \$241,967**

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Map view showing the property location on W HAZELWOOD ST. Price tags for nearby homes include: \$219K, \$223K, \$246K, \$277K, \$235K, \$236K, \$199K, \$192K, \$242K, \$273K, \$211K, \$198K, \$236K, \$302K, \$198K. Zillow.com logo is visible in the bottom right of the map.

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**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Single family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	1.0
<b>Sq ft:</b>	1,244
<b>Lot size:</b>	7,768 sq ft / 0.18 acres
<b>Year built:</b>	1947
<b>Year updated:</b>	--
<b># Stories:</b>	1
<b>Total rooms:</b>	5

**Are you the owner?**

11/26

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**Zestimate: \$241,967**

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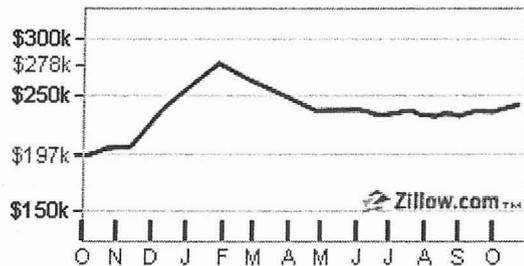
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**Sale History & Tax Info**

**Sale History & Tax Info**

Sale History	
<b>09/29/1999:</b>	\$92,900
<b>07/19/1999:</b>	\$69,000
<b>05/13/1999:</b>	\$64,150

<b>2006 Property Tax</b>	\$786
<b>Assessed value bldgs:</b>	\$8,440
<b>Assessed value land:</b>	+ \$2,110
<b>Total assessed value:</b>	= \$10,550

12/26

## Comparable Homes

### How this home stacks up

1. <sup>1</sup> 320 W Hazelwood St  
Sold 05/15/2006: \$230,500
2. <sup>2</sup> 306 W Hazelwood St  
Sold 06/30/2006: \$235,000
3. <sup>3</sup> 306 W Coolidge St  
Sold 07/19/2006: \$211,000
4. <sup>4</sup> 337 W Minnezona Ave  
Sold 04/21/2006: \$218,000

## Financing 101



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**4615 N 4th St, Phoenix, AZ 85012**  
**ZESTIMATE™: \$237,056**

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**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
Residence:	Single family
Bedrooms:	--
Bathrooms:	2.0
Sq ft:	1,384
Lot size:	6,965 sq ft / 0.16 acres
Year built:	1951
Year updated:	--
# Stories:	1
Total rooms:	6

**Are you the owner?**

14/26

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**Zestimate: \$237,056**

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# Save up to \$2,000 at closing.

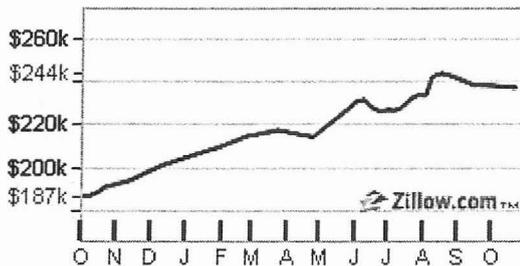
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**Sale History & Tax Info**

**Sale History & Tax Info**

Sale History

**07/10/2006:** \$240,000

No other sale data is available

**2006 Property Tax** \$892

**Assessed value bldgs:** \$7,840

**Assessed value land:** + \$1,960

**Total assessed value:** = \$9,800

**Comparable Homes**

15/26

### How this home stacks up

1. <sup>1</sup> 4609 N 4th St  
Sold 07/28/2006: \$272,500
2. <sup>2</sup> 4610 N 6th St  
Sold 11/21/2005: \$305,000
3. <sup>3</sup> 4510 N 9th St  
Sold 03/16/2006: \$265,000
4. <sup>4</sup> 4617 N 8th Pl  
Sold 08/14/2006: \$250,000

### Financing 101



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**4526 N 8th Pl, Phoenix, AZ 85014**  
**ZESTIMATE™: \$198,983**

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**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Multi family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	--
<b>Sq ft:</b>	1,389
<b>Lot size:</b>	6,918 sq ft / 0.16 acres
<b>Year built:</b>	1962
<b>Year updated:</b>	1962
<b># Stories:</b>	1
<b># Units:</b>	2
<b>Total rooms:</b>	--

17/26

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**Zestimate: \$198,983**

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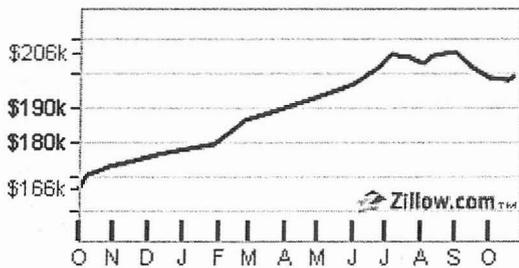


BED/BATH: **3Bd 2Ba** SQ. FT.: **2200** **Go**

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**Sale History & Tax Info**

**Sale History & Tax Info**

Sale History	
<b>04/30/1991:</b>	\$40,000
No other sale data is available	

<b>2006 Property Tax</b>	\$758
<b>Assessed value bldgs:</b>	\$7,440
<b>Assessed value land:</b>	+ \$1,860
<b>Total assessed value:</b>	= \$9,300

## Comparable Homes

### How this home stacks up

1. <sup>1</sup> 4515 N 8th St  
Sold 07/12/2006: \$144,000
2. <sup>2</sup> 1023 E Mariposa St  
Sold 07/21/2006: \$160,000
3. <sup>3</sup> 4545 N 14th St  
Sold 02/17/2006: \$148,100
4. <sup>4</sup> 1507 E Highland Ave  
Sold 08/31/2006: \$104,000

## Financing 101



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**4307 N 13th Pl, Phoenix, AZ 85014**  
**ZESTIMATE™: \$247,292**

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- [View maps side-by-side](#)
- [Map comparable homes](#)

**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Single family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	1.0
<b>Sq ft:</b>	1,159
<b>Lot size:</b>	13,800 sq ft / 0.32 acres
<b>Year built:</b>	1924
<b>Year updated:</b>	--
<b># Stories:</b>	1
<b>Total rooms:</b>	5

**Are you the owner?**

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**Zestimate: \$247,292**

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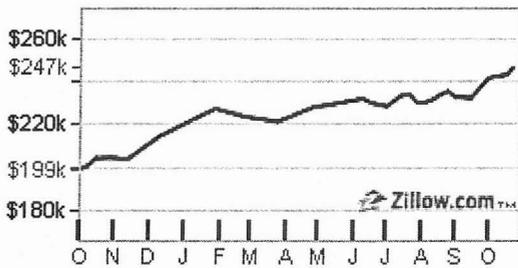
Search for **PHOENIX** homes on the MLS.

BED/BATH:  SQ. FT.:

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**Sale History & Tax Info**

**Sale History & Tax Info**

Sale History

No sale history is available for this home

<b>2006 Property Tax</b>		\$666
<b>Assessed value bldgs:</b>		\$8,440
<b>Assessed value land:</b>	+	\$2,110
<b>Total assessed value:</b>	=	\$10,550

**Comparable Homes**

**How this home stacks up**

21/26

1. <sup>1</sup> 4211 N Longview Ave  
Sold 07/14/2006: \$229,000
2. <sup>2</sup> 4133 N Longview Ave  
Sold 08/14/2006: \$190,000
3. <sup>3</sup> 4534 N 14th Pl  
Sold 09/14/2006: \$195,000
4. <sup>4</sup> 4505 N 14th St  
Sold 03/15/2006: \$170,000

**Financing 101**



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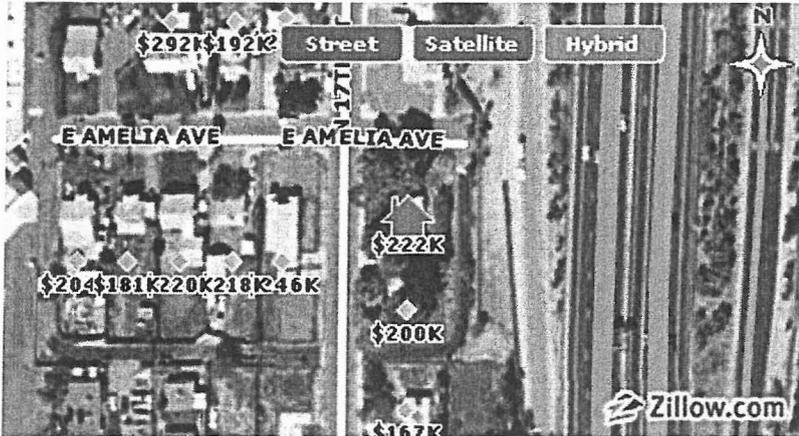
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**1701 E Amelia Ave, Phoenix, AZ 85016**  
**ZESTIMATE™: \$222,177**

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- [Map comparable homes](#)

**Home Facts**

**Public Facts**

**Owner's Facts**

**Home Facts**

Owner Facts	
<b>Residence:</b>	Single family
<b>Bedrooms:</b>	--
<b>Bathrooms:</b>	1.0
<b>Sq ft:</b>	1,097
<b>Lot size:</b>	7,675 sq ft / 0.18 acres
<b>Year built:</b>	1935
<b>Year updated:</b>	--
<b># Stories:</b>	1
<b>Total rooms:</b>	6

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**Zestimate: \$222,177**

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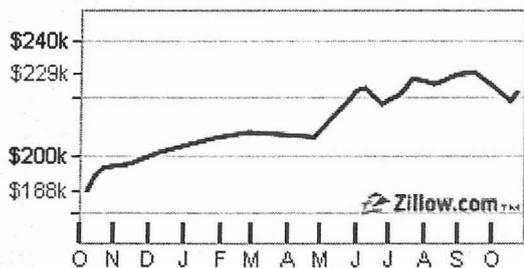
Search for **PHOENIX** homes on the MLS.

BED/BATH:  SQ. FT.:

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### Sale History & Tax Info

### Comparable Homes

#### How this home stacks up

1. [1649 E Amelia Ave](#)  
Sold 09/27/2006: \$235,000
2. [1835 E Fairmount Ave](#)  
Sold 06/22/2006: \$239,900
3. [1836 E Indianola Ave](#)  
Sold 06/12/2006: \$136,000
4. [1840 E Indianola Ave](#)  
Sold 05/31/2006: \$230,000

### Financing 101

**Alternative #13 - Buy-out Homes Along Grand Canal (100-year)**

Group	LAV	IAV	TAV
1	\$3,177,684	\$2,184,400	\$5,362,084
2	\$8,262,076	\$8,642,340	\$16,904,416
3	\$13,643,540	\$14,123,700	\$27,767,240
4	Pierson Place		
5	\$3,888,343	\$4,354,166	\$8,242,509
6	\$5,821,652	\$6,542,670	\$12,364,322
7	\$7,485,936	\$7,565,234	\$15,051,170
8	\$2,422,425	\$2,308,333	\$4,730,758
9	\$4,038,761	\$4,393,600	\$8,432,361
Total	\$48,740,417	\$50,114,443	\$98,854,860

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Buy Out Homes in Grand Canal Floodplain	LS	\$98,854,860.00	1	\$ 98,854,860.00
2	Demolition	EA	\$11,000.00	407	\$ 4,477,000.00
3	Resale of Land	EA	\$150,000.00	407	\$ (61,050,000.00)
4	Relocation, Admin., Broker Costs (25% of Purchase Price)	LS	\$24,713,715.00	1	\$ 24,713,715.00
Sub Total					\$ 66,995,575.00
<i>Contingencies (20%)</i>					\$ 13,399,115.00
<b>TOTAL</b>					<b>\$ 80,394,700.00</b>

26/26

# Alternative #14 - Linear Parks and Storage in Floodplain along the Grand Canal

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Basin Sketches	2-10
Basin Volume Calculations	11-19
Basin Drain Times	20
Cost Estimate	21

### Grand Canal Alternative #14

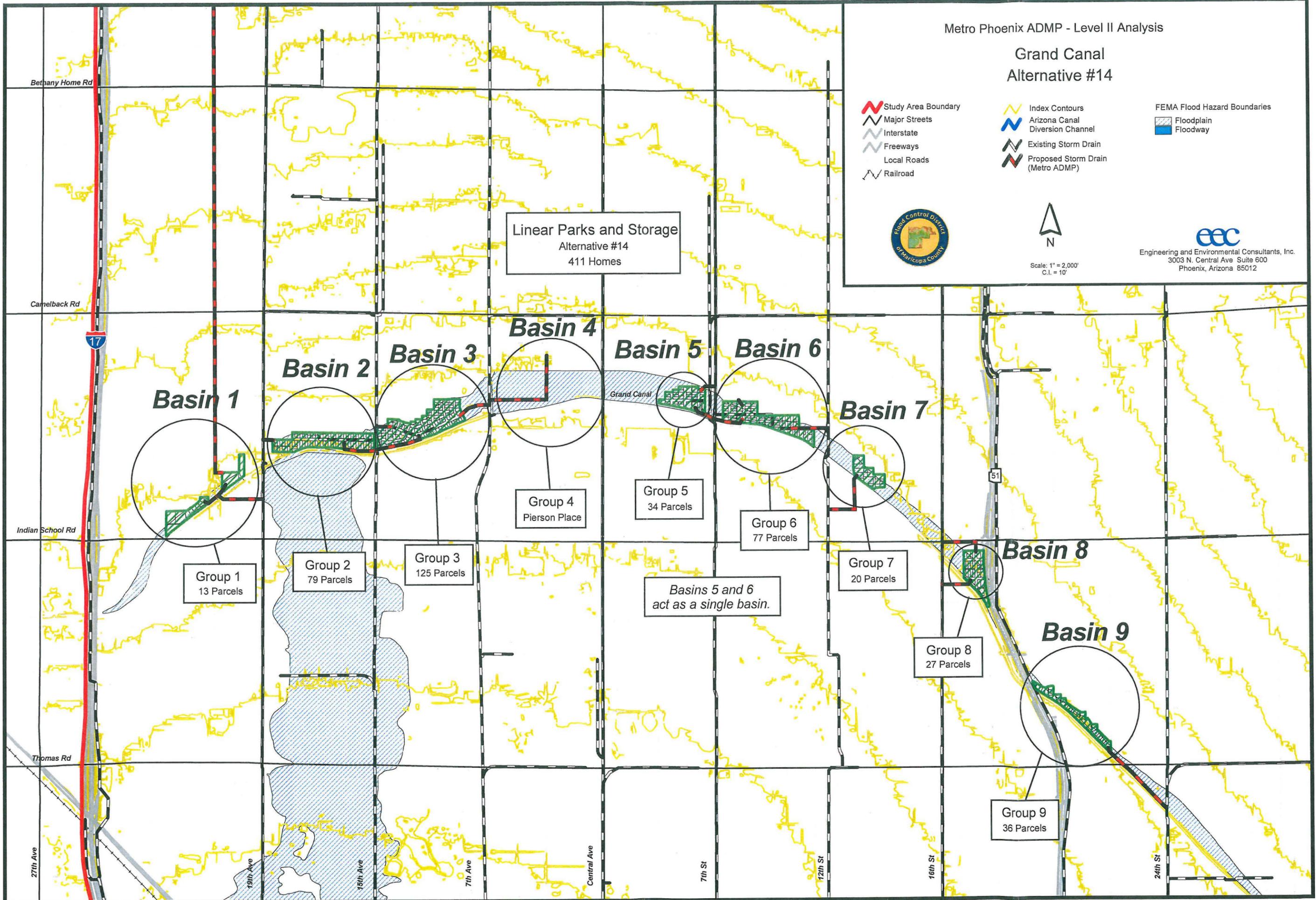
- Study Area Boundary
- Major Streets
- Interstate
- Freeways
- Local Roads
- Railroad
- Index Contours
- Arizona Canal
- Diversion Channel
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

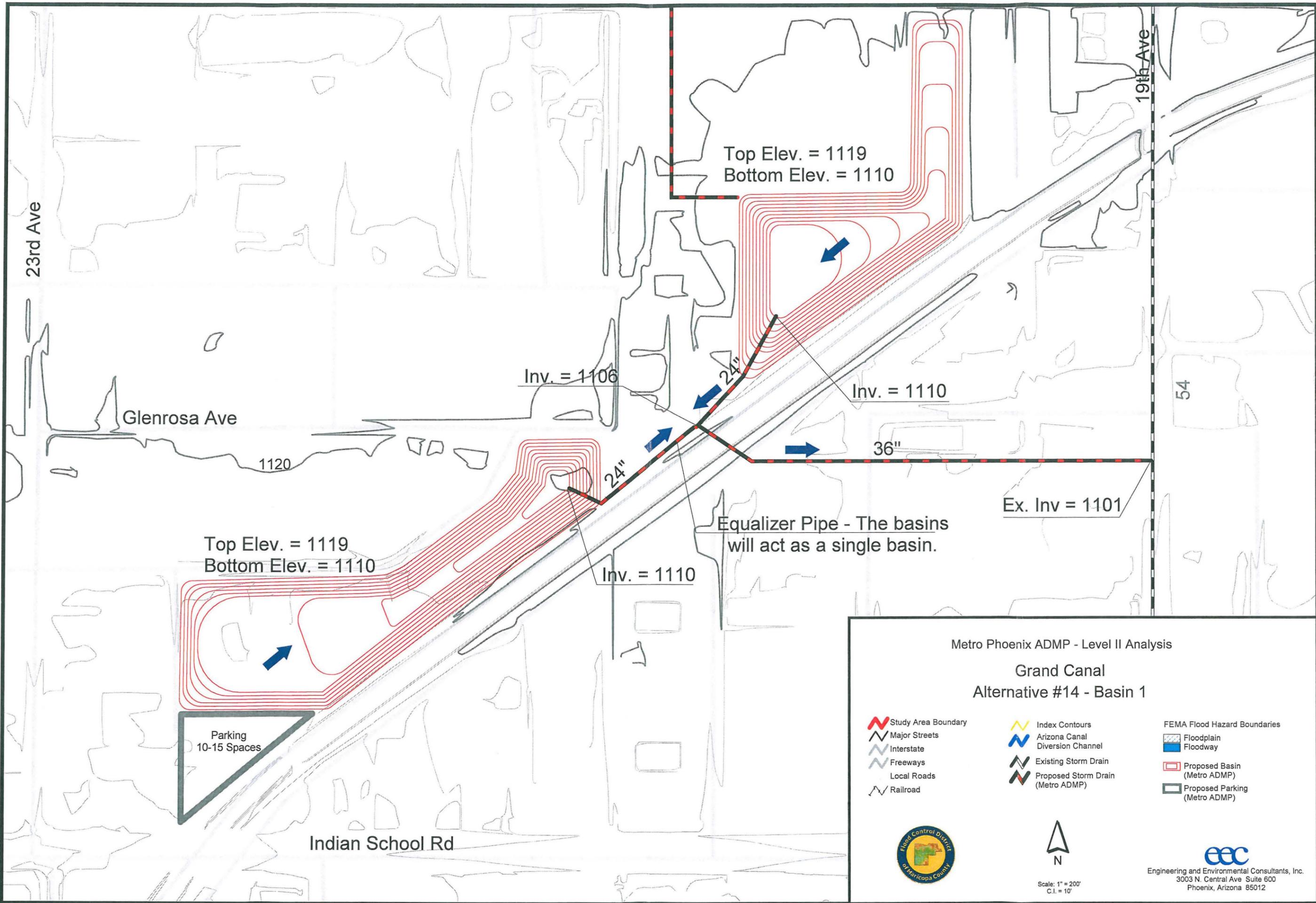


Scale: 1" = 2,000'  
C.I. = 10'



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Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 1

- |                     |                                   |                               |
|---------------------|-----------------------------------|-------------------------------|
| Study Area Boundary | Index Contours                    | FEMA Flood Hazard Boundaries  |
| Major Streets       | Arizona Canal                     | Floodplain                    |
| Interstate          | Diversion Channel                 | Floodway                      |
| Freeways            | Existing Storm Drain              | Proposed Basin (Metro ADMP)   |
| Local Roads         | Proposed Storm Drain (Metro ADMP) | Proposed Parking (Metro ADMP) |
| Railroad            |                                   |                               |



Scale: 1" = 200'  
C.I. = 10'



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19th Ave

15th Ave

81

Ex. Inv = 1098  
Diversion Structure  
W/ Low Flow Bypass

1122  
Top Elev. = 1121  
Bottom Elev. = 1105

1120

24" Pipe

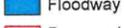
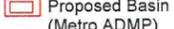
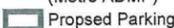
24" Pipe  
Inv = 1097

Ex. Inv = 1095

81

Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 2

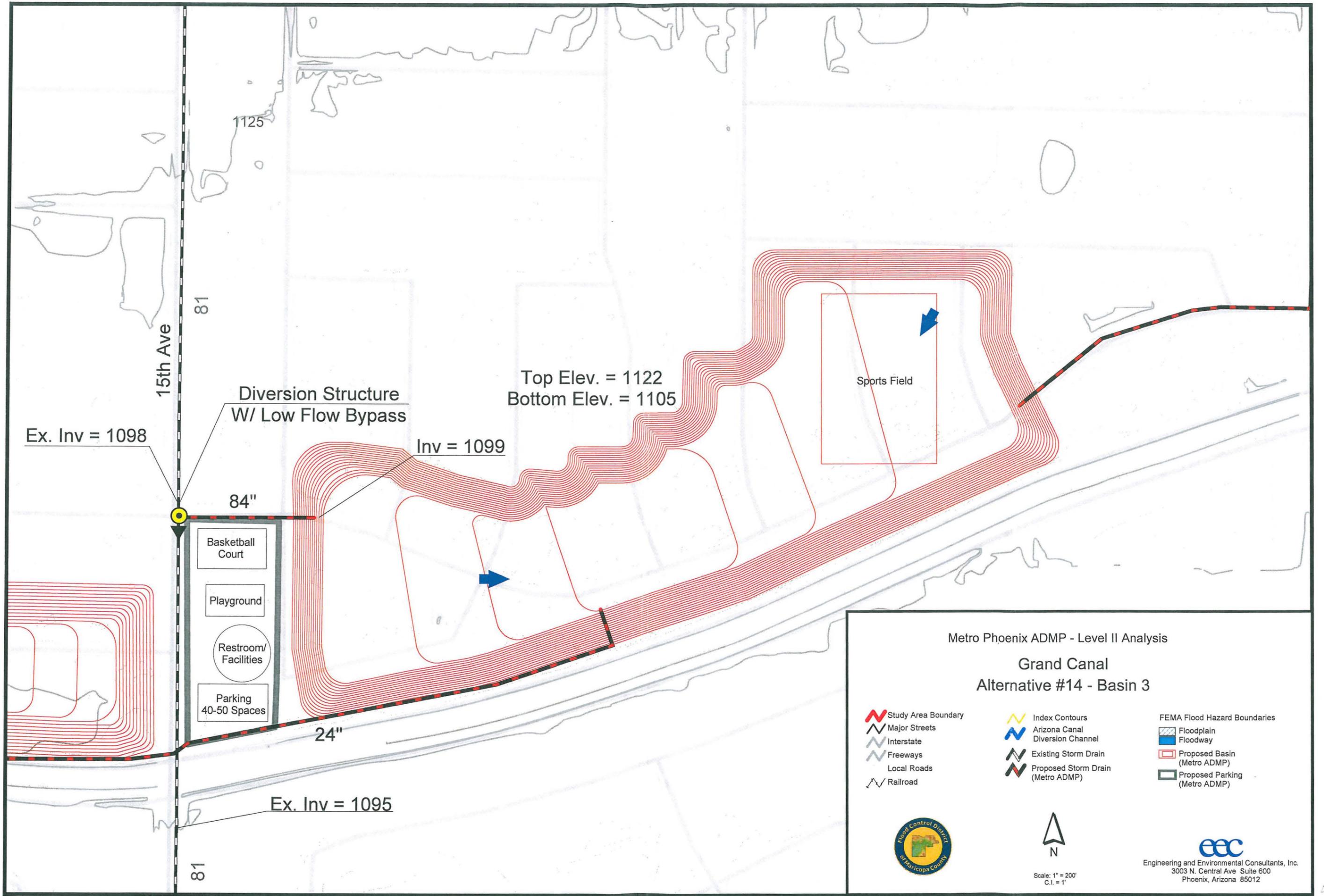
- |   |  |  |
|---|--|--|
|  Study Area Boundary |  Index Contours                       |  FEMA Flood Hazard Boundaries<br>Floodplain |
|  Major Streets       |  Arizona Canal<br>Diversion Channel   |  Floodway                                   |
|  Interstate          |  Existing Storm Drain                 |  Proposed Basin<br>(Metro ADMP)             |
|  Freeways            |  Proposed Storm Drain<br>(Metro ADMP) |  Proposed Parking<br>(Metro ADMP)           |
|  Local Roads         |  |  |
|  Railroad            |  |  |



Scale: 1" = 200'  
C.I. = 10'



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Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 3

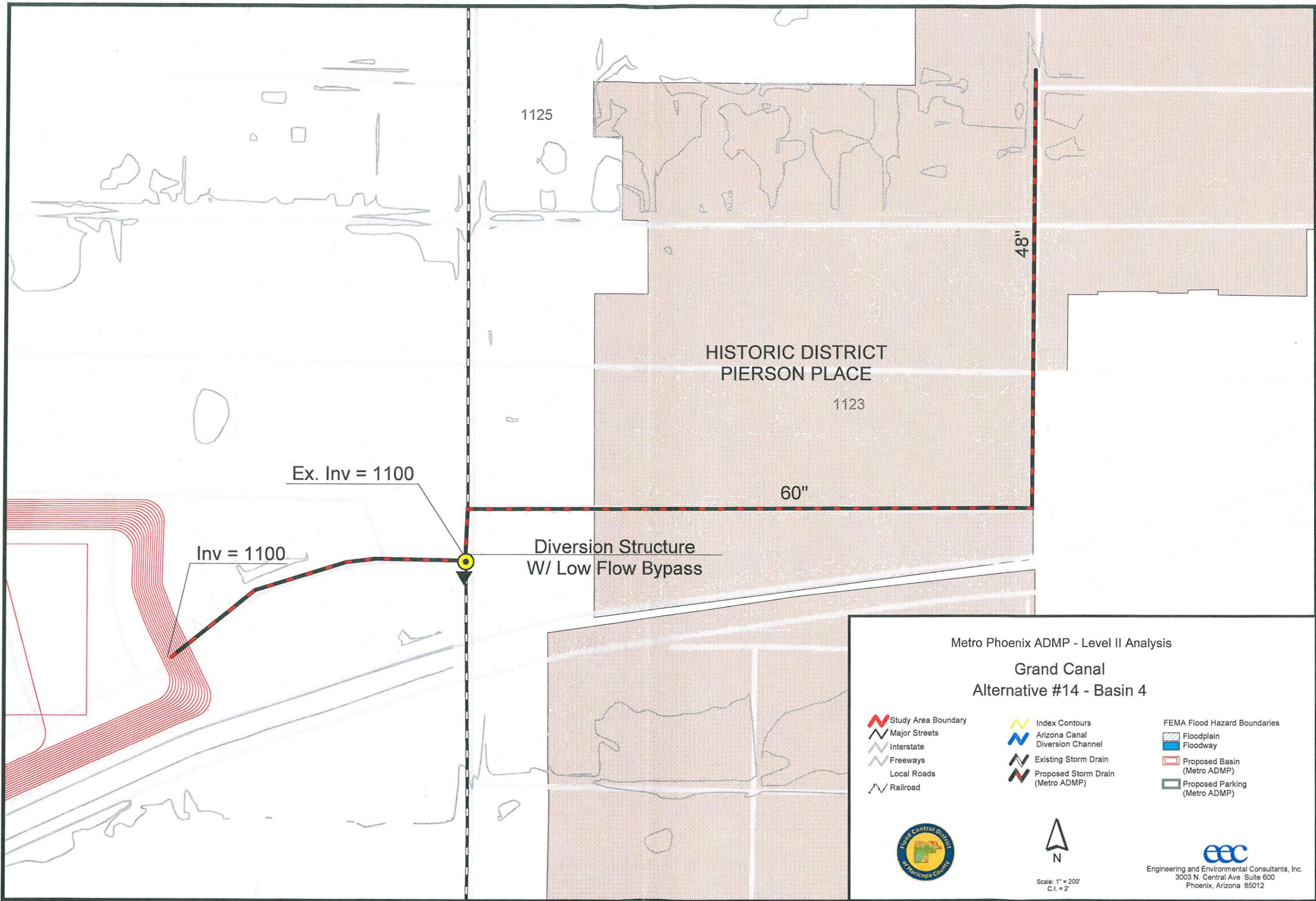
- |                     |                                   |                               |
|---------------------|-----------------------------------|-------------------------------|
| Study Area Boundary | Index Contours                    | FEMA Flood Hazard Boundaries  |
| Major Streets       | Arizona Canal                     | Floodway                      |
| Interstate          | Diversion Channel                 | Proposed Basin (Metro ADMP)   |
| Freeways            | Existing Storm Drain              | Proposed Parking (Metro ADMP) |
| Local Roads         | Proposed Storm Drain (Metro ADMP) |                               |
| Railroad            |                                   |                               |



Scale: 1" = 200'  
C.L. = 1'



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Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 4

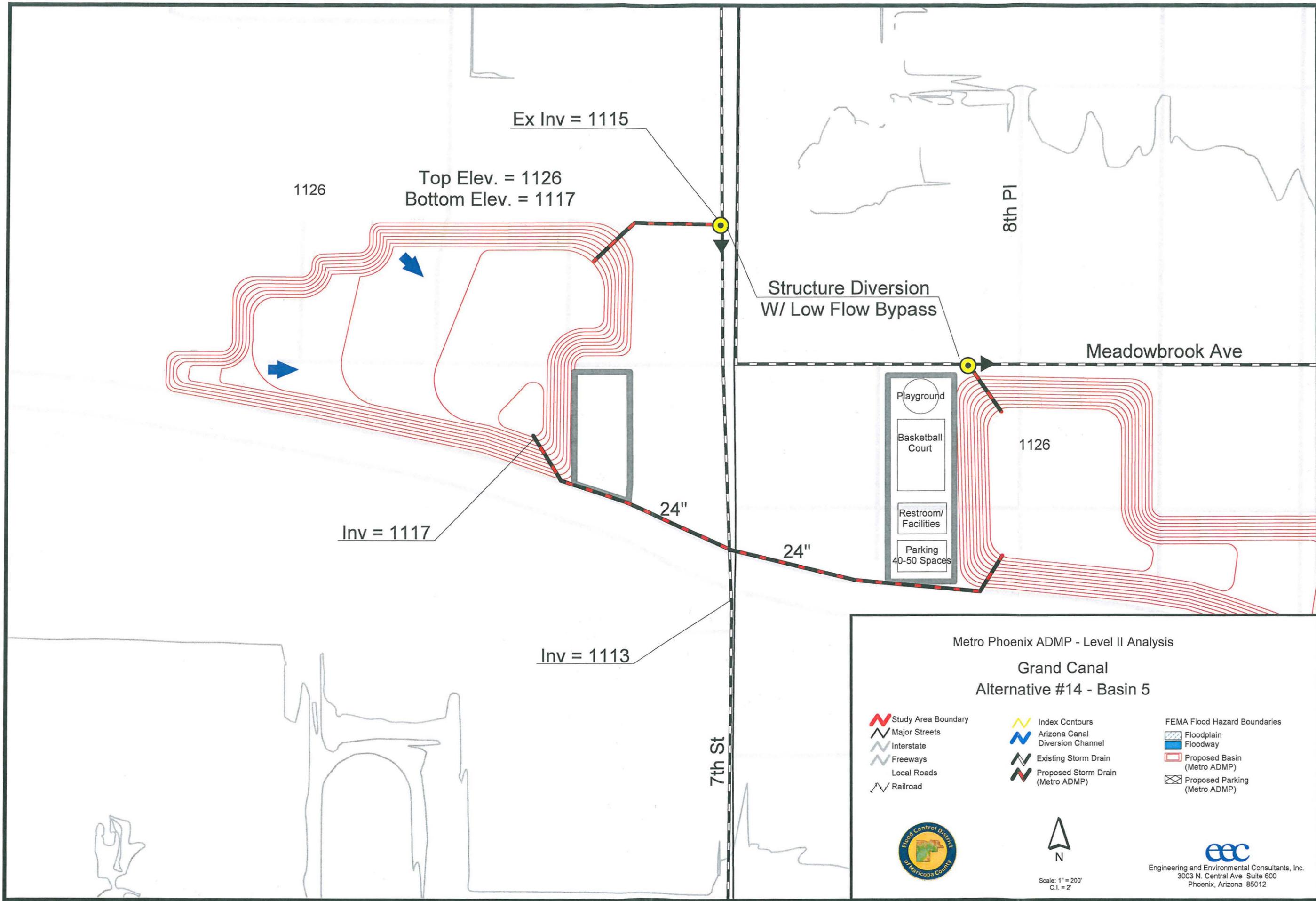
- |                     |                                   |                               |
|---------------------|-----------------------------------|-------------------------------|
| Study Area Boundary | Index Contours                    | FEMA Flood Hazard Boundaries  |
| Major Streets       | Arizona Canal                     | Floodplain                    |
| Interstate          | Diversion Channel                 | Floodway                      |
| Freeways            | Existing Storm Drain              | Proposed Basin (Metro ADMP)   |
| Local Roads         | Proposed Storm Drain (Metro ADMP) | Proposed Parking (Metro ADMP) |
| Railroad            |                                   |                               |



Scale: 1" = 200'  
C.I. = 2'



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Ex Inv = 1115

1126

Top Elev. = 1126  
Bottom Elev. = 1117

8th PI

Structure Diversion  
W/ Low Flow Bypass

Meadowbrook Ave

- Playground
- Basketball Court
- Restroom/  
Facilities
- Parking  
40-50 Spaces

1126

Inv = 1117

24"

24"

Inv = 1113

7th St

Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 5

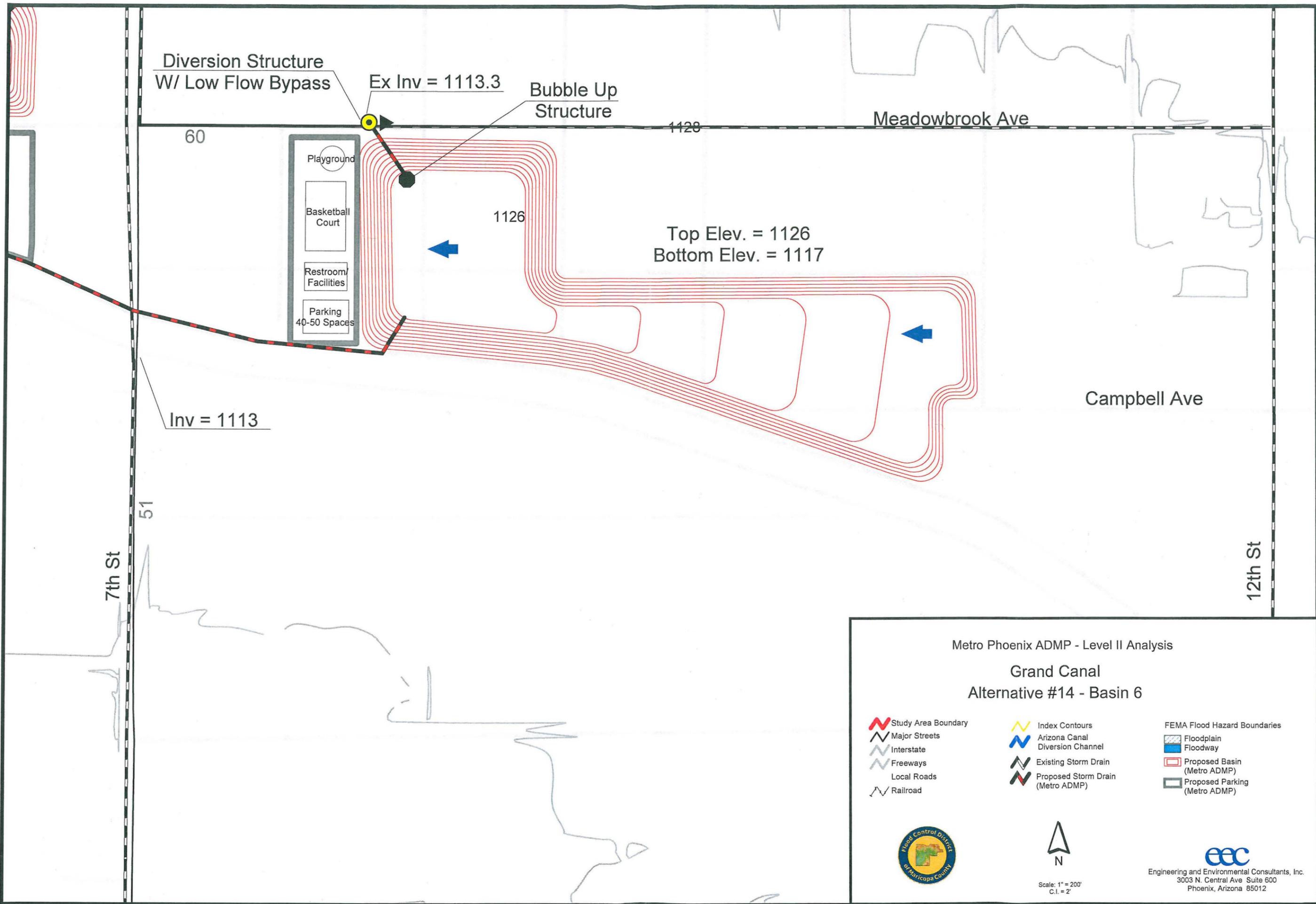
- |                     |                                   |                               |
|---------------------|-----------------------------------|-------------------------------|
| Study Area Boundary | Index Contours                    | FEMA Flood Hazard Boundaries  |
| Major Streets       | Arizona Canal Diversion Channel   | Floodway                      |
| Interstate          | Existing Storm Drain              | Proposed Basin (Metro ADMP)   |
| Freeways            | Proposed Storm Drain (Metro ADMP) | Proposed Parking (Metro ADMP) |
| Local Roads         |                                   |                               |
| Railroad            |                                   |                               |



Scale: 1" = 200'  
C.L. = 2'



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Diversion Structure  
W/ Low Flow Bypass

Ex Inv = 1113.3

Bubble Up  
Structure

Meadowbrook Ave

60

1128

- Playground
- Basketball Court
- Restroom/Facilities
- Parking 40-50 Spaces

1126

Top Elev. = 1126  
Bottom Elev. = 1117

Inv = 1113

Campbell Ave

7th St

51

12th St

Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 6

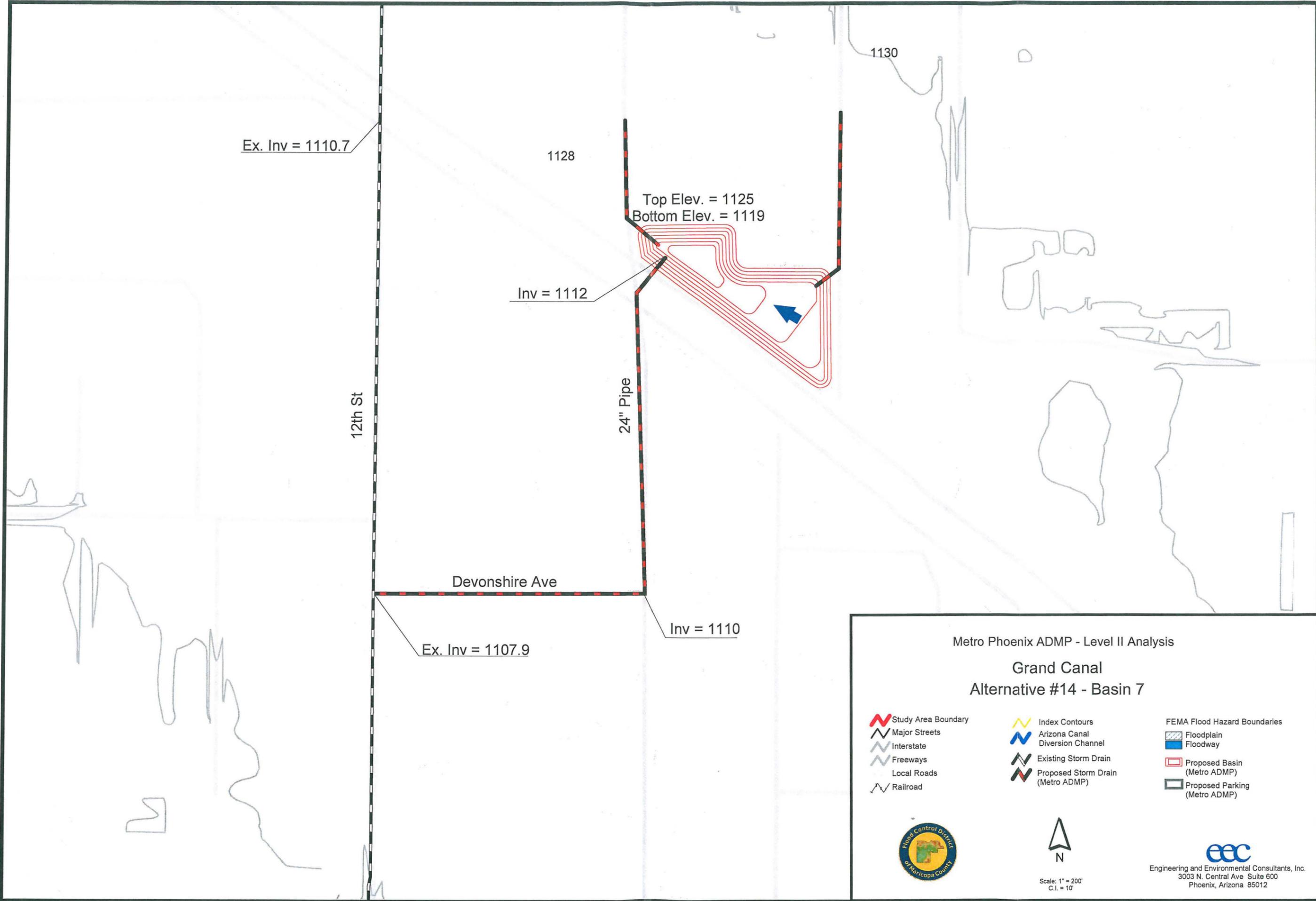
- |                     |                                   |                               |
|---------------------|-----------------------------------|-------------------------------|
| Study Area Boundary | Index Contours                    | FEMA Flood Hazard Boundaries  |
| Major Streets       | Arizona Canal Diversion Channel   | Floodway                      |
| Interstate          | Existing Storm Drain              | Proposed Basin (Metro ADMP)   |
| Freeways            | Proposed Storm Drain (Metro ADMP) | Proposed Parking (Metro ADMP) |
| Local Roads         |                                   |                               |
| Railroad            |                                   |                               |



Scale: 1" = 200'  
C.I. = 2'



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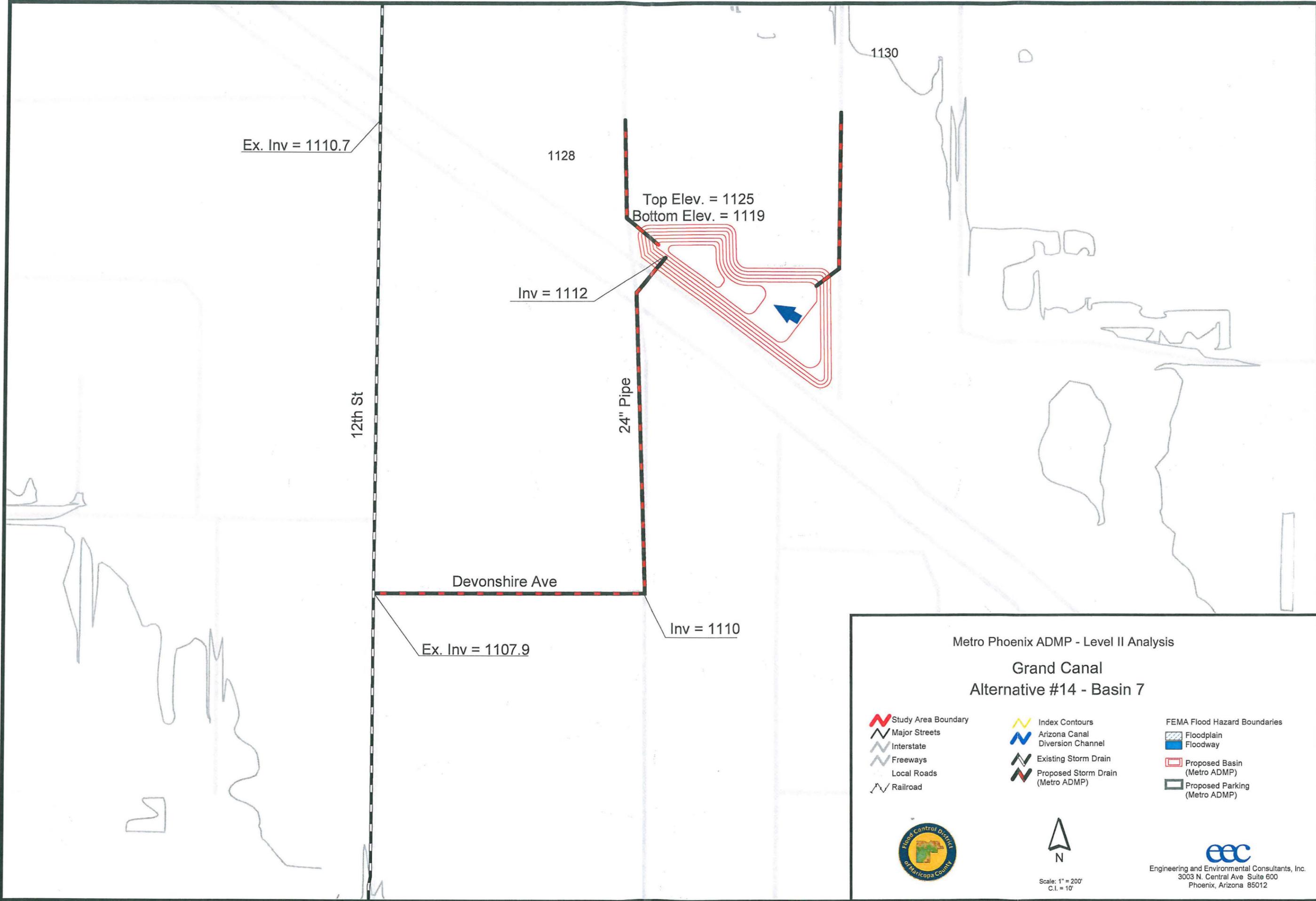
Metro Phoenix ADMP - Level II Analysis  
**Grand Canal**  
 Alternative #14 - Basin 7

Study Area Boundary	Index Contours	FEMA Flood Hazard Boundaries
Major Streets	Arizona Canal	Floodplain
Interstate	Diversion Channel	Floodway
Freeways	Existing Storm Drain	Proposed Basin (Metro ADMP)
Local Roads	Proposed Storm Drain (Metro ADMP)	Proposed Parking (Metro ADMP)
Railroad		

N

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Scale: 1" = 200'  
 C.I. = 10'



Metro Phoenix ADMP - Level II Analysis  
Grand Canal  
Alternative #14 - Basin 7

Study Area Boundary	Index Contours	FEMA Flood Hazard Boundaries
Major Streets	Arizona Canal Diversion Channel	Floodplain
Interstate	Existing Storm Drain	Floodway
Freeways	Proposed Storm Drain (Metro ADMP)	Proposed Basin (Metro ADMP)
Local Roads	Proposed Storm Drain (Metro ADMP)	Proposed Parking (Metro ADMP)
Railroad		





Scale: 1" = 200'  
C.I. = 10'

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Diversion Structure  
W/ Low Flow Bypass

Inv = 1109.3

24" Pipe

Indian School Rd

Bubble Up  
Structure

Top Elev. = 1130  
Bottom Elev. = 1123

Parking  
20-30 Spaces

Playground

60" Pipe

Inv = 1117

24" Pipe

Inv = 1106.8

Inv = 1108

16th St

Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 8

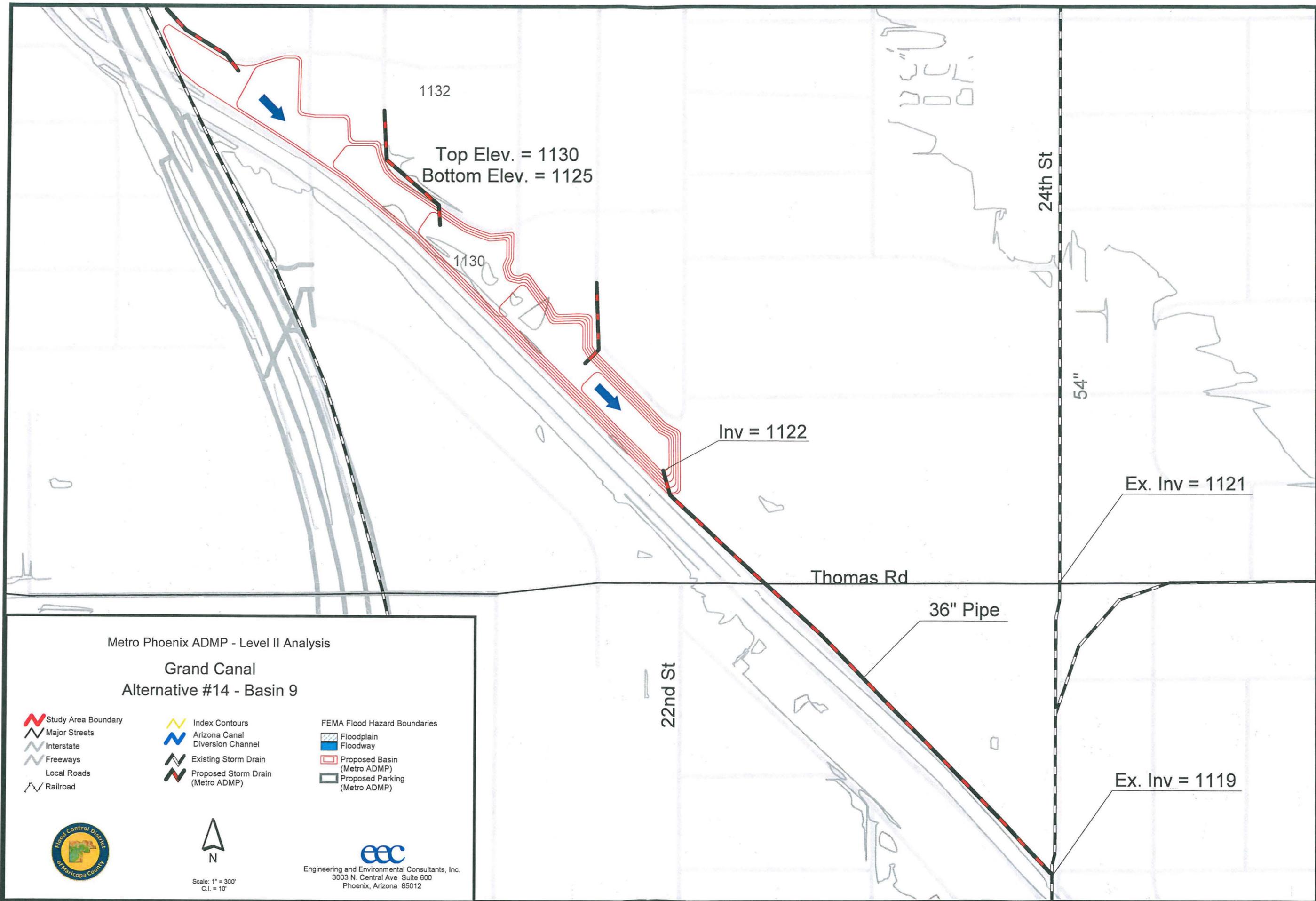
- Study Area Boundary
- Major Streets
- Interstate
- Freeways
- Local Roads
- Railroad
- Index Contours
- Arizona Canal  
Diversion Channel
- Existing Storm Drain
- Proposed Storm Drain  
(Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway
- Proposed Basin  
(Metro ADMP)
- Proposed Parking  
(Metro ADMP)



Scale: 1" = 200'  
C.I. = 2'



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Metro Phoenix ADMP - Level II Analysis

Grand Canal  
Alternative #14 - Basin 9

- |                     |                                   |                               |
|---------------------|-----------------------------------|-------------------------------|
| Study Area Boundary | Index Contours                    | FEMA Flood Hazard Boundaries  |
| Major Streets       | Arizona Canal Diversion Channel   | Floodway                      |
| Interstate          | Existing Storm Drain              | Proposed Basin (Metro ADMP)   |
| Freeways            | Proposed Storm Drain (Metro ADMP) | Proposed Parking (Metro ADMP) |
| Local Roads         |                                   |                               |
| Railroad            |                                   |                               |



Scale: 1" = 300'  
C.I. = 10'

**eec**  
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Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-1

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Basin A Volume [acre-ft]	Basin B Volume [acre-ft]	Total Volume [acre-ft]	Discharge [cfs]
1110	0	0.0	0.0	0.0	0.0
1111	1	0.2	0.8	1.0	20.0
1112	1	0.7	1.9	2.6	24.6
1113	1	1.8	3.3	5.1	28.7
1114	1	4.0	5.0	9.0	32.4
1115	1	7.4	7.1	14.5	35.8
1116	1	11.2	9.6	20.8	38.9
1117	1	15.5	12.3	27.8	41.7
1118	1	20.3	15.5	35.8	44.4
1119	1	25.5	19.6	45.1	46.9

2-300' broadcrested weirs  $\Delta d = 2K(900) \text{ cfs} @ \text{Elev } 1119 \rightarrow 1120$   
1800 cfs

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-2

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1105	0	31,116	0.71	0.0	0	0.0
1106	1	70,655	1.62	1.1	1.1	20.0
1107	1	122,637	2.82	2.2	3.3	24.6
1108	1	183,548	4.21	3.5	6.8	28.7
1109	1	255,825	5.87	5.0	11.8	32.4
1110	1	334,612	7.68	6.8	18.6	35.8
1111	1	368,078	8.45	8.1	26.7	38.9
1112	1	400,832	9.20	8.8	35.5	41.7
1113	1	434,136	9.97	9.6	45.1	44.4
1114	1	467,883	10.74	10.4	55.4	46.9
1115	1	502,207	11.53	11.1	66.5	49.3
1116	1	537,067	12.33	11.9	78.5	50.0
1117	1	572,462	13.14	12.7	91.2	50.0
1118	1	608,393	13.97	13.6	104.8	50.0
1119	1	644,859	14.80	14.4	119.1	50.0
1120	1	681,927	15.65	15.2	134.4	50.0
1121	1	719,349	16.51	16.1	150.5	50.0

400' broadcrested weir  $\Delta d = 1200$  cfs @ Elev 1121-1122

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-3

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1105	0	108,374	2.49	0.0	0	0.0
1106	1	238,497	5.48	3.9	3.9	20.0
1107	1	428,031	9.83	7.5	11.4	24.6
1108	1	670,287	15.39	12.5	23.9	28.7
1109	1	693,432	15.92	15.7	39.6	32.4
1110	1	716,821	16.46	16.2	55.8	35.8
1111	1	741,040	17.01	16.7	72.5	38.9
1112	1	764,922	17.56	17.3	89.8	41.7
1113	1	789,053	18.11	17.8	107.6	44.4
1114	1	813,434	18.67	18.4	126.0	46.9
1115	1	838,067	19.24	19.0	145.0	49.3
1116	1	862,596	19.80	19.5	164.5	50.0
1117	1	888,144	20.39	20.1	184.6	50.0
1118	1	913,371	20.97	20.7	205.3	50.0
1119	1	938,987	21.56	21.3	226.5	50.0
1120	1	964,743	22.15	21.9	248.4	50.0
1121	1	990,714	22.74	22.4	270.8	50.0
1122	1	1,016,901	23.34	23.0	293.9	50.0

400' broad crested weir  $\Delta d = 1200 \text{ cfs}$  @ Elev 1122 → 1123



Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-5

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1117	0	9,490	0.22	0.0	0	0.0
1118	1	116,506	2.67	1.2	1.2	20.0
1119	1	213,432	4.90	3.7	5.0	24.6
1120	1	279,707	6.42	5.6	10.6	28.7
1121	1	304,216	6.98	6.7	17.3	32.4
1122	1	328,028	7.53	7.3	24.5	35.8
1123	1	351,610	8.07	7.8	32.3	38.9
1124	1	375,246	8.61	8.3	40.7	41.7
1125	1	399,520	9.17	8.9	49.6	44.4
1126	1	424,726	9.75	9.5	59.0	46.9

400' Broad crested weir  $\Delta d = 1200 \text{ cfs @ Elev } 1126 \rightarrow 1127$

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-6

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1117	0	116,769	2.68	0.0	0	0.0
1118	1	146,145	3.36	3.0	3.0	20.0
1119	1	193,188	4.43	3.9	6.9	24.6
1120	1	258,265	5.93	5.2	12.1	28.7
1121	1	343,718	7.89	6.9	18.9	32.4
1122	1	430,385	9.88	8.9	27.8	35.8
1123	1	462,062	10.61	10.2	38.1	38.9
1124	1	494,327	11.35	11.0	49.0	41.7
1125	1	527,180	12.10	11.7	60.8	44.4
1126	1	560,662	12.87	12.5	73.2	46.9

400' Broad Crested Weir  $\Delta d = 1200 \text{ cfs @ Elev } 1126-1127$

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-7

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1119	0	6,838	0.16	0.0	0	0.0
1120	1	15,828	0.36	0.3	0.3	20.0
1121	1	35,623	0.82	0.6	0.8	24.6
1122	1	51,525	1.18	1.0	1.8	28.7
1123	1	62,413	1.43	1.3	3.1	32.4
1124	1	73,013	1.68	1.6	4.7	35.8
1125	1	84,017	1.93	1.8	6.5	38.9

400' Broad crested weir  $\Delta d = 1200$  cfs @ Elev 1125-1126

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt 14-8

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1123	0	208,634	4.79	0.0	0	0.0
1124	1	248,052	5.69	5.2	5.2	20.0
1125	1	285,146	6.55	6.1	11.4	24.6
1126	1	316,067	7.26	6.9	18.2	28.7
1127	1	343,397	7.88	7.6	25.8	32.4
1128	1	371,906	8.54	8.2	34.0	35.8
1129	1	397,903	9.13	8.8	42.9	38.9
1130	1	424,429	9.74	9.4	52.3	41.7

300' Broadcrested weir  $\Delta d = 900 \text{ cfs @ Elev } 1130-1131$

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume  
Alt. 14-9

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]	Discharge [cfs]
1125	0	36,301	0.83	0.0	0	0.0
1126	1	93,960	2.16	1.4	1.4	40.0
1127	1	181,762	4.17	3.1	4.6	49.2
1128	1	237,450	5.45	4.8	9.4	71.6
1129	1	324,924	7.46	6.4	15.8	77.8
1130	1	401,428	9.22	8.3	24.1	83.4

Note - Basin discharges through 2 - 24" pipes.

300' broadcrested weir  $\Delta d = 900 \text{ cfs @ Elev. } 1130 \rightarrow 1131$

## Basin Drain Time Calculations

	Volume (cubic feet)
Basin 1	1964527
Basin 2	6553829
Basin 3	12801031
Basin 4	N/A
Basin 5	2571865
Basin 6	3190194
Basin 7	282395
Basin 8	2278037
Basin 9	452097

Drain Time = Volume (cf) / Infiltration Rate (cfs) / 3600sec per hour

	Drain Time (hours)
Basin 1	27.3
Basin 2	91.0
Basin 3	177.8
Basin 4	N/A
Basin 5	35.7
Basin 6	44.3
Basin 7	3.9
Basin 8	31.6
Basin 9	6.3

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Buy out homes for Linear Park	LS	\$90,106,742.00	1	\$ 90,106,742.00
2	Excavation and Haul	CY	\$15.00	1100000	\$ 16,500,000.00
3	Construction of Parks/Open Space	AC	\$100,000.00	155	\$ 15,500,000.00
4	24" and 30" Pipe	LF	\$448.81	32000	\$ 14,362,022.40
5	Demolition	EA	\$11,000.00	411	\$ 4,521,000.00
6	Relocation, Admin. Costs (20% of Purchase Price)	LS	\$18,021,348.40	1	\$ 18,021,348.40
	Sub Total				\$ 159,011,112.80
	Contingencies (20%)				\$ 31,802,222.56
	<b>TOTAL</b>				<b>\$ 190,813,300.00</b>

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# Alternative #15 – Floodproofing Along Grand Canal

## Table of Contents

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Plan View Exhibit	1
Cost Estimate	2

### Grand Canal Alternative #15

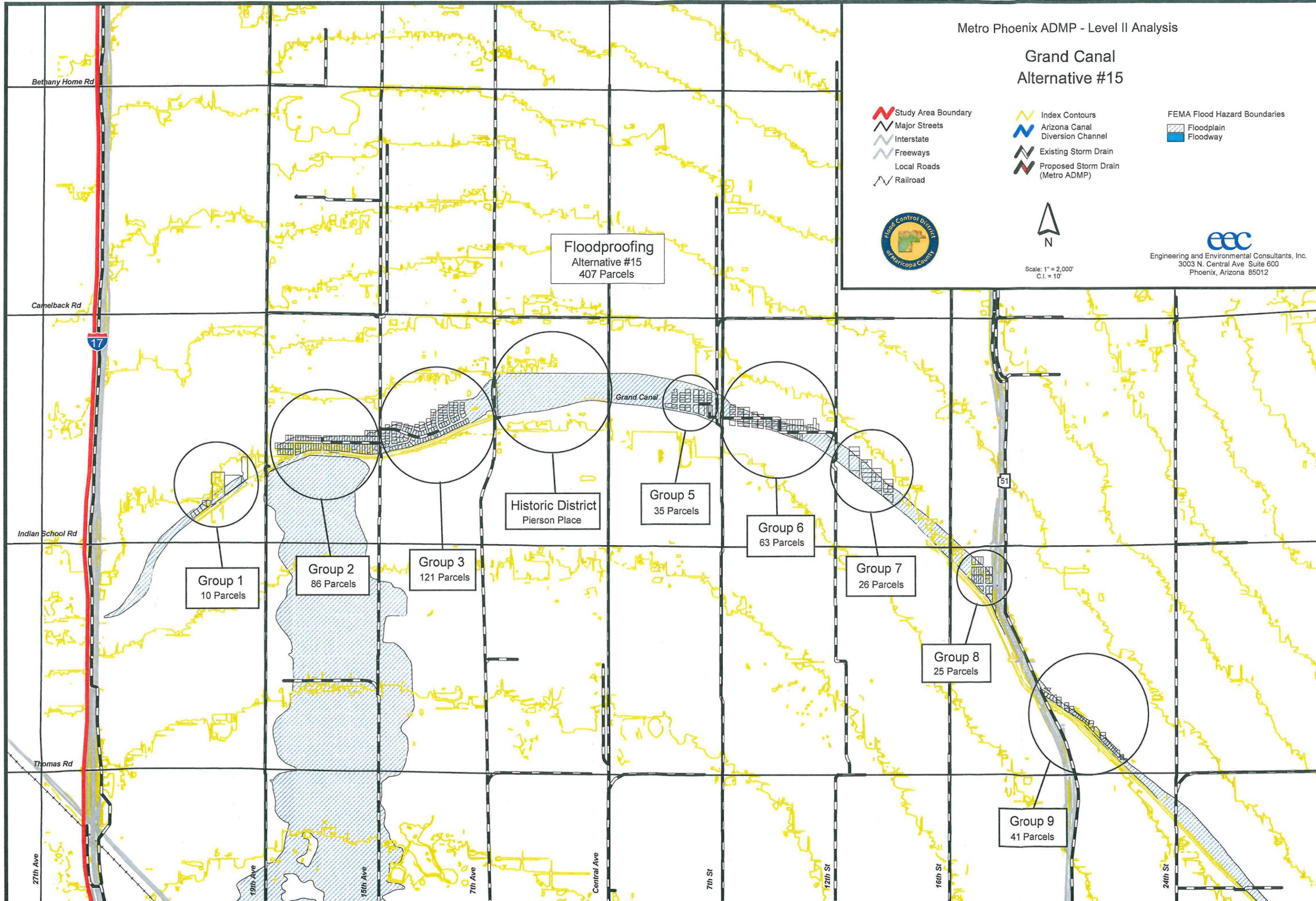
- Study Area Boundary
- Major Streets
- Interstate
- Freeways
- Local Roads
- Railroad
- Index Contours
- Arizona Canal
- Diversion Channel
- Existing Storm Drain
- Proposed Storm Drain (Metro ADMP)
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway



Scale: 1" = 2,000'  
C.I. = 10'



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Phoenix, Arizona 85012



Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Floodproof Home - Raise Finish Floor Elevation	EA	\$150,000.00	407	\$ 61,050,000.00
2	Move Residents and Provide Temporary Housing	EA	\$25,000.00	407	\$ 10,175,000.00
Sub Total					\$ 71,225,000.00
<i>Contingencies (20%)</i>					\$ 14,245,000.00
<b>TOTAL</b>					<b>\$ 85,470,000.00</b>

# Alternative #16 - Modifications to 16th Street Storm Drain

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Cost Estimate	2

McDOWELL RD

16th Street Laterals  
10-year Design  
Alternative #16



Ex. Pipe Capacity = 160 cfs

141 cfs

VAN BUREN ST

Ex. Pipe Capacity = 220 cfs

Ex. Pipe Capacity = 30 cfs

250 cfs

16TH ST

66

36

EAST TUNNEL 21" DIAMETER



Metro Phoenix ADMP  
Phase I - Downtown Area  
Upstream of Railroad  
10-year Design  
Alternative #16

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

- Pipe Dimensions (inches)  
Existing Storm Drains
- Proposed Storm Drain  
(Metro ADMP)



Scale: 1" = 1,000'  
C.I. = 10'

Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	26	\$ 260,000.00
2	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1300	\$ 583,457.16
					\$ -
	Sub Total				\$ 843,457.16
	Contingencies (20%)				\$ 168,691.43
	<b>TOTAL</b>				\$ <b>1,012,100.00</b>

# Alternative #17 - Fillmore Street (East) Storm Drain

## Table of Contents

	<u>Page</u>
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Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-5
Cost Estimate	6

**ALTERNATIVE #17**  
**Fillmore Street (East) Storm Drain**

McDOWELL RD

13TH ST

Fillmore Street (East)  
Storm Drain  
10-year Design  
Alternative #17



FILLMORE ST

VAN BUREN ST

WEST TUNNEL 21' DIAMETER

7TH ST

Metro Phoenix ADMP  
Phase I - Downtown Area  
Upstream of Railroad  
10-year Design  
Alternative #17

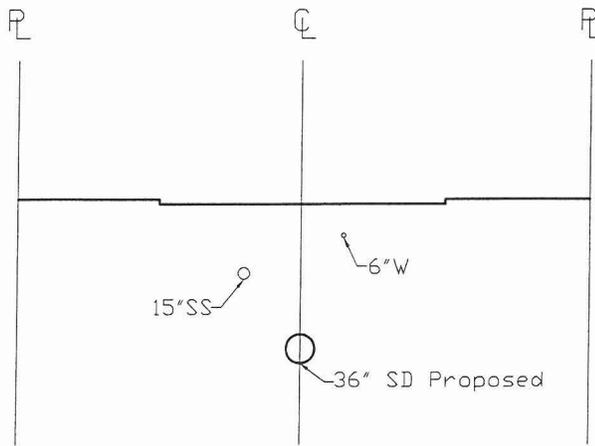
- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

- Pipe Dimensions (inches)
- Existing Storm Drains
- Proposed Storm Drain (Metro ADMP)

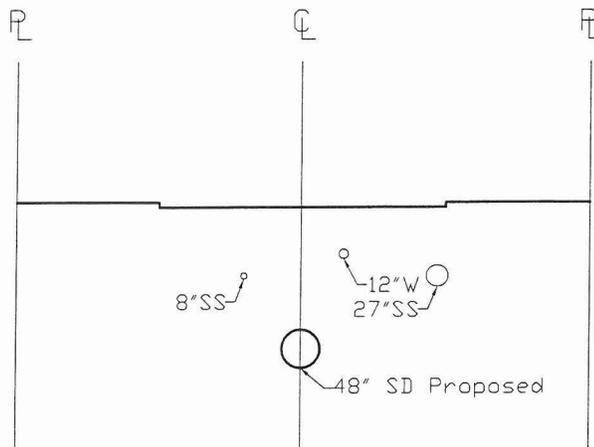


Scale: 1" = 1,000'  
C.I. = 10'

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3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



13th Street - Moreland St to Fillmore St      60' ROW  
 Proposed 36" SD - 10 year Design  
 Inv Moreland Street = 1085.0  
 Inv @ Fillmore Street = 1080.0  
 Alternative #17



Fillmore - 13th St to 2nd St      60' ROW  
 Proposed 48" SD - 10 year Design  
 Inv @ 2nd St = 1058.5  
 Alternative #17

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 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 6

## Worksheet for S1 - Fillmore Street (East) - Moreland to 12th St.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.01130 ft/ft  
Normal Depth                                3.00 ft  
Diameter                                      3.00 ft  
Discharge                                    71.00 ft<sup>3</sup>/s

⇒ 36" PIPE

### Results

Diameter                                      3.00 ft  
Normal Depth                                3.00 ft  
Flow Area                                    7.08 ft<sup>2</sup>  
Wetted Perimeter                            9.43 ft  
Top Width                                    0.00 ft  
Critical Depth                                2.67 ft  
Percent Full                                 100.0 %  
Critical Slope                                0.01005 ft/ft  
Velocity                                      10.03 ft/s  
Velocity Head                                1.56 ft  
Specific Energy                              4.57 ft  
Froude Number                               0.00  
Maximum Discharge                         76.38 ft<sup>3</sup>/s  
Discharge Full                               71.00 ft<sup>3</sup>/s  
Slope Full                                    0.01130 ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                         0.00 ft  
Length                                        0.00 ft  
Number Of Steps                             0

### GVF Output Data

Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                 100.00 %

## Worksheet for S2 - Fillmore Street (East) - 12th St. to 5th St.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02167	ft/ft
Normal Depth	3.00	ft
Diameter	3.00	ft ⇒ 36" PIPE
Discharge	98.00	ft <sup>3</sup> /s

### Results

Diameter	3.00	ft
Normal Depth	3.00	ft
Flow Area	7.06	ft <sup>2</sup>
Wetted Perimeter	9.42	ft
Top Width	0.00	ft
Critical Depth	2.89	ft
Percent Full	100.0	%
Critical Slope	0.01892	ft/ft
Velocity	13.88	ft/s
Velocity Head	3.00	ft
Specific Energy	5.99	ft
Froude Number	0.00	
Maximum Discharge	105.42	ft <sup>3</sup> /s
Discharge Full	98.00	ft <sup>3</sup> /s
Slope Full	0.02167	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S3 - 5th St to 2nd St.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.02167 ft/ft  
Normal Depth                                3.92 ft  
Diameter                                      3.92 ft  
Discharge                                    200.00 ft<sup>3</sup>/s

⇒ 48" PIPE

### Results

Diameter                                      3.92 ft  
Normal Depth                                3.92 ft  
Flow Area                                    12.05 ft<sup>2</sup>  
Wetted Perimeter                            12.31 ft  
Top Width                                    0.00 ft  
Critical Depth                                3.79 ft  
Percent Full                                100.0 %  
Critical Slope                                0.01904 ft/ft  
Velocity                                      16.59 ft/s  
Velocity Head                                4.28 ft  
Specific Energy                               8.20 ft  
Froude Number                               0.00  
Maximum Discharge                        215.14 ft<sup>3</sup>/s  
Discharge Full                               200.00 ft<sup>3</sup>/s  
Slope Full                                    0.02167 ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00 ft  
Length                                      0.00 ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                100.00 %

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	36" SD in 13th St, I-10 to Fillmore, 13th Street to 5th Street	LF	\$506.89	6480	\$ 3,284,667.94
2	48" SD in Fillmore, 5th Street to West Tunnel	LF	\$637.14	1100	\$ 700,851.36
3	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	32	\$ 320,000.00
4	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1600	\$ 718,101.12
5	Utility Relocation	LM	\$50,000.00	1.5	\$ 75,000.00
Sub Total					\$ 5,098,620.42
<i>Contingencies (20%)</i>					\$ 1,019,724.08
<b>TOTAL</b>					<b>\$ 6,118,300.00</b>

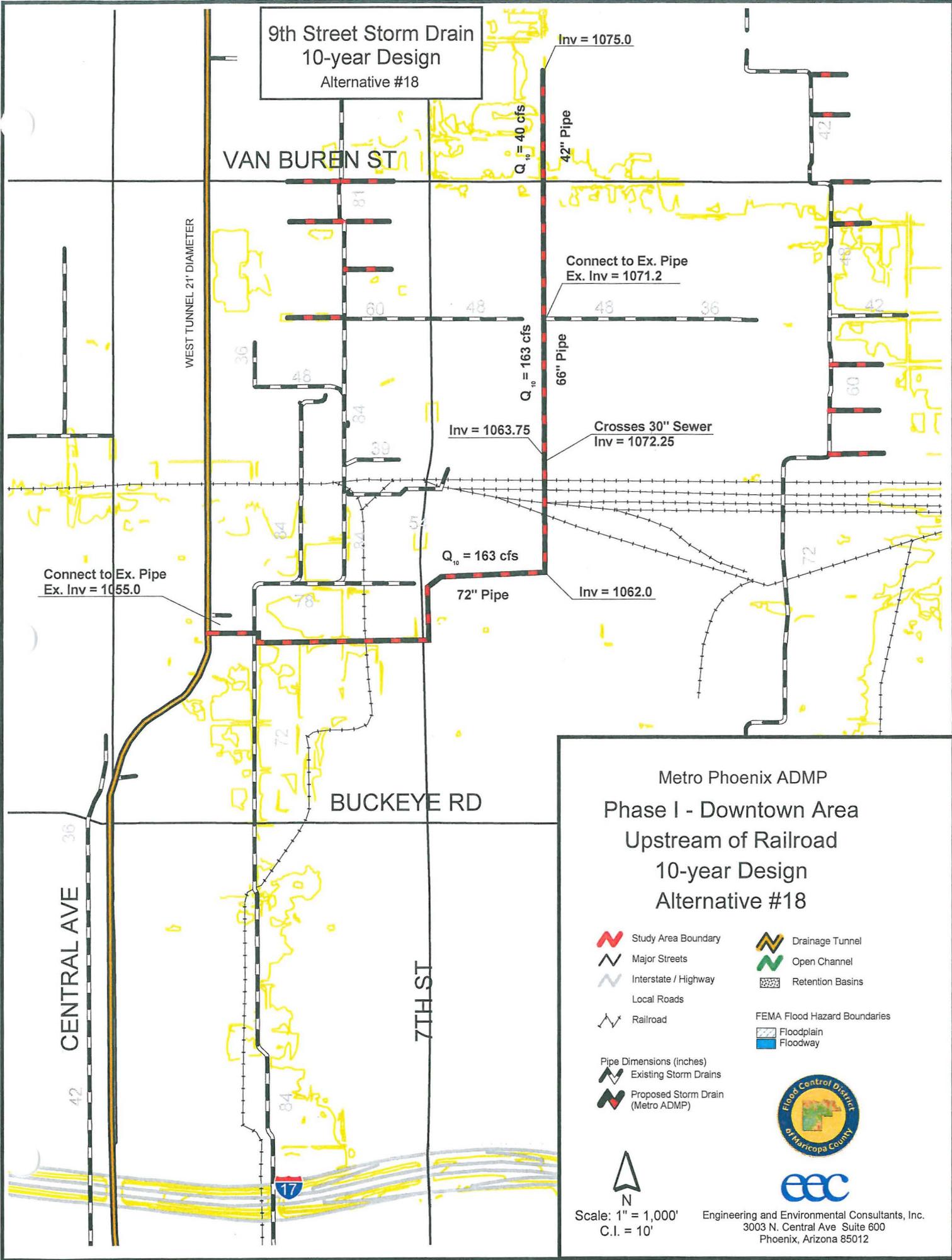
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# Alternative #18 - 9th Street Storm Drain

## Table of Contents

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Plan View Exhibit	1
Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-5
Cost Estimate	6

9th Street Storm Drain  
10-year Design  
Alternative #18



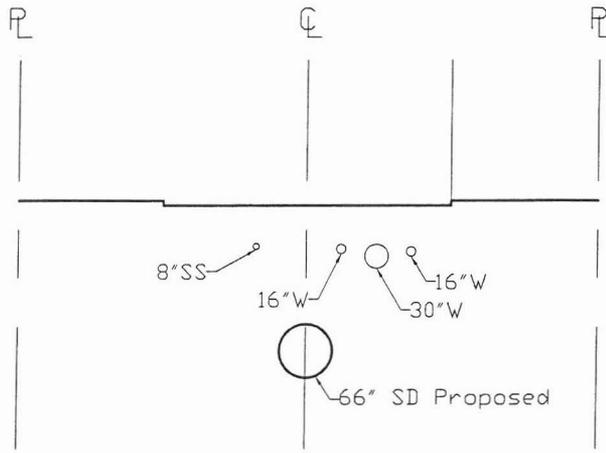
Metro Phoenix ADMP  
 Phase I - Downtown Area  
 Upstream of Railroad  
 10-year Design  
 Alternative #18

Study Area Boundary	Drainage Tunnel
Major Streets	Open Channel
Interstate / Highway	Retention Basins
Local Roads	FEMA Flood Hazard Boundaries
Railroad	Floodplain
	Floodway

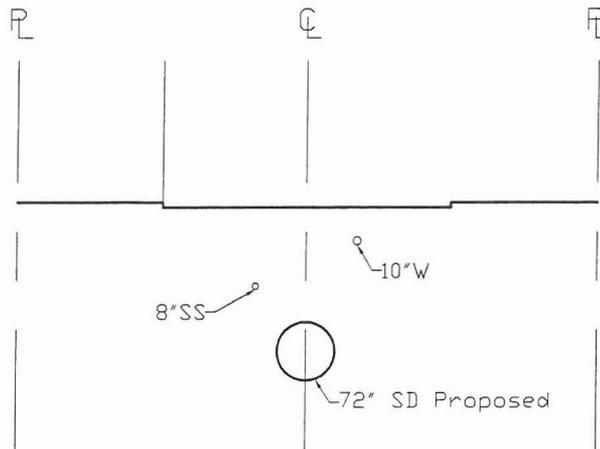
Pipe Dimensions (inches)  
 Existing Storm Drains  
 Proposed Storm Drain (Metro ADMP)

Scale: 1" = 1,000'  
 C.I. = 10'

Engineering and Environmental Consultants, Inc.  
 3003 N. Central Ave Suite 600  
 Phoenix, Arizona 85012



9th Street - Taylor St. to Washington St      60' ROW  
 Proposed 66" SD - 10 year Design  
 Inv @ Taylor = 1075.0  
 Inv @ Lincoln = 1062.0



Grant - Washington St to Southern Pacific Dr      60' ROW  
 Proposed 72" SD - 10 year Design  
 Inv @ 9th Street = 1062.0  
 Inv @ West Tunnel = 1055.0

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 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	05/2007
	DRAWN	KLH	05/2007
	CHECKED	LAV	05/2007
		 <small>Engineering and Environmental Consultants, Inc. 3203 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 6

## Worksheet for S1 - 9th Street - Taylor to Washington

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00320    ft/ft  
Normal Depth                                3.10    ft  
Diameter                                      3.10    ft    ⇒ 42" PIPE  
Discharge                                    41.00    ft<sup>3</sup>/s

### Results

Diameter                                      3.10    ft  
Normal Depth                                3.10    ft  
Flow Area                                    7.52    ft<sup>2</sup>  
Wetted Perimeter                            9.72    ft  
Top Width                                    0.00    ft  
Critical Depth                                2.07    ft  
Percent Full                                100.0    %  
Critical Slope                                0.00518    ft/ft  
Velocity                                      5.45    ft/s  
Velocity Head                                0.46    ft  
Specific Energy                               3.56    ft  
Froude Number                               0.00  
Maximum Discharge                        44.10    ft<sup>3</sup>/s  
Discharge Full                               41.00    ft<sup>3</sup>/s  
Slope Full                                    0.00320    ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00    ft  
Length                                        0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise            0.00    %  
Normal Depth Over Rise                100.00    %

## Worksheet for S2 - 9th Street - Washington to Lincoln

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00320    ft/ft  
Normal Depth                                5.19    ft  
Diameter                                      5.19    ft  
Discharge                                    163.00    ft<sup>3</sup>/s

⇒ 66" PIPE

### Results

Diameter                                      5.19    ft  
Normal Depth                                5.19    ft  
Flow Area                                    21.18    ft<sup>2</sup>  
Wetted Perimeter                            16.32    ft  
Top Width                                    0.00    ft  
Critical Depth                                3.63    ft  
Percent Full                                100.0    %  
Critical Slope                                0.00460    ft/ft  
Velocity                                      7.69    ft/s  
Velocity Head                                0.92    ft  
Specific Energy                              6.11    ft  
Froude Number                                0.00  
Maximum Discharge                        175.35    ft<sup>3</sup>/s  
Discharge Full                                163.01    ft<sup>3</sup>/s  
Slope Full                                    0.00320    ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00    ft  
Length                                      0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise            0.00    %  
Normal Depth Over Rise                100.00    %

## Worksheet for S3 - 9th Street - Lincoln to East Tunnel

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00210	ft/ft
Normal Depth	5.62	ft
Diameter	5.62	ft ⇒ 72" PIPE
Discharge	163.00	ft <sup>3</sup> /s

### Results

Diameter	5.62	ft
Normal Depth	5.62	ft
Flow Area	24.81	ft <sup>2</sup>
Wetted Perimeter	17.66	ft
Top Width	0.00	ft
Critical Depth	3.54	ft
Percent Full	100.0	%
Critical Slope	0.00401	ft/ft
Velocity	6.57	ft/s
Velocity Head	0.67	ft
Specific Energy	6.29	ft
Froude Number	0.00	
Maximum Discharge	175.35	ft <sup>3</sup> /s
Discharge Full	163.01	ft <sup>3</sup> /s
Slope Full	0.00210	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

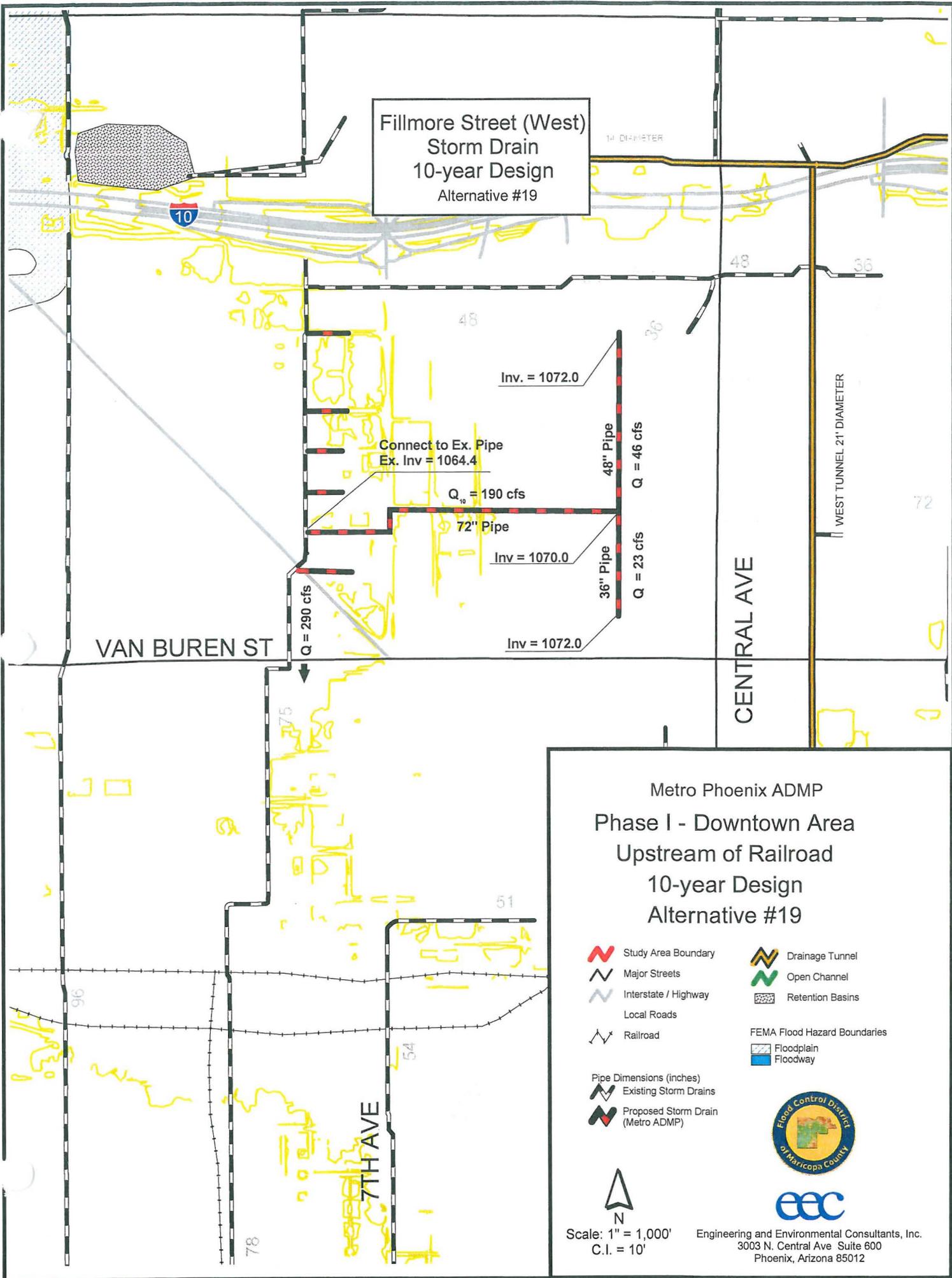
Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	42" SD in 9th Street, Taylor to Washington	LF	\$578.17	2000	\$ 1,156,346.40
2	66" SD in 9th Street, Washington to UPRR	LF	\$819.44	2120	\$ 1,737,218.74
3	72" SD in Lincoln, 9th Street to West Tunnel	LF	\$878.70	2970	\$ 2,609,731.87
4	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	36	\$ 360,000.00
5	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1800	\$ 807,863.76
6	Utility Relocation	LM	\$50,000.00	1.3	\$ 65,000.00
Sub Total					\$ 6,736,160.77
<i>Contingencies (20%)</i>					\$ 1,347,232.15
<b>TOTAL</b>					<b>\$ 8,083,400.00</b>

# Alternative #19 - Fillmore Street (West) Storm Drain

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Plan View Exhibit	1
Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-5
Cost Estimate	6

Fillmore Street (West)  
Storm Drain  
10-year Design  
Alternative #19



Metro Phoenix ADMP  
Phase I - Downtown Area  
Upstream of Railroad  
10-year Design  
Alternative #19

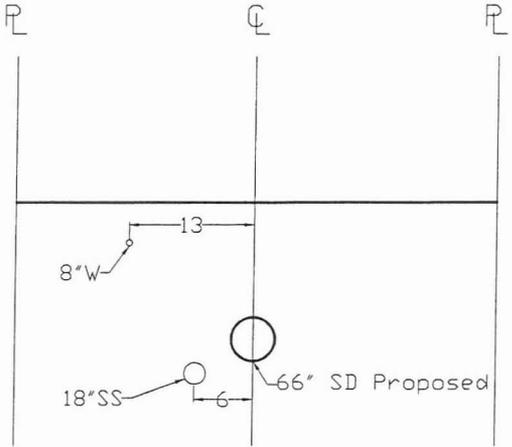
- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

- Pipe Dimensions (inches)
- Existing Storm Drains
- Proposed Storm Drain (Metro ADMP)



Scale: 1" = 1,000'  
C.I. = 10'

Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



Gold Alley (Between Jackson and Madison)  
 9th Ave to 2nd Ave  
 Proposed 66" SD - 10 year Design  
 Inv @ 2nd Ave = 1070.0  
 Inv @ 9th Ave (Tie into Existing) = 1064.4  
 Alternative #19

50' ROW

N:\305008\DOWN TOWN - SECTIONS.DWG, 5/22/2007 3:04:50 PM, \pdxsn01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX          AREA DRAINAGE MASTER PLAN          FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		 <small>Engineering and Environmental Consultants, Inc.          3003 N. Central Avenue, Suite 600          Phoenix, Arizona 85012-2905          TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 6

## Worksheet for S1 - Fillmore Street (West) - Central Ave. to 11th Ave.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00220 ft/ft
Normal Depth	5.90 ft
Diameter	5.90 ft
Discharge	190.00 ft <sup>3</sup> /s

### Results

Diameter	5.90 ft
Normal Depth	5.90 ft
Flow Area	27.35 ft <sup>2</sup>
Wetted Perimeter	18.54 ft
Top Width	0.00 ft
Critical Depth	3.78 ft
Percent Full	100.0 %
Critical Slope	0.00400 ft/ft
Velocity	6.95 ft/s
Velocity Head	0.75 ft
Specific Energy	6.65 ft
Froude Number	0.00
Maximum Discharge	204.39 ft <sup>3</sup> /s
Discharge Full	190.00 ft <sup>3</sup> /s
Slope Full	0.00220 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

## Worksheet for L1 - 2nd Ave (North)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00150 ft/ft
Normal Depth	3.72 ft
Diameter	3.72 ft
Discharge	46.00 ft <sup>3</sup> /s

### Results

Diameter	3.72 ft
Normal Depth	3.72 ft
Flow Area	10.90 ft <sup>2</sup>
Wetted Perimeter	11.70 ft
Top Width	0.00 ft
Critical Depth	2.08 ft
Percent Full	100.0 %
Critical Slope	0.00419 ft/ft
Velocity	4.22 ft/s
Velocity Head	0.28 ft
Specific Energy	4.00 ft
Froude Number	0.00
Maximum Discharge	49.48 ft <sup>3</sup> /s
Discharge Full	46.00 ft <sup>3</sup> /s
Slope Full	0.00150 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for L2 - 2nd Ave (South)

---

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	2.61	ft
Diameter	2.61	ft
Discharge	23.00	ft <sup>3</sup> /s

### Results

Diameter	2.61	ft
Normal Depth	2.61	ft
Flow Area	5.35	ft <sup>2</sup>
Wetted Perimeter	8.20	ft
Top Width	0.00	ft
Critical Depth	1.61	ft
Percent Full	100.0	%
Critical Slope	0.00508	ft/ft
Velocity	4.30	ft/s
Velocity Head	0.29	ft
Specific Energy	2.90	ft
Froude Number	0.00	
Maximum Discharge	24.74	ft <sup>3</sup> /s
Discharge Full	23.00	ft <sup>3</sup> /s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	72" SD in Fillmore Rd., 2nd Avenue to 9th Avenue	LF	\$878.70	2800	\$ 2,460,353.28
2	48" SD in 2nd Ave, Roosevelt to Fillmore	LF	\$637.14	1400	\$ 891,992.64
3	36" SD in 2nd Ave, Polk to Fillmore	LF	\$506.89	900	\$ 456,203.88
4	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	24	\$ 240,000.00
5	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1200	\$ 538,575.84
6	Utility Relocation	LM	\$50,000.00	1	\$ 50,000.00
Sub Total					\$ 4,637,125.64
<i>Contingencies (20%)</i>					\$ 927,425.13
<b>TOTAL</b>					<b>\$ 5,564,600.00</b>

9/9

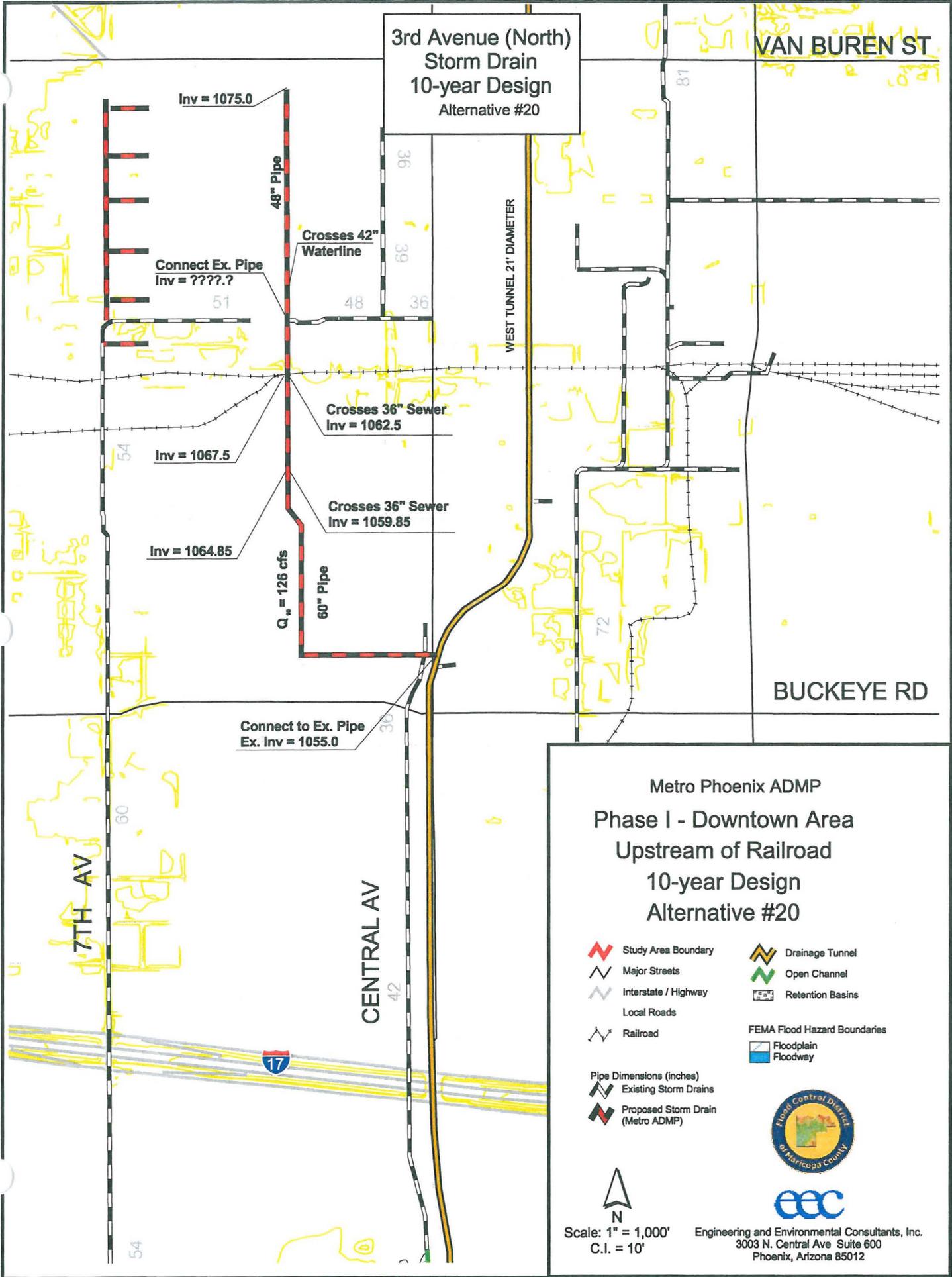
# Alternative #20 - 3rd Avenue (North) Storm Drain

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-4
Cost Estimate	5

**3rd Avenue (North)  
Storm Drain  
10-year Design  
Alternative #20**

VAN BUREN ST



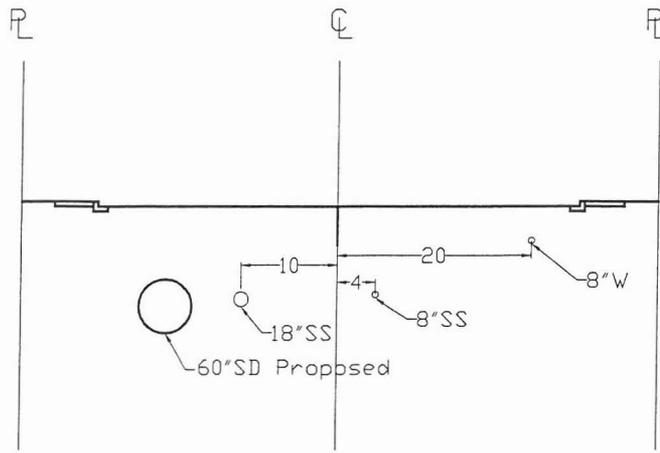
**Metro Phoenix ADMP  
Phase I - Downtown Area  
Upstream of Railroad  
10-year Design  
Alternative #20**

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway
- Pipe Dimensions (Inches)
- Existing Storm Drains
- Proposed Storm Drain (Metro ADMP)



Scale: 1" = 1,000'  
C.I. = 10'

Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



3rd Ave - Van Buren St to Tonto St  
 Proposed 60" SD - 10 year Design  
 Inv @ Van Buren = 1075.0  
 Inv @ West Tunnel (@ Tonto) = 1055.0  
 Alternative #20

66' ROW

N:\305008\DOWNTOWN - SECTIONS.DWG, 8/13/2007 10:05:02 AM, \\phxsv01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	05/2007
	DRAWN	KLH	05/2007
	CHECKED	LAV	05/2007
	 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602)248-7702 FAX: (602)248-7851</small>		
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 5

## Worksheet for S1 - 3rd Avenue (North) - Van Buren to Railroad

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00330 ft/ft
Normal Depth	3.62 ft
Diameter	3.62 ft
Discharge	63.00 ft <sup>3</sup> /s

⇒ 48" PIPE

### Results

Diameter	3.62 ft
Normal Depth	3.62 ft
Flow Area	10.26 ft <sup>2</sup>
Wetted Perimeter	11.36 ft
Top Width	0.00 ft
Critical Depth	2.47 ft
Percent Full	100.0 %
Critical Slope	0.00504 ft/ft
Velocity	6.14 ft/s
Velocity Head	0.59 ft
Specific Energy	4.20 ft
Froude Number	0.00
Maximum Discharge	67.77 ft <sup>3</sup> /s
Discharge Full	63.00 ft <sup>3</sup> /s
Slope Full	0.00330 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

## Worksheet for S2 - 3rd Avenue (North) - Railroad to West Tunnel

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00370 ft/ft  
Normal Depth                                4.90 ft  
Diameter                                      4.90 ft  
Discharge                                    150.00 ft<sup>3</sup>/s

⇒ 60" PIPE

### Results

Diameter                                      4.90 ft  
Normal Depth                                4.90 ft  
Flow Area                                    18.85 ft<sup>2</sup>  
Wetted Perimeter                            15.39 ft  
Top Width                                    0.00 ft  
Critical Depth                                3.53 ft  
Percent Full                                100.0 %  
Critical Slope                                0.00490 ft/ft  
Velocity                                      7.96 ft/s  
Velocity Head                                0.98 ft  
Specific Energy                               5.88 ft  
Froude Number                               0.00  
Maximum Discharge                        161.34 ft<sup>3</sup>/s  
Discharge Full                               149.99 ft<sup>3</sup>/s  
Slope Full                                    0.00370 ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00 ft  
Length                                      0.00 ft  
Number Of Steps                            0

### GVF Output Data

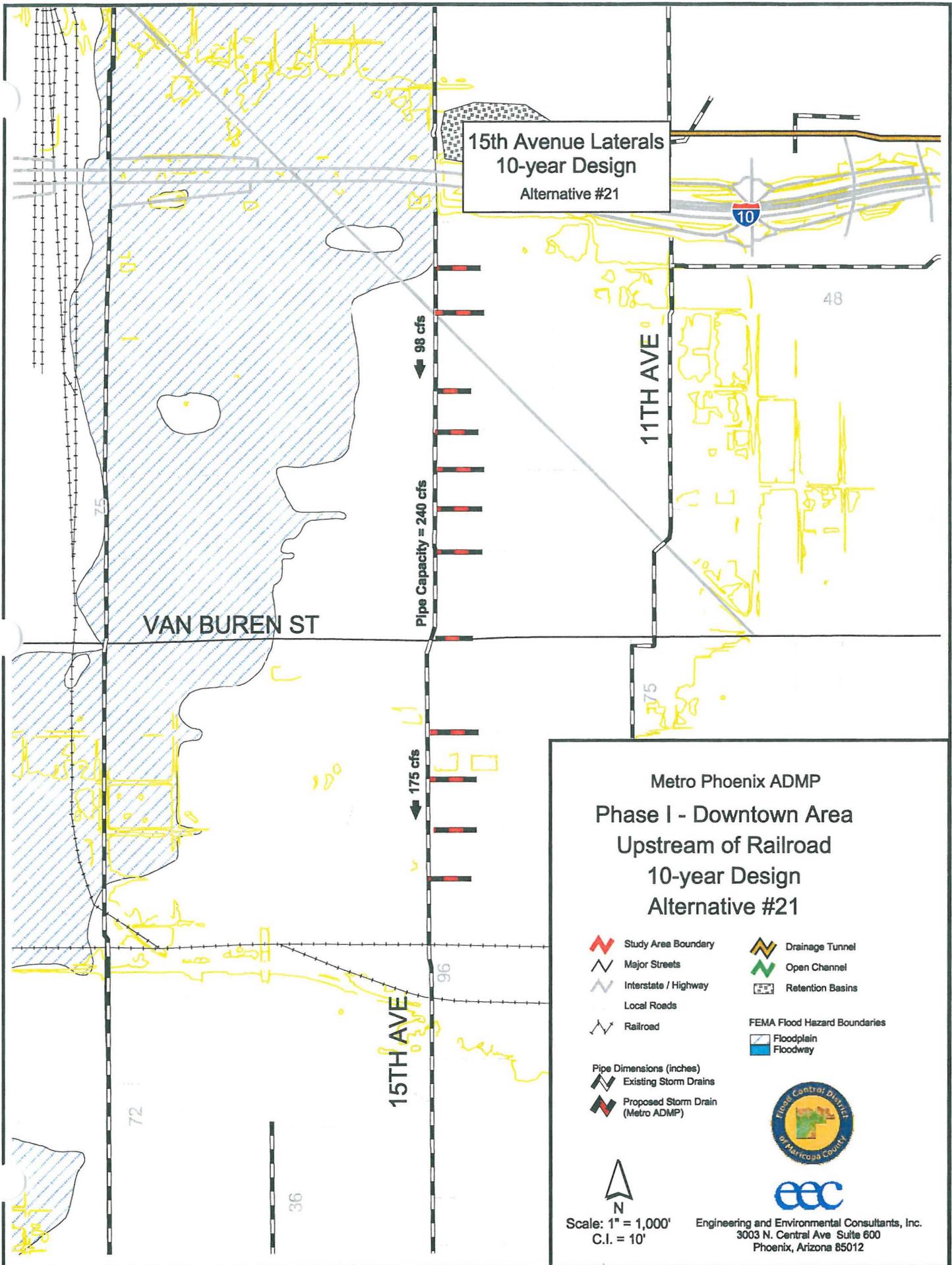
Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                100.00 %

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" SD in 3rd Avenue, Van Buren to Lincoln	LF	\$637.14	3000	\$ 1,911,412.80
2	60" SD in 3rd Avenue, Lincoln to Tonto/West Tunnel	LF	\$759.41	2740	\$ 2,080,781.21
3	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	22	\$ 220,000.00
4	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1100	\$ 493,694.52
5	Utility Relocation	LM	\$50,000.00	1.1	\$ 55,000.00
Sub Total					\$ 4,760,888.53
<i>Contingencies (20%)</i>					\$ 952,177.71
<b>TOTAL</b>					<b>\$ 5,713,100.00</b>

# Alternative #21 - Modifications to 15th Avenue Storm Drain

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Cost Estimate	2



15th Avenue Laterals  
10-year Design  
Alternative #21

Metro Phoenix ADMP  
Phase I - Downtown Area  
Upstream of Railroad  
10-year Design  
Alternative #21

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
  - Floodplain
  - Floodway

- Pipe Dimensions (inches)
- Existing Storm Drains
  - Proposed Storm Drain (Metro ADMP)



Scale: 1" = 1,000'  
C.I. = 10'

Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

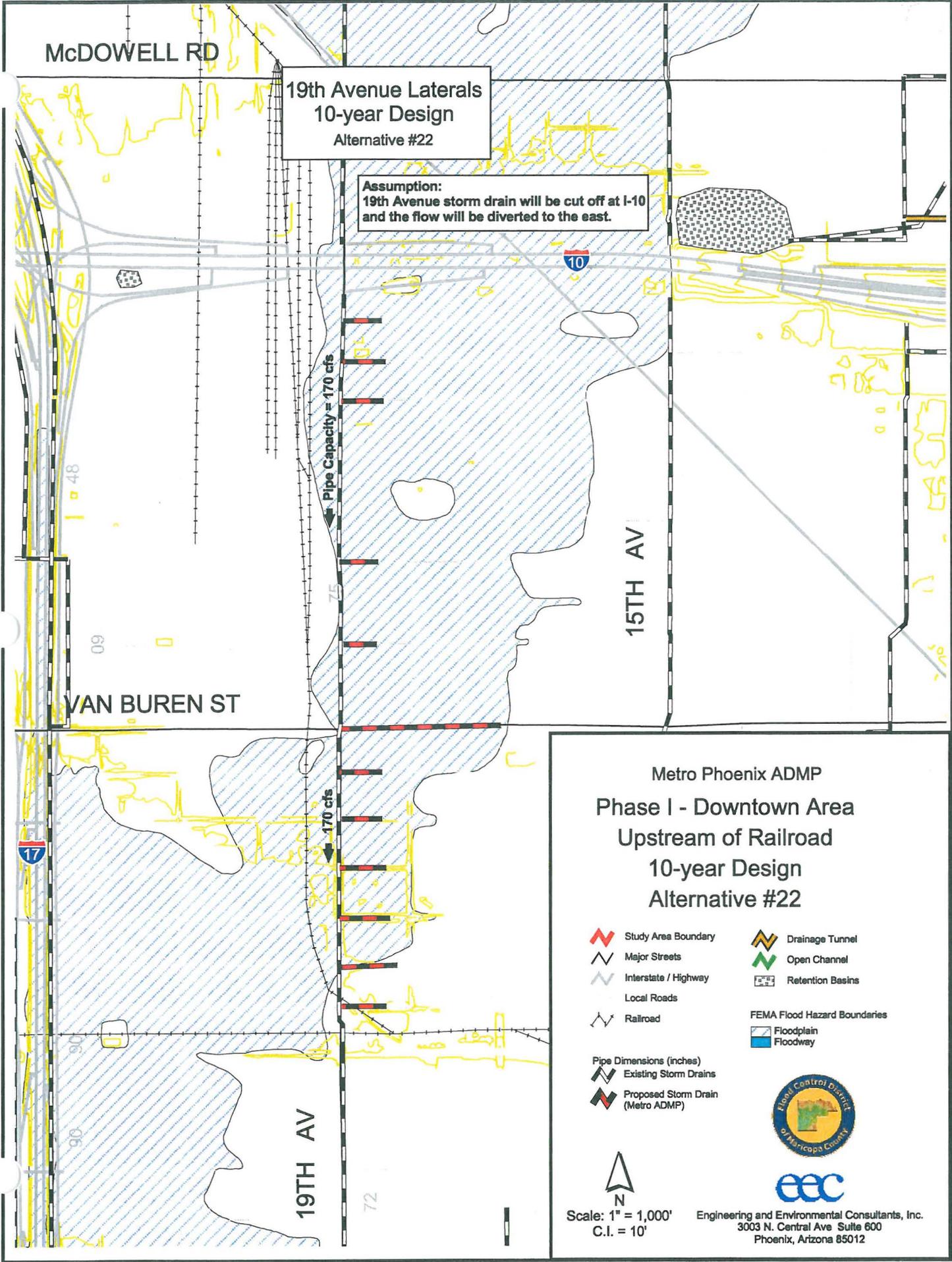
1/2

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	24	\$ 240,000.00
2	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1200	\$ 538,575.84
3	Utility Relocation	LM	\$50,000.00	0.25	\$ 12,500.00
	Sub Total				\$ 791,075.84
	Contingencies (20%)				\$ 158,215.17
	<b>TOTAL</b>				<b>\$ 949,300.00</b>

# Alternative #22 - Modifications to 19th Avenue Storm Drain

## Table of Contents

	<u>Page</u>
Plan View Exhibit	1
Cost Estimate	2



McDOWELL RD

19th Avenue Laterals  
10-year Design  
Alternative #22

Assumption:  
19th Avenue storm drain will be cut off at I-10  
and the flow will be diverted to the east.

Pipe Capacity = 170 cfs

15TH AV

VAN BUREN ST

170 cfs

19TH AV

Metro Phoenix ADMP  
Phase I - Downtown Area  
Upstream of Railroad  
10-year Design  
Alternative #22

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway
- Pipe Dimensions (inches)
- Existing Storm Drains
- Proposed Storm Drain (Metro ADMP)



Scale: 1" = 1,000'  
C.I. = 10'

Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

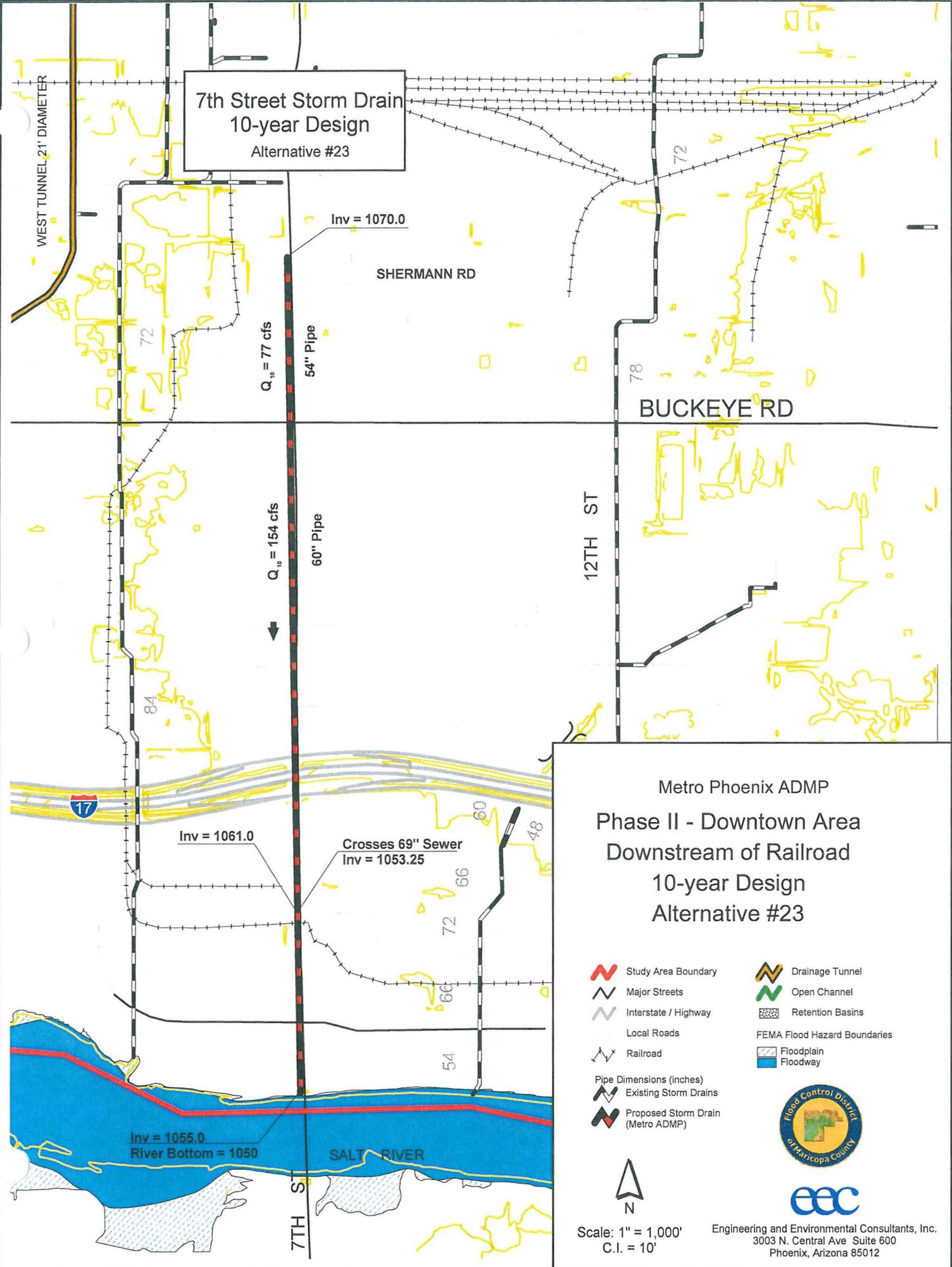
Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	24	\$ 240,000.00
2	New 30" Storm Drain Laterals on Existing Storm Drains	LF	\$448.81	1200	\$ 538,575.84
3	Utility Relocation	LM	\$50,000.00	0.25	\$ 12,500.00
	Sub Total				\$ 791,075.84
	Contingencies (20%)				\$ 158,215.17
	<b>TOTAL</b>				<b>\$ 949,300.00</b>

# Alternative #23 - 7<sup>th</sup> Street Storm Drain

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	<u>Page</u>
Plan View Exhibit	1
Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-5
Cost Estimate	6

**7th Street Storm Drain  
10-year Design  
Alternative #23**



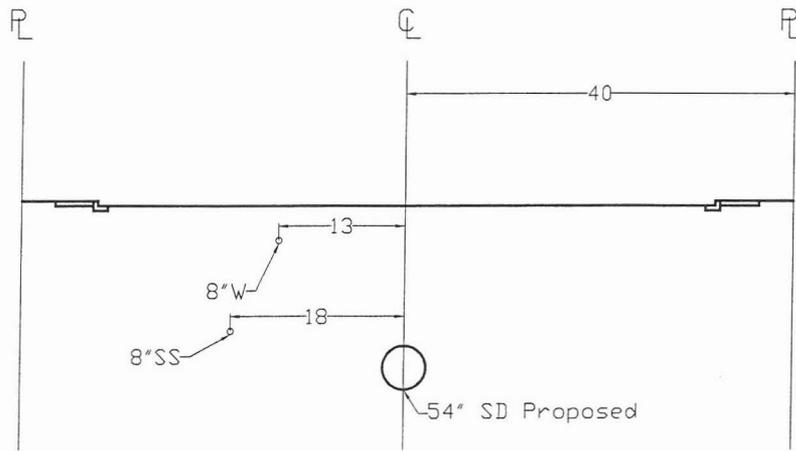
**Metro Phoenix ADMP  
Phase II - Downtown Area  
Downstream of Railroad  
10-year Design  
Alternative #23**

Study Area Boundary	Drainage Tunnel
Major Streets	Open Channel
Interstate / Highway	Retention Basins
Local Roads	FEMA Flood Hazard Boundaries
Railroad	Floodplain
Pipe Dimensions (inches)	Floodway
Existing Storm Drains	
Proposed Storm Drain (Metro ADMP)	

N

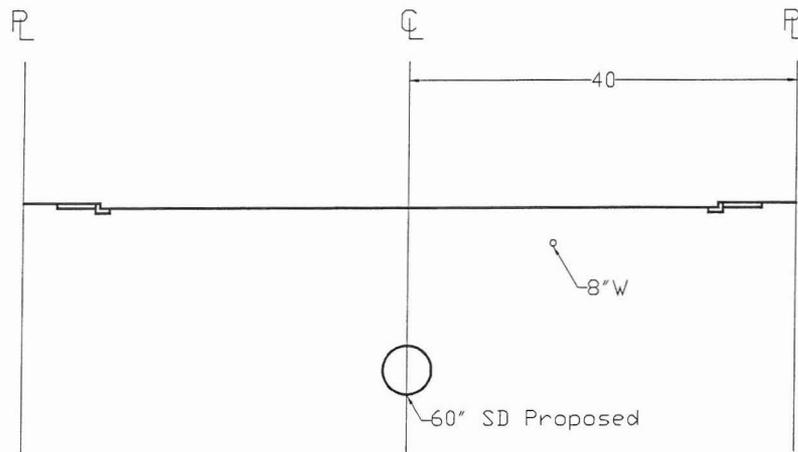
Scale: 1" = 1,000'  
C.I. = 10'

**eec**  
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Phoenix, Arizona 85012



7th St - Sherman to I-17  
 Proposed 54" SD - 10 year Design  
 Inv @ Sherman = 1070  
 Alternative #23

80' ROW



7th St - I-17 to Salt River  
 Proposed 66" SD - 10 year Design  
 Inv @ Salt River = 1055  
 Alternative #23

80' ROW

N:\305008\DOWNTOWN - SECTIONS.DWG, 5/22/2007 4:18:43 PM, \phxsv01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN</b> <b>FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		 <small>Engineering and Environmental Consultants, Inc.          3003 N. Central Avenue, Suite 600          Phoenix, Arizona 85012-2905          TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 6

## Worksheet for S1 - 7th Street - Shermann to Buckeye

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00170	ft/ft
Normal Depth	4.41	ft
Diameter	4.41	ft ⇒ 54" PIPE
Discharge	77.00	ft <sup>3</sup> /s

### Results

Diameter	4.41	ft
Normal Depth	4.41	ft
Flow Area	15.30	ft <sup>2</sup>
Wetted Perimeter	13.87	ft
Top Width	0.00	ft
Critical Depth	2.58	ft
Percent Full	100.0	%
Critical Slope	0.00408	ft/ft
Velocity	5.03	ft/s
Velocity Head	0.39	ft
Specific Energy	4.81	ft
Froude Number	0.00	
Maximum Discharge	82.83	ft <sup>3</sup> /s
Discharge Full	77.00	ft <sup>3</sup> /s
Slope Full	0.00170	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 7th Street - Buckeye to Watkins

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00170	ft/ft
Normal Depth	5.72	ft
Diameter	5.72	ft ⇒ 60" PIPE
Discharge	154.00	ft³/s

### Results

Diameter	5.72	ft
Normal Depth	5.72	ft
Flow Area	25.73	ft²
Wetted Perimeter	17.98	ft
Top Width	0.00	ft
Critical Depth	3.42	ft
Percent Full	100.0	%
Critical Slope	0.00381	ft/ft
Velocity	5.98	ft/s
Velocity Head	0.56	ft
Specific Energy	6.28	ft
Froude Number	0.00	
Maximum Discharge	165.66	ft³/s
Discharge Full	154.00	ft³/s
Slope Full	0.00170	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S3 - 7th Street - Watkins to Salt River

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00400	ft/ft
Normal Depth	4.88	ft
Diameter	4.88	ft ⇒ 60" PIPE
Discharge	154.00	ft <sup>3</sup> /s

### Results

Diameter	4.88	ft
Normal Depth	4.88	ft
Flow Area	18.67	ft <sup>2</sup>
Wetted Perimeter	15.32	ft
Top Width	0.00	ft
Critical Depth	3.58	ft
Percent Full	100.0	%
Critical Slope	0.00506	ft/ft
Velocity	8.25	ft/s
Velocity Head	1.06	ft
Specific Energy	5.93	ft
Froude Number	0.00	
Maximum Discharge	165.64	ft <sup>3</sup> /s
Discharge Full	153.98	ft <sup>3</sup> /s
Slope Full	0.00400	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	54" SD in 7th Street, Shermann Street to Buckeye	LF	\$698.29	1350	\$ 942,695.82
2	60" SD in 7th Street, Buckeye to Salt River	LF	\$759.41	5520	\$ 4,191,938.78
3	Utility Relocation	EA	\$50,000.00	1	\$ 50,000.00
Sub Total					\$ 5,184,634.60
<i>Contingencies (20%)</i>					\$ 1,036,926.92
<b>TOTAL</b>					<b>\$ 6,221,600.00</b>

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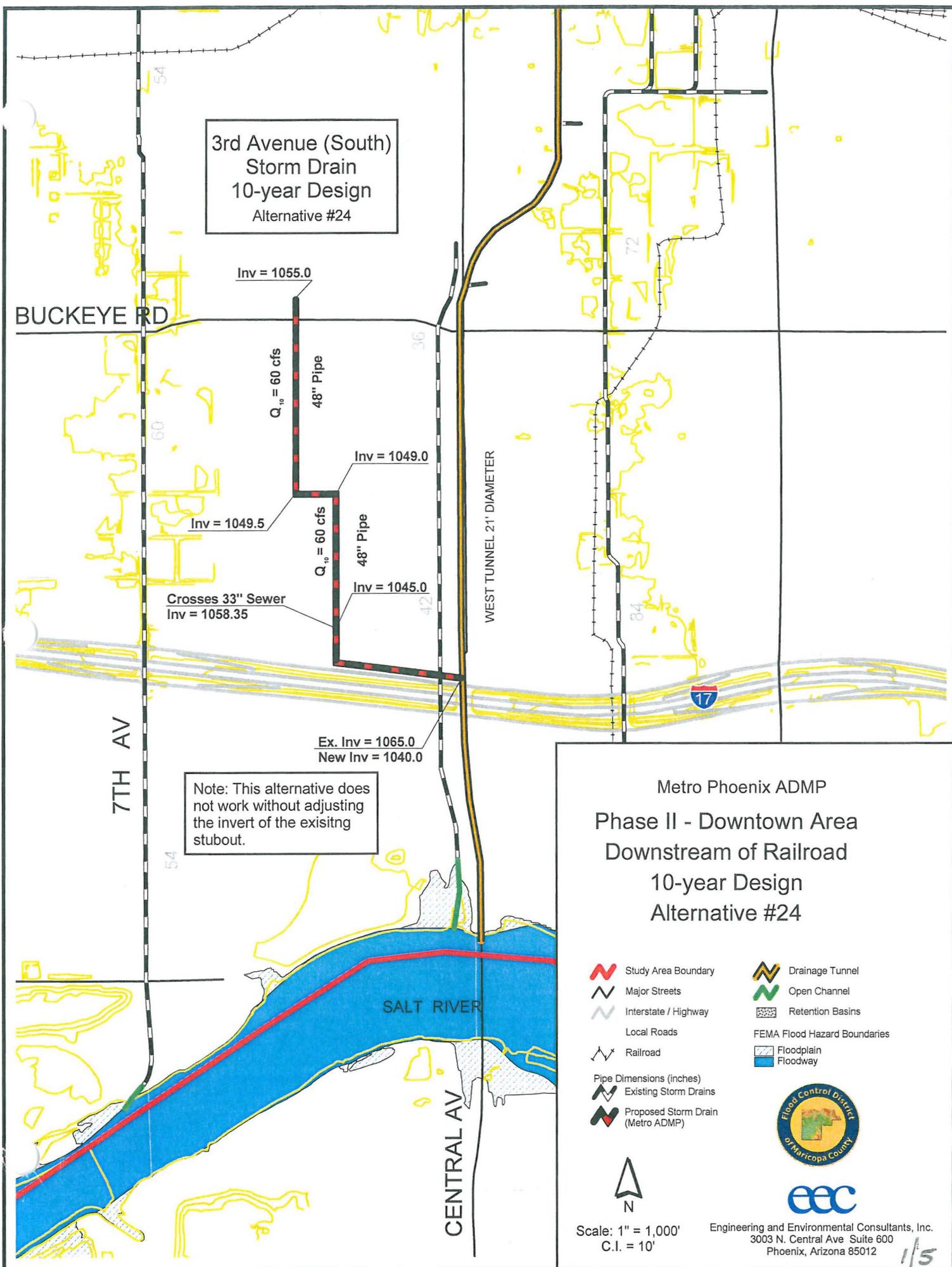
# Alternative #24 - 3<sup>rd</sup> Avenue (South) Storm Drain

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Cost Estimate	5

**ALTERNATIVE #24**  
**3rd Avenue (South) Storm Drain**

3rd Avenue (South)  
Storm Drain  
10-year Design  
Alternative #24



Note: This alternative does not work without adjusting the invert of the existing stubout.

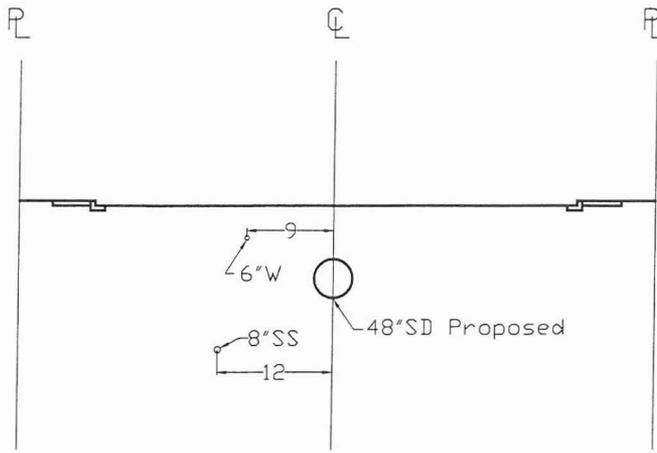
Metro Phoenix ADMP  
Phase II - Downtown Area  
Downstream of Railroad  
10-year Design  
Alternative #24

Study Area Boundary	Drainage Tunnel
Major Streets	Open Channel
Interstate / Highway	Retention Basins
Local Roads	FEMA Flood Hazard Boundaries
Railroad	Floodplain
Pipe Dimensions (inches)	Floodway
Existing Storm Drains	
Proposed Storm Drain (Metro ADMP)	

Scale: 1" = 1,000'  
C.I. = 10'

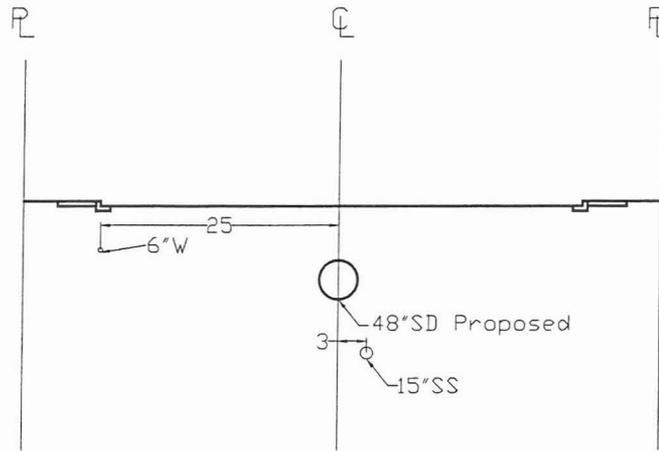
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Phoenix, Arizona 85012

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3rd Ave - Buckeye to Pima St  
 Proposed 48" SD - 10 year Design  
 Inv @ Van Buren = 1055.0  
 Alternative #24

66' ROW



3rd Ave - Pima St. to I-17  
 Proposed 60" SD - 10 year Design  
 Inv @ West Tunnel (@ I-17) = 1040.0  
 Alternative #24

66' ROW

-SECTIONS.DWG, 5/22/2007 4:47:10 PM, \\phxsvr01\HP\_LaserJet\_4050 N:\305008\DOWN TOWN

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		 <small>Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2 / 5

## Worksheet for S1 - 3rd Avenue (South) - Buckeye to Pima

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00340 ft/ft
Normal Depth	3.53 ft
Diameter	3.53 ft
Discharge	60.00 ft <sup>3</sup> /s

### Results

Diameter	3.53 ft
Normal Depth	3.53 ft
Flow Area	9.79 ft <sup>2</sup>
Wetted Perimeter	11.09 ft
Top Width	0.00 ft
Critical Depth	2.42 ft
Percent Full	100.0 %
Critical Slope	0.00512 ft/ft
Velocity	6.13 ft/s
Velocity Head	0.58 ft
Specific Energy	4.11 ft
Froude Number	0.00
Maximum Discharge	64.54 ft <sup>3</sup> /s
Discharge Full	60.00 ft <sup>3</sup> /s
Slope Full	0.00340 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

## Worksheet for S2 - 3rd Avenue (South) - Pima to Salt River

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00330 ft/ft
Normal Depth	3.55 ft
Diameter	3.55 ft
Discharge	60.00 ft <sup>3</sup> /s

### Results

Diameter	3.55 ft
Normal Depth	3.55 ft
Flow Area	9.90 ft <sup>2</sup>
Wetted Perimeter	11.15 ft
Top Width	0.00 ft
Critical Depth	2.42 ft
Percent Full	100.0 %
Critical Slope	0.00506 ft/ft
Velocity	6.06 ft/s
Velocity Head	0.57 ft
Specific Energy	4.12 ft
Froude Number	0.00
Maximum Discharge	64.54 ft <sup>3</sup> /s
Discharge Full	60.00 ft <sup>3</sup> /s
Slope Full	0.00330 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

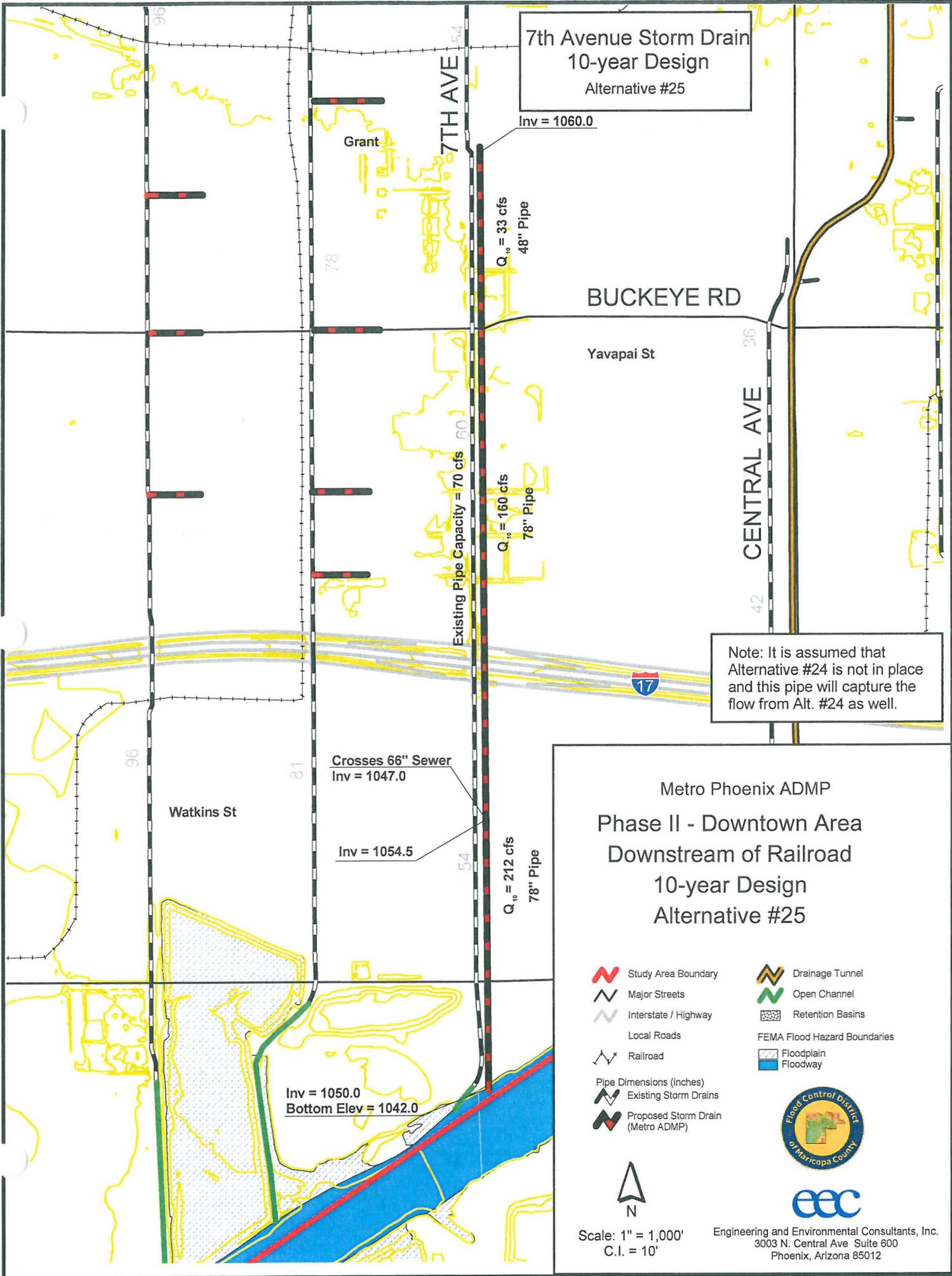
Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" SD in 3rd Avenue, Buckeye Road to West Tunnel at I-17	LF	\$759.41	4350	\$ 3,303,430.02
2	Utility Relocation	EA	\$50,000.00	1	\$ 50,000.00
	Sub Total				\$ 3,353,430.02
	Contingencies (20%)				\$ 670,686.00
	<b>TOTAL</b>				<b>\$ 4,024,100.00</b>

# Alternative #25 - 7th Avenue Storm Drain

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Cost Estimate	6



7th Avenue Storm Drain  
10-year Design  
Alternative #25

Inv = 1060.0

Q<sub>10</sub> = 33 cfs  
48" Pipe

Q<sub>10</sub> = 160 cfs  
78" Pipe

Existing Pipe Capacity = 70 cfs

Q<sub>10</sub> = 212 cfs  
78" Pipe

Crosses 66" Sewer  
Inv = 1047.0

Inv = 1054.5

Inv = 1050.0  
Bottom Elev = 1042.0

Note: It is assumed that Alternative #24 is not in place and this pipe will capture the flow from Alt. #24 as well.

Metro Phoenix ADMP  
Phase II - Downtown Area  
Downstream of Railroad  
10-year Design  
Alternative #25

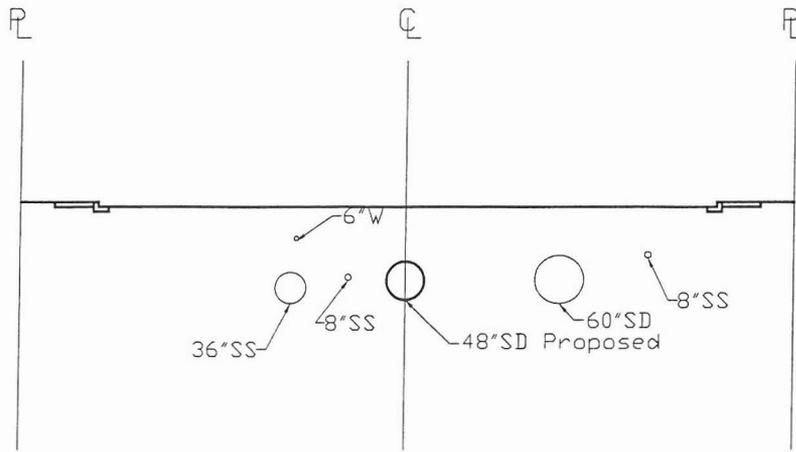
- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Pipe Dimensions (inches)
- Existing Storm Drains
- Proposed Storm Drain (Metro ADMP)
- Drainage Tunnel
- Open Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway



Scale: 1" = 1,000'  
C.I. = 10'

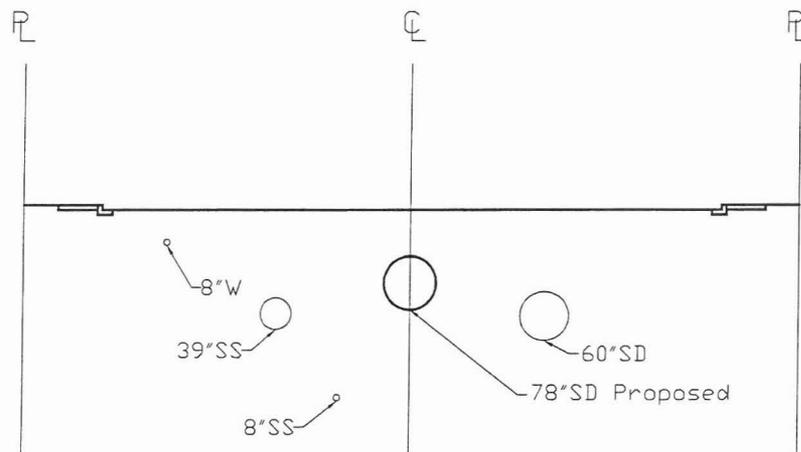


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Phoenix, Arizona 85012



7th Ave - Grant st. to Yavapai St.  
 Proposed 48" SD - 10 year Design  
 Inv @ Grant = 1060.0  
 Alternative #25

80' ROW



7th Ave - Yavapai St to Salt River  
 Proposed 78" SD - 10 year Design  
 Alternative #25

80' ROW

N:\305008\DOWNTOWN - SECTIONS.DWG, 8/14/2007 2:12:48 PM, \phxsrvt01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	DATE
	DRAWN	KLH	05/2007
	CHECKED	LAV	05/2007
 Engineering and Environmental Consultants, Inc. <small>3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851</small>			
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF <b>2/6</b>

## Worksheet for S1 - 7th Avenue - Grant to Buckeye

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00100	ft/ft
Normal Depth	3.55	ft
Diameter	3.55	ft ⇒ 48" PIPE
Discharge	33.00	ft <sup>3</sup> /s

### Results

Diameter	3.55	ft
Normal Depth	3.55	ft
Flow Area	9.89	ft <sup>2</sup>
Wetted Perimeter	11.15	ft
Top Width	0.00	ft
Critical Depth	1.77	ft
Percent Full	100.0	%
Critical Slope	0.00402	ft/ft
Velocity	3.34	ft/s
Velocity Head	0.17	ft
Specific Energy	3.72	ft
Froude Number	0.00	
Maximum Discharge	35.50	ft <sup>3</sup> /s
Discharge Full	33.00	ft <sup>3</sup> /s
Slope Full	0.00100	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - 7th Avenue - Buckeye to Watkins

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00100 ft/ft
Normal Depth	6.41 ft
Diameter	6.41 ft
Discharge	160.00 ft <sup>3</sup> /s

⇒ 78" Pipe

### Results

Diameter	6.41 ft
Normal Depth	6.41 ft
Flow Area	32.31 ft <sup>2</sup>
Wetted Perimeter	20.15 ft
Top Width	0.00 ft
Critical Depth	3.37 ft
Percent Full	100.0 %
Critical Slope	0.00338 ft/ft
Velocity	4.95 ft/s
Velocity Head	0.38 ft
Specific Energy	6.80 ft
Froude Number	0.00
Maximum Discharge	172.13 ft <sup>3</sup> /s
Discharge Full	160.01 ft <sup>3</sup> /s
Slope Full	0.00100 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

## Worksheet for S3 - 7th Avenue - Watkins to Salt River

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	6.26	ft
Diameter	6.26	ft ⇒ 78" Pipe
Discharge	212.00	ft <sup>3</sup> /s

### Results

Diameter	6.26	ft
Normal Depth	6.26	ft
Flow Area	30.77	ft <sup>2</sup>
Wetted Perimeter	19.66	ft
Top Width	0.00	ft
Critical Depth	3.93	ft
Percent Full	100.0	%
Critical Slope	0.00385	ft/ft
Velocity	6.89	ft/s
Velocity Head	0.74	ft
Specific Energy	7.00	ft
Froude Number	0.00	
Maximum Discharge	228.05	ft <sup>3</sup> /s
Discharge Full	212.00	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" SD in 7th Avenue, Grant Street to Buckeye Road	LF	\$637.14	1500	\$ 955,706.40
2	78" SD in 7th Avenue, Buckeye Road to Salt River	LF	\$937.95	6190	\$ 5,805,925.36
3	New Inlets on Existing Storm Drains - Includes Connector Pipe	EA	\$10,000.00	14	\$ 140,000.00
4	30" Storm Drain Laterals	LF	\$448.81	700	\$ 314,169.24
	Sub Total				\$ 7,215,801.00
	Contingencies (20%)				\$ 1,443,160.20
	<b>TOTAL</b>				<b>\$ 8,659,000.00</b>

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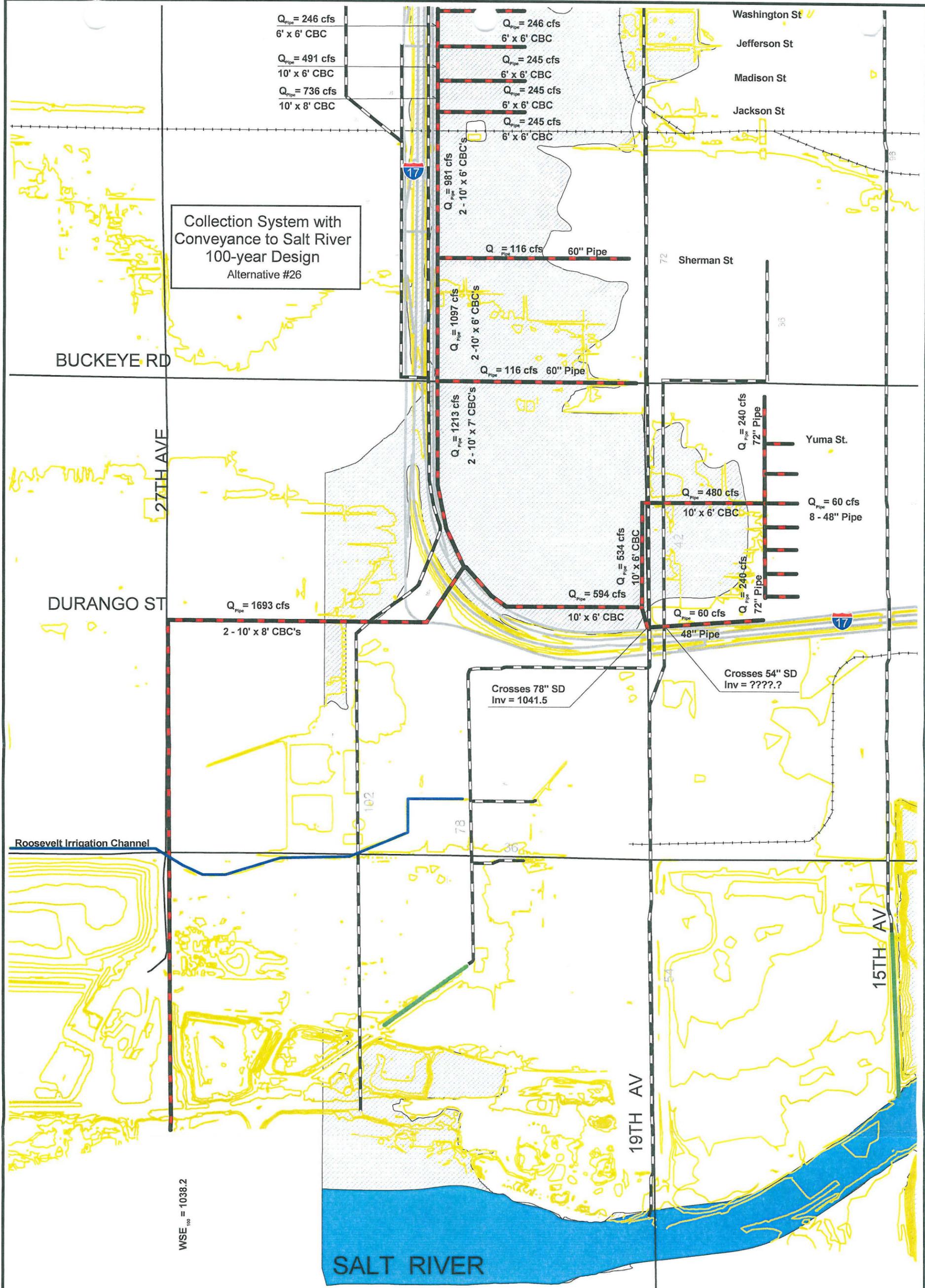
# Alternative #26 - New 100-Year Conveyance System from Durango Curve to Salt River

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Cross Sections	2
Hydraulic Calculations for Proposed Storm Drains	3-42
Cost Estimate	43

**ALTERNATIVE #26**

**New 100-Year Conveyance System from Durango Curve to Salt River**



Metro Phoenix ADMP - Level II Analysis  
 Durango Curve  
 Alternative #26

- |                      |                  |                                   |                              |
|----------------------|------------------|-----------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel  | Pipe Dimensions (inches)          | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel     | Existing Storm Drains             | Floodplain                   |
| Interstate / Highway | Retention Basins | Proposed Storm Drain (Metro ADMP) | Floodway                     |
| Local Roads          |                  |                                   |                              |
| Railroad             |                  |                                   |                              |

Scale: 1" = 1,000'  
 C.I. = 10'



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24



## Worksheet for S1g - Durango Curve Outfall to Salt River

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 2-10'x8' CBC's

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	846.50	ft <sup>3</sup> /s

### Results

Normal Depth	7.86	ft
Flow Area	78.63	ft <sup>2</sup>
Wetted Perimeter	25.73	ft
Top Width	10.00	ft
Critical Depth	6.06	ft
Critical Slope	0.00389	ft/ft
Velocity	10.77	ft/s
Velocity Head	1.80	ft
Specific Energy	9.66	ft
Froude Number	0.68	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.86	ft
Critical Depth	6.06	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00389	ft/ft

---

## Worksheet for S1g - Durango Curve Outfall to Salt River

---

### Messages

Notes

total flow is 1693

2 - 10' x 8' CBC

## Worksheet for L1a - I17 Frontage - Jefferson St

### Project Description

Friction Method  
Solve For

Manning Formula  
Normal Depth

*USE 6'x6' CBL*

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	246.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.22	ft
Flow Area	31.32	ft <sup>2</sup>
Wetted Perimeter	16.44	ft
Top Width	6.00	ft
Critical Depth	3.74	ft
Critical Slope	0.00467	ft/ft
Velocity	7.86	ft/s
Velocity Head	0.96	ft
Specific Energy	6.18	ft
Froude Number	0.61	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.22	ft
Critical Depth	3.74	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00467	ft/ft

---

## Worksheet for L1a - I17 Frontage - Jefferson St

---

Messages

Notes

1 - 6' x 6' CBC

## Worksheet for L1b - I17 Frontage - Madison St

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 6' x 6' CBC

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	245.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.20	ft
Flow Area	31.21	ft <sup>2</sup>
Wetted Perimeter	16.40	ft
Top Width	6.00	ft
Critical Depth	3.73	ft
Critical Slope	0.00466	ft/ft
Velocity	7.85	ft/s
Velocity Head	0.96	ft
Specific Energy	6.16	ft
Froude Number	0.61	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.20	ft
Critical Depth	3.73	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00466	ft/ft

---

## Worksheet for L1b - I17 Frontage - Madison St

---

Messages

Notes

1 - 6' x 6' CBC

## Worksheet for L1c - I17 Frontage - Jackson St

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth                      *USE 6' x 6' CBC*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00200    ft/ft  
Bottom Width                              6.00    ft  
Discharge                                  245.00    ft<sup>3</sup>/s

### Results

Normal Depth                              5.20    ft  
Flow Area                                  31.21    ft<sup>2</sup>  
Wetted Perimeter                          16.40    ft  
Top Width                                  6.00    ft  
Critical Depth                              3.73    ft  
Critical Slope                              0.00466    ft/ft  
Velocity                                    7.85    ft/s  
Velocity Head                              0.96    ft  
Specific Energy                              6.16    ft  
Froude Number                              0.61  
Flow Type                                  Subcritical

### GVF Input Data

Downstream Depth                          0.00    ft  
Length                                    0.00    ft  
Number Of Steps                              0

### GVF Output Data

Upstream Depth                              0.00    ft  
Profile Description  
Profile Headloss                              0.00    ft  
Downstream Velocity                          Infinity    ft/s  
Upstream Velocity                              Infinity    ft/s  
Normal Depth                              5.20    ft  
Critical Depth                              3.73    ft  
Channel Slope                              0.00200    ft/ft  
Critical Slope                              0.00466    ft/ft

---

## Worksheet for L1c - I17 Frontage - Jackson St

---

Messages

Notes

1 - 6' x 6' CBC

## Worksheet for L1d - I17 Frontage - Harrison St

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 6'x6' CBC

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	245.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.20	ft
Flow Area	31.21	ft <sup>2</sup>
Wetted Perimeter	16.40	ft
Top Width	6.00	ft
Critical Depth	3.73	ft
Critical Slope	0.00466	ft/ft
Velocity	7.85	ft/s
Velocity Head	0.96	ft
Specific Energy	6.16	ft
Froude Number	0.61	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.20	ft
Critical Depth	3.73	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00466	ft/ft

---

## Worksheet for L1d - I17 Frontage - Harrison St

---

Messages

Notes

1 - 6' x 6' CBC

## Worksheet for S1a - I17 Frontage - Jefferson St to Madison St

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 6'x6' CBC

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	246.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.22	ft
Flow Area	31.32	ft <sup>2</sup>
Wetted Perimeter	16.44	ft
Top Width	6.00	ft
Critical Depth	3.74	ft
Critical Slope	0.00467	ft/ft
Velocity	7.86	ft/s
Velocity Head	0.96	ft
Specific Energy	6.18	ft
Froude Number	0.61	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.22	ft
Critical Depth	3.74	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00467	ft/ft

---

## Worksheet for S1a - I17 Frontage - Jefferson St to Madison St

---

Messages

Notes

1-6' x 6' CBC

## Worksheet for S1b - I17 Frontage - Madison St to Jackson St

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	<i>USE 10' x 6' CBC</i>

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00200 ft/ft
Bottom Width	10.00 ft
Discharge	491.00 ft <sup>3</sup> /s

### Results

Normal Depth	5.16 ft $\Rightarrow 6'$
Flow Area	51.60 ft <sup>2</sup>
Wetted Perimeter	20.32 ft
Top Width	10.00 ft
Critical Depth	4.22 ft
Critical Slope	0.00345 ft/ft
Velocity	9.52 ft/s
Velocity Head	1.41 ft
Specific Energy	6.57 ft
Froude Number	0.74
Flow Type	Subcritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.16 ft
Critical Depth	4.22 ft
Channel Slope	0.00200 ft/ft
Critical Slope	0.00345 ft/ft

*15/43*

---

## Worksheet for S1b - I17 Frontage - Madison St to Jackson St

---

Messages

Notes

1-10' x6' CBC

## Worksheet for S1c - I17 Frontage - Jackson St to Harrison St

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 10' x 8' CBC

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	736.00	ft <sup>3</sup> /s

### Results

Normal Depth	7.04	ft	⇒ 8'
Flow Area	70.42	ft <sup>2</sup>	
Wetted Perimeter	24.08	ft	
Top Width	10.00	ft	
Critical Depth	5.52	ft	
Critical Slope	0.00376	ft/ft	
Velocity	10.45	ft/s	
Velocity Head	1.70	ft	
Specific Energy	8.74	ft	
Froude Number	0.69		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.04	ft
Critical Depth	5.52	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00376	ft/ft

---

**Worksheet for S1c - I17 Frontage - Jackson St to Harrison St**

---

Messages

Notes

1-10' x 8' CBC

## Worksheet for S1d - I17 Frontage - Harrison St to Lincoln St

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth                      *USE 2- 10'x6' CBC's*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00200    ft/ft  
Bottom Width                              10.00    ft  
Discharge                                  490.50    ft<sup>3</sup>/s

### Results

Normal Depth                              5.16    ft    *→ 6'*  
Flow Area                                  51.56    ft<sup>2</sup>  
Wetted Perimeter                          20.31    ft  
Top Width                                  10.00    ft  
Critical Depth                              4.21    ft  
Critical Slope                              0.00344    ft/ft  
Velocity                                    9.51    ft/s  
Velocity Head                              1.41    ft  
Specific Energy                            6.56    ft  
Froude Number                              0.74  
Flow Type                                  Subcritical

### GVF Input Data

Downstream Depth                          0.00    ft  
Length                                      0.00    ft  
Number Of Steps                              0

### GVF Output Data

Upstream Depth                              0.00    ft  
Profile Description  
Profile Headloss                              0.00    ft  
Downstream Velocity                          Infinity    ft/s  
Upstream Velocity                            Infinity    ft/s  
Normal Depth                              5.16    ft  
Critical Depth                              4.21    ft  
Channel Slope                              0.00200    ft/ft  
Critical Slope                              0.00344    ft/ft

---

## Worksheet for S1d - I17 Frontage - Harrison St to Lincoln St

---

### Messages

Notes

total flow is 981 cfs

2 - 10' x 6' CBCs

## Worksheet for L1e - I17 Frontage - Lincoln St.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00300 ft/ft
Normal Depth	4.63 ft
Diameter	4.63 ft
Discharge	116.00 ft <sup>3</sup> /s

### Results

Diameter	4.63 ft
Normal Depth	4.63 ft
Flow Area	16.81 ft <sup>2</sup>
Wetted Perimeter	14.54 ft
Top Width	0.00 ft
Critical Depth	3.15 ft
Percent Full	100.0 %
Critical Slope	0.00462 ft/ft
Velocity	6.90 ft/s
Velocity Head	0.74 ft
Specific Energy	5.37 ft
Froude Number	0.00
Maximum Discharge	124.78 ft <sup>3</sup> /s
Discharge Full	116.00 ft <sup>3</sup> /s
Slope Full	0.00300 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for L1e - I17 Frontage - Lincoln St.

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.63	ft
Critical Depth	3.15	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00462	ft/ft

## Worksheet for S1e - I17 Frontage - Lincoln St. to Buckeye Rd

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 2 -10'x6' CBC's

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	548.50	ft <sup>3</sup> /s <span style="margin-left: 20px;">Total Flow = 1097cfs</span>

### Results

Normal Depth	5.61	ft	⇒ 6'
Flow Area	56.11	ft <sup>2</sup>	
Wetted Perimeter	21.22	ft	
Top Width	10.00	ft	
Critical Depth	4.54	ft	
Critical Slope	0.00352	ft/ft	
Velocity	9.77	ft/s	
Velocity Head	1.48	ft	
Specific Energy	7.10	ft	
Froude Number	0.73		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.61	ft
Critical Depth	4.54	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00352	ft/ft

---

## Worksheet for S1e - I17 Frontage - Lincoln St. to Buckeye Rd

---

### Messages

Notes

total flow is 1097 cfs

2 - 10' x 6' CBC's

## Worksheet for L1f - I17 Frontage - Buckeye Rd

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	4.63	ft
Diameter	4.63	ft
Discharge	116.00	ft <sup>3</sup> /s

### Results

Diameter	4.63	ft
Normal Depth	4.63	ft
Flow Area	16.81	ft <sup>2</sup>
Wetted Perimeter	14.54	ft
Top Width	0.00	ft
Critical Depth	3.15	ft
Percent Full	100.0	%
Critical Slope	0.00462	ft/ft
Velocity	6.90	ft/s
Velocity Head	0.74	ft
Specific Energy	5.37	ft
Froude Number	0.00	
Maximum Discharge	124.78	ft <sup>3</sup> /s
Discharge Full	116.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L1f - I17 Frontage - Buckeye Rd

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.63	ft
Critical Depth	3.15	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00462	ft/ft

## Worksheet for S1f - I17 Frontage - Buckeye Rd to Durango Curve

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	<i>USE 2-10'x7' CRC's</i>

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	606.50	ft <sup>3</sup> /s <i>Total Flow = 1213 cfs</i>

### Results

Normal Depth	6.06	ft	<i>⇒ 7'</i>
Flow Area	60.60	ft <sup>2</sup>	
Wetted Perimeter	22.12	ft	
Top Width	10.00	ft	
Critical Depth	4.85	ft	
Critical Slope	0.00359	ft/ft	
Velocity	10.01	ft/s	
Velocity Head	1.56	ft	
Specific Energy	7.62	ft	
Froude Number	0.72		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.06	ft
Critical Depth	4.85	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00359	ft/ft

---

## Worksheet for S1f - I17 Frontage - Buckeye Rd to Durango Curve

---

### Messages

Notes

total flow is 1213 cfs

2 - 10' x 7' CBC's

## Worksheet for S2 - Durango St - 19th Ave to 22nd Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth                      *USE 10'x6' CBC*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00200 ft/ft  
Bottom Width                              10.00 ft  
Discharge                                  594.00 ft<sup>3</sup>/s

### Results

Normal Depth                              5.96 ft     *⇒ 6'*  
Flow Area                                  59.64 ft<sup>2</sup>  
Wetted Perimeter                          21.93 ft  
Top Width                                  10.00 ft  
Critical Depth                              4.79 ft  
Critical Slope                              0.00358 ft/ft  
Velocity                                      9.96 ft/s  
Velocity Head                              1.54 ft  
Specific Energy                              7.51 ft  
Froude Number                              0.72  
Flow Type                                  Subcritical

### GVF Input Data

Downstream Depth                          0.00 ft  
Length                                      0.00 ft  
Number Of Steps                              0

### GVF Output Data

Upstream Depth                              0.00 ft  
Profile Description  
Profile Headloss                              0.00 ft  
Downstream Velocity                          Infinity ft/s  
Upstream Velocity                              Infinity ft/s  
Normal Depth                              5.96 ft  
Critical Depth                              4.79 ft  
Channel Slope                              0.00200 ft/ft  
Critical Slope                              0.00358 ft/ft

---

**Worksheet for S2 - Durango St - 19th Ave to 22nd Ave**

---

Messages

Notes

1 - 10' x 6'

## Worksheet for L2a - 19th Avenue - Pima St to Durango St

### Project Description

Friction Method

Manning Formula

Solve For

Normal Depth

USE 10'x6' CBC

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00200 ft/ft
Bottom Width	10.00 ft
Discharge	534.00 ft <sup>3</sup> /s

### Results

Normal Depth	5.50 ft	⇒ 6'
Flow Area	54.99 ft <sup>2</sup>	
Wetted Perimeter	21.00 ft	
Top Width	10.00 ft	
Critical Depth	4.46 ft	
Critical Slope	0.00350 ft/ft	
Velocity	9.71 ft/s	
Velocity Head	1.47 ft	
Specific Energy	6.96 ft	
Froude Number	0.73	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.50 ft
Critical Depth	4.46 ft
Channel Slope	0.00200 ft/ft
Critical Slope	0.00350 ft/ft

---

**Worksheet for L2a - 19th Avenue - Pima St to Durango St**

---

Messages

Notes

1 - 10' x 6' CBC

## Worksheet for L2b - Pima St - 17th Ave to 19th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

*USE 10'x6' CBC*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                      0.00200    ft/ft  
Bottom Width                                      10.00    ft  
Discharge    480.00    ft<sup>3</sup>/s

### Results

Normal Depth                                      5.07    ft  $\Rightarrow$  6'  
Flow Area    50.73    ft<sup>2</sup>  
Wetted Perimeter                                20.15    ft  
Top Width    10.00    ft  
Critical Depth                                      4.15    ft  
Critical Slope                                      0.00343    ft/ft  
Velocity    9.46    ft/s  
Velocity Head                                      1.39    ft  
Specific Energy                                    6.46    ft  
Froude Number                                    0.74  
Flow Type    Subcritical

### GVF Input Data

Downstream Depth                                0.00    ft  
Length    0.00    ft  
Number Of Steps                                    0

### GVF Output Data

Upstream Depth                                    0.00    ft  
Profile Description  
Profile Headloss                                    0.00    ft  
Downstream Velocity                                Infinity    ft/s  
Upstream Velocity                                    Infinity    ft/s  
Normal Depth                                      5.07    ft  
Critical Depth                                      4.15    ft  
Channel Slope                                      0.00200    ft/ft  
Critical Slope                                      0.00343    ft/ft

---

**Worksheet for L2b - Pima St - 17th Ave to 19th Ave**

---

Messages

Notes

1 - 10' x 6' CBC

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## Worksheet for L2c- 17th Ave - Buckeye Rd to Pima St

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00300 ft/ft
Normal Depth	6.08 ft
Diameter	6.08 ft
Discharge	240.00 ft <sup>3</sup> /s

### Results

Diameter	6.08 ft
Normal Depth	6.08 ft
Flow Area	29.01 ft <sup>2</sup>
Wetted Perimeter	19.09 ft
Top Width	0.00 ft
Critical Depth	4.23 ft
Percent Full	100.0 %
Critical Slope	0.00435 ft/ft
Velocity	8.27 ft/s
Velocity Head	1.06 ft
Specific Energy	7.14 ft
Froude Number	0.00
Maximum Discharge	258.17 ft <sup>3</sup> /s
Discharge Full	240.00 ft <sup>3</sup> /s
Slope Full	0.00300 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for L2c- 17th Ave - Buckeye Rd to Pima St

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.08	ft
Critical Depth	4.23	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00435	ft/ft

## Worksheet for L2d - 17th Ave - Durango St to Pima St

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	6.08	ft
Diameter	6.08	ft
Discharge	240.00	ft <sup>3</sup> /s

### Results

Diameter	6.08	ft
Normal Depth	6.08	ft
Flow Area	29.01	ft <sup>2</sup>
Wetted Perimeter	19.09	ft
Top Width	0.00	ft
Critical Depth	4.23	ft
Percent Full	100.0	%
Critical Slope	0.00435	ft/ft
Velocity	8.27	ft/s
Velocity Head	1.06	ft
Specific Energy	7.14	ft
Froude Number	0.00	
Maximum Discharge	258.17	ft <sup>3</sup> /s
Discharge Full	240.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L2d - 17th Ave - Durango St to Pima St

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.08	ft
Critical Depth	4.23	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00435	ft/ft

## Worksheet for L2e - 17th Ave, 8 laterals

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00300 ft/ft
Normal Depth	3.61 ft
Diameter	3.61 ft
Discharge	60.00 ft <sup>3</sup> /s

### Results

Diameter	3.61 ft
Normal Depth	3.61 ft
Flow Area	10.26 ft <sup>2</sup>
Wetted Perimeter	11.35 ft
Top Width	0.00 ft
Critical Depth	2.41 ft
Percent Full	100.0 %
Critical Slope	0.00490 ft/ft
Velocity	5.85 ft/s
Velocity Head	0.53 ft
Specific Energy	4.15 ft
Froude Number	0.00
Maximum Discharge	64.54 ft <sup>3</sup> /s
Discharge Full	60.00 ft <sup>3</sup> /s
Slope Full	0.00300 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for L2e - 17th Ave, 8 laterals

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.61	ft
Critical Depth	2.41	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00490	ft/ft

## Worksheet for L2f - 19th Ave - I17 Frontage

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00200 ft/ft
Normal Depth	3.90 ft
Diameter	3.90 ft
Discharge	60.00 ft <sup>3</sup> /s

### Results

Diameter	3.90 ft
Normal Depth	3.90 ft
Flow Area	11.94 ft <sup>2</sup>
Wetted Perimeter	12.25 ft
Top Width	0.00 ft
Critical Depth	2.35 ft
Percent Full	100.0 %
Critical Slope	0.00436 ft/ft
Velocity	5.03 ft/s
Velocity Head	0.39 ft
Specific Energy	4.29 ft
Froude Number	0.00
Maximum Discharge	64.54 ft <sup>3</sup> /s
Discharge Full	60.00 ft <sup>3</sup> /s
Slope Full	0.00200 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for L2f - 19th Ave - I17 Frontage

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.90	ft
Critical Depth	2.35	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00436	ft/ft

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	SD Line 1a, Jefferson to Madison, 6' x 6' CBC	LF	\$1,268.22	300	\$ 380,464.92
2	SD Line 1b, Madison to Jackson, 10' x 6' CBC	LF	\$1,740.25	400	\$ 696,099.36
3	SD Line 1c, Jackson to Harrison, 10' x 8' CBC	LF	\$1,897.79	350	\$ 664,226.64
4	SD Line 1d, Harrison to Lincoln, 2 - 10' x 6' CBCs	LF	\$2,920.99	1300	\$ 3,797,284.92
5	SD Line 1e, Lincoln to Buckeye, 2 - 10' x 6' CBCs	LF	\$2,920.99	1650	\$ 4,819,630.86
6	SD Line 1f, Buckeye to 22nd Ave, 2 - 10' x 7' CBCs	LF	\$3,052.33	2200	\$ 6,715,122.48
7	SD Line 1 Laterals, Jefferson - Harrison, 6' x 6' CBC	LF	\$1,268.22	4000	\$ 5,072,865.60
8	SD Line 1 Lateral, Lincoln St, 60" Pipe	LF	\$759.41	2100	\$ 1,594,759.32
9	SD Line 1 Lateral, Buckeye Rd, 60" Pipe	LF	\$759.41	2100	\$ 1,594,759.32
10	SD Line 4, 19th Ave to Durango Curve, 10' x 6' CBC	LF	\$1,740.25	2200	\$ 3,828,546.48
11	SD Line 4 Lateral, Cocopah to Durango, 10' x 6' CBC	LF	\$1,740.25	800	\$ 1,392,198.72
12	SD Line 4 Lateral, Pima to Cocopah, 10' x 6' CBC	LF	\$1,740.25	400	\$ 696,099.36
13	SD Line 4 Lateral, Pima, 17th to 19th, 10' x 6' CBC	LF	\$1,740.25	1300	\$ 2,262,322.92
14	SD Line 4 Lateral, 17th North, Buckeye to Pima, 72" Pipe	LF	\$878.70	1250	\$ 1,098,372.00
15	SD Line 4 Lateral, 17th South, Durango to Pima, 72" Pipe	LF	\$878.70	1100	\$ 966,567.36
16	SD Line 4 Laterals, 7-48" Pipes	LF	\$637.14	1400	\$ 891,992.64
17	SD Line 4 Lateral, I17 Frontage, 17th to 19th, 48" Pipe	LF	\$637.14	1300	\$ 828,278.88
18	SD Line 5, Durango Curve to Salt River, 2 - 10' x 8' CBCs	LF	\$3,162.28	9100	\$ 28,776,788.04
19	Special Structure at Durango Curve	LS	\$300,000.00	1	\$ 300,000.00
20	Utility Relocation	LM	\$500,000.00	6.3	\$ 3,150,000.00
Sub Total					\$ 69,526,379.82
Contingencies (20%)					\$ 13,905,275.96
<b>TOTAL</b>					<b>\$ 83,431,700.00</b>

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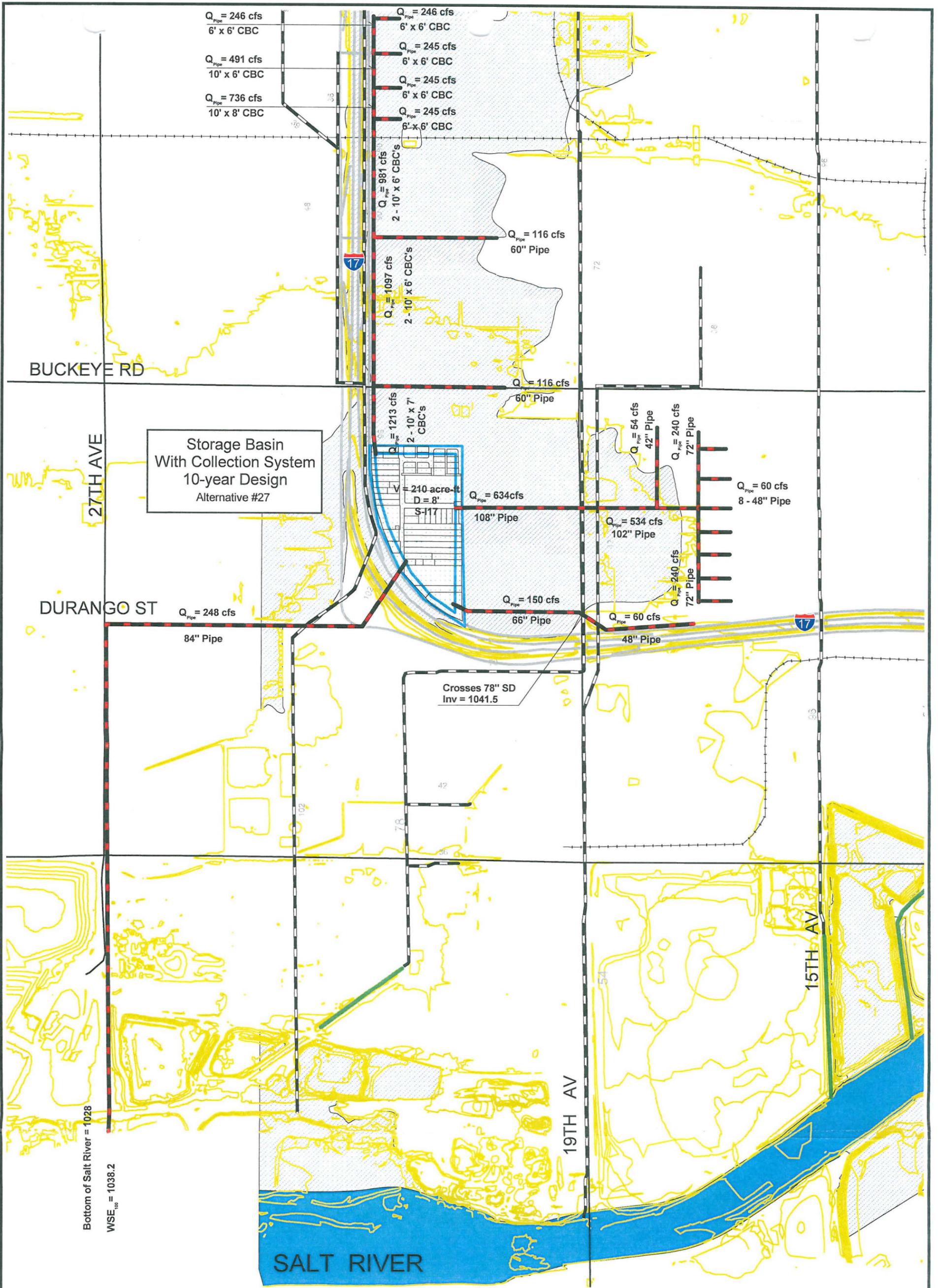
# **Alternative #27 - New 100-Yr Storage Basin at Durango Curve with Conveyance to Salt River**

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### **ALTERNATIVE #27**

**New 100-Yr Storage Basin at Durango Curve with Conveyance to Salt River**



Metro Phoenix ADMP - Level II Analysis

Durango Curve  
Alternative #27

- |                      |                  |                                   |                              |
|----------------------|------------------|-----------------------------------|------------------------------|
| Study Area Boundary  | Drainage Tunnel  | Pipe Dimensions (inches)          | FEMA Flood Hazard Boundaries |
| Major Streets        | Open Channel     | Existing Storm Drains             | Floodplain                   |
| Interstate / Highway | Retention Basins | Proposed Storm Drain (Metro ADMP) | Floodway                     |
| Local Roads          |                  |                                   |                              |
| Railroad             |                  |                                   |                              |

Scale: 1" = 1,000'  
C.I. = 10'



Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

Storage Basin  
With Collection System  
100-year Design  
Alternative #27  
61 Commercial Parcels  
Basin is created with 8:1 SS

2 - 10' x 7' CBC's

1213 cfs

Spill Elev. = 1056

S-117  
Area = 35 acres  
Top Elev. = 1056  
Bottom Elev. = 1048  
Peak Stage = 1053.5  
Peak Inflow = 2202 cfs  
Peak Outflow = 248 cfs

22 ND AVE

108" Pipe PIMA ST

634 cfs

84" Pipe  
248 cfs

66" Pipe

150 cfs

DURANGO ST

Metro Phoenix ADMP - Level II Analysis

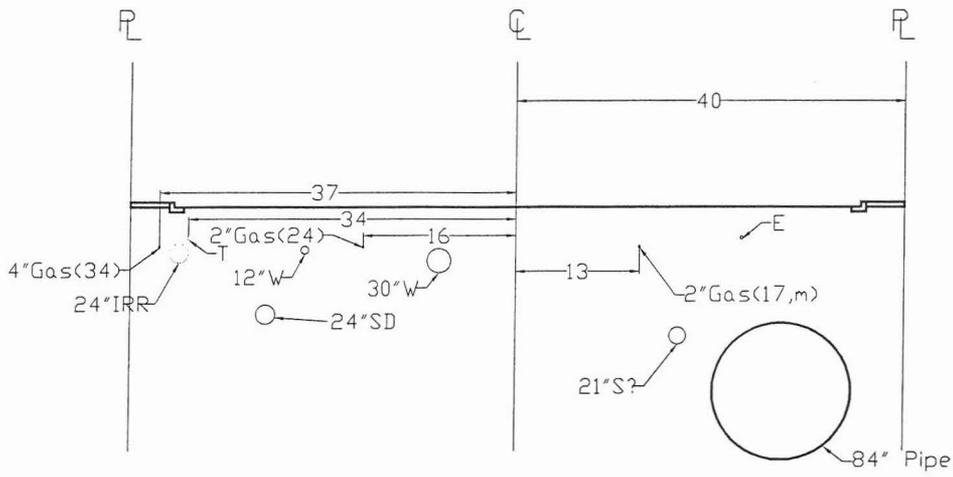
Durango Curve  
Alternative #27

-  Study Area Boundary
-  Major Streets
-  Interstate / Highway
-  Local Roads
-  Railroad
-  Proposed Contour
-  Parcel Boundary
-  FEMA Flood Hazard Boundaries
-  Floodplain
-  Floodway

Scale: 1" = 200'  
C.I. = 10'



Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



Durango - I-17 to 27th Ave  
 Proposed 84" Pipe  
 Alternative #27

80' ROW

N:\305008\ALT 26-32 - ST CTIONS.DWG, 8/14/2007 1:05:20 PM, \p\p\serv01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		<small>Engineering and Environmental Consultants, Inc.          3003 N. Central Avenue, Suite 600          Phoenix, Arizona 85017-2905          TEL: (602)248-7702 FAX: (602)248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF <b>3/93</b>

## Worksheet for S1a - I17 Frontage, Jefferson St. to Madison St.

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth                      *USE 6' x 6' CBC*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00200    ft/ft  
Bottom Width                              6.00    ft  
Discharge                                  246.00    ft<sup>3</sup>/s

### Results

Normal Depth                              5.22    ft    ⇒ 6'  
Flow Area                                  31.32    ft<sup>2</sup>  
Wetted Perimeter                          16.44    ft  
Top Width                                  6.00    ft  
Critical Depth                              3.74    ft  
Critical Slope                              0.00467    ft/ft  
Velocity                                    7.86    ft/s  
Velocity Head                              0.96    ft  
Specific Energy                            6.18    ft  
Froude Number                            0.61  
Flow Type                                  Subcritical

### GVF Input Data

Downstream Depth                          0.00    ft  
Length                                    0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Downstream Velocity                      Infinity    ft/s  
Upstream Velocity                        Infinity    ft/s  
Normal Depth                              5.22    ft  
Critical Depth                              3.74    ft  
Channel Slope                              0.00200    ft/ft  
Critical Slope                              0.00467    ft/ft

---

## Worksheet for S1a - I17 Frontage, Jefferson St. to Madison St.

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Messages

Notes

1 - 6' x 6' CBC

## Worksheet for S1b - I17 Frontage, Madison St. to Jackson St.

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 10' x 6' CBL

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	491.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.16	ft	⇒ 6'
Flow Area	51.60	ft <sup>2</sup>	
Wetted Perimeter	20.32	ft	
Top Width	10.00	ft	
Critical Depth	4.22	ft	
Critical Slope	0.00345	ft/ft	
Velocity	9.52	ft/s	
Velocity Head	1.41	ft	
Specific Energy	6.57	ft	
Froude Number	0.74		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.16	ft
Critical Depth	4.22	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00345	ft/ft

---

**Worksheet for S1b - I17 Frontage, Madison St. to Jackson St.**

---

Messages

Notes

1 - 10' x 6' CBC

7/43

## Worksheet for S1c - I17 Frontage, Jackson St. to Harrison St.

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	<i>USE 10' x 8' CBC</i>

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	736.00	ft <sup>3</sup> /s

### Results

Normal Depth	7.04	ft	<i>⇒ 8'</i>
Flow Area	70.42	ft <sup>2</sup>	
Wetted Perimeter	24.08	ft	
Top Width	10.00	ft	
Critical Depth	5.52	ft	
Critical Slope	0.00376	ft/ft	
Velocity	10.45	ft/s	
Velocity Head	1.70	ft	
Specific Energy	8.74	ft	
Froude Number	0.69		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.04	ft
Critical Depth	5.52	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00376	ft/ft

---

**Worksheet for S1c - I17 Frontage, Jackson St. to Harrison St.**

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Messages

Notes

1 - 10' x 8' CBC

## Worksheet for L1a - Jefferson St. Lateral

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 6' x 6' CBC

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	246.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.22	ft	⇒ 6'
Flow Area	31.32	ft <sup>2</sup>	
Wetted Perimeter	16.44	ft	
Top Width	6.00	ft	
Critical Depth	3.74	ft	
Critical Slope	0.00467	ft/ft	
Velocity	7.86	ft/s	
Velocity Head	0.96	ft	
Specific Energy	6.18	ft	
Froude Number	0.61		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.22	ft
Critical Depth	3.74	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00467	ft/ft

---

## Worksheet for L1a - Jefferson St. Lateral

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Messages

Notes

1 - 6' x 6' CBC

## Worksheet for L1b- Madison St. Lateral

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	<i>USE 6'x6' CBC</i>

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	245.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.20	ft	<i>⇒ 6'</i>
Flow Area	31.21	ft <sup>2</sup>	
Wetted Perimeter	16.40	ft	
Top Width	6.00	ft	
Critical Depth	3.73	ft	
Critical Slope	0.00466	ft/ft	
Velocity	7.85	ft/s	
Velocity Head	0.96	ft	
Specific Energy	6.16	ft	
Froude Number	0.61		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.20	ft
Critical Depth	3.73	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00466	ft/ft

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## Worksheet for L1b- Madison St. Lateral

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Messages

Notes

1 - 6' x 6' CBC

## Worksheet for L1c- Jackson St. Lateral

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	USE 6' x 6' CBC

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	6.00	ft
Discharge	245.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.20	ft	⇒ 6'
Flow Area	31.21	ft <sup>2</sup>	
Wetted Perimeter	16.40	ft	
Top Width	6.00	ft	
Critical Depth	3.73	ft	
Critical Slope	0.00466	ft/ft	
Velocity	7.85	ft/s	
Velocity Head	0.96	ft	
Specific Energy	6.16	ft	
Froude Number	0.61		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.20	ft
Critical Depth	3.73	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00466	ft/ft

---

## Worksheet for L1c- Jackson St. Lateral

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Messages

Notes

1 - 6' x 6' CBC

## Worksheet for L1d- Harrison St. Lateral

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth                      *USE 6' x 6' CBC*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00200    ft/ft  
Bottom Width                                 6.00    ft  
Discharge                                     245.00    ft<sup>3</sup>/s

### Results

Normal Depth                                5.20    ft    *⇒ 6'*  
Flow Area                                    31.21    ft<sup>2</sup>  
Wetted Perimeter                            16.40    ft  
Top Width                                    6.00    ft  
Critical Depth                                3.73    ft  
Critical Slope                                0.00466    ft/ft  
Velocity                                      7.85    ft/s  
Velocity Head                                0.96    ft  
Specific Energy                              6.16    ft  
Froude Number                               0.61  
Flow Type                                    Subcritical

### GVF Input Data

Downstream Depth                            0.00    ft  
Length                                        0.00    ft  
Number Of Steps                              0

### GVF Output Data

Upstream Depth                              0.00    ft  
Profile Description  
Profile Headloss                              0.00    ft  
Downstream Velocity                            Infinity    ft/s  
Upstream Velocity                              Infinity    ft/s  
Normal Depth                                5.20    ft  
Critical Depth                                3.73    ft  
Channel Slope                                0.00200    ft/ft  
Critical Slope                                0.00466    ft/ft

---

## Worksheet for L1d- Harrison St. Lateral

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Messages

Notes

1 - 6' x 6' CBC

## Worksheet for S1d - I17 Frontage, Harrison St. to Lincoln

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth                      *USE 2-10' x 6' CBC*

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                              0.00200 ft/ft  
Bottom Width                              10.00 ft  
Discharge                              490.50 ft<sup>3</sup>/s                      *Total Flow = 981cfs*

### Results

Normal Depth                              5.16 ft                      *⇒ 6'*  
Flow Area                              51.56 ft<sup>2</sup>  
Wetted Perimeter                      20.31 ft  
Top Width                              10.00 ft  
Critical Depth                              4.21 ft  
Critical Slope                              0.00344 ft/ft  
Velocity                              9.51 ft/s  
Velocity Head                              1.41 ft  
Specific Energy                              6.56 ft  
Froude Number                              0.74  
Flow Type                              Subcritical

### GVF Input Data

Downstream Depth                      0.00 ft  
Length                              0.00 ft  
Number Of Steps                      0

### GVF Output Data

Upstream Depth                      0.00 ft  
Profile Description  
Profile Headloss                      0.00 ft  
Downstream Velocity                      Infinity ft/s  
Upstream Velocity                      Infinity ft/s  
Normal Depth                              5.16 ft  
Critical Depth                              4.21 ft  
Channel Slope                              0.00200 ft/ft  
Critical Slope                              0.00344 ft/ft

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## Worksheet for S1d - I17 Frontage, Harrison St. to Lincoln

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### Messages

Notes

Total flow 981 cfs

2-10'x6' CBC

19/43

## Worksheet for S1e - I17 Frontage, Lincoln St. to Buckeye Rd.

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	<i>USE 240' x 6' CBC</i>

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	548.50	ft <sup>3</sup> /s <i>Total Flow = 1097 cfs</i>

### Results

Normal Depth	5.61	ft	<i>⇒ 6'</i>
Flow Area	56.11	ft <sup>2</sup>	
Wetted Perimeter	21.22	ft	
Top Width	10.00	ft	
Critical Depth	4.54	ft	
Critical Slope	0.00352	ft/ft	
Velocity	9.77	ft/s	
Velocity Head	1.48	ft	
Specific Energy	7.10	ft	
Froude Number	0.73		
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.61	ft
Critical Depth	4.54	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00352	ft/ft

---

**Worksheet for S1e - I17 Frontage, Lincoln St. to Buckeye Rd.**

---

Messages

Notes

Total flow 1097 cfs

2-10'x6' CBC

21/43

## Worksheet for S1f - I17 Frontage, Buckeye Rd. to Basin

### Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	<i>USE 2-10'x7' CBC's</i>

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Bottom Width	10.00	ft
Discharge	606.50	ft <sup>3</sup> /s

*Total Flow = 1213 cfs*

### Results

Normal Depth	6.06	ft
Flow Area	60.60	ft <sup>2</sup>
Wetted Perimeter	22.12	ft
Top Width	10.00	ft
Critical Depth	4.85	ft
Critical Slope	0.00359	ft/ft
Velocity	10.01	ft/s
Velocity Head	1.56	ft
Specific Energy	7.62	ft
Froude Number	0.72	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.06	ft
Critical Depth	4.85	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00359	ft/ft

---

## Worksheet for S1f - I17 Frontage, Buckeye Rd. to Basin

---

### Messages

Notes

Total flow 1213 cfs

2-10'x7' CBC

## Worksheet for L3a - 18th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	3.47	ft
Diameter	3.47	ft
Discharge	54.00	ft <sup>3</sup> /s

### Results

Diameter	3.47	ft
Normal Depth	3.47	ft
Flow Area	9.48	ft <sup>2</sup>
Wetted Perimeter	10.91	ft
Top Width	0.00	ft
Critical Depth	2.30	ft
Percent Full	100.0	%
Critical Slope	0.00495	ft/ft
Velocity	5.70	ft/s
Velocity Head	0.50	ft
Specific Energy	3.98	ft
Froude Number	0.00	
Maximum Discharge	58.09	ft <sup>3</sup> /s
Discharge Full	54.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3a - 18th Ave

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.47	ft
Critical Depth	2.30	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00495	ft/ft

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## Worksheet for L3b - 17th Ave North

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	6.08	ft
Diameter	6.08	ft
Discharge	240.00	ft <sup>3</sup> /s

### Results

Diameter	6.08	ft
Normal Depth	6.08	ft
Flow Area	29.01	ft <sup>2</sup>
Wetted Perimeter	19.09	ft
Top Width	0.00	ft
Critical Depth	4.23	ft
Percent Full	100.0	%
Critical Slope	0.00435	ft/ft
Velocity	8.27	ft/s
Velocity Head	1.06	ft
Specific Energy	7.14	ft
Froude Number	0.00	
Maximum Discharge	258.17	ft <sup>3</sup> /s
Discharge Full	240.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3b - 17th Ave North

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.08	ft
Critical Depth	4.23	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00435	ft/ft

## Worksheet for L3c - 17th Ave South

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	6.08	ft
Diameter	6.08	ft
Discharge	240.00	ft <sup>3</sup> /s

### Results

Diameter	6.08	ft
Normal Depth	6.08	ft
Flow Area	29.01	ft <sup>2</sup>
Wetted Perimeter	19.09	ft
Top Width	0.00	ft
Critical Depth	4.23	ft
Percent Full	100.0	%
Critical Slope	0.00435	ft/ft
Velocity	8.27	ft/s
Velocity Head	1.06	ft
Specific Energy	7.14	ft
Froude Number	0.00	
Maximum Discharge	258.17	ft <sup>3</sup> /s
Discharge Full	240.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3c - 17th Ave South

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.08	ft
Critical Depth	4.23	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00435	ft/ft

## Worksheet for L3d - 8 laterals

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	3.61	ft
Diameter	3.61	ft
Discharge	60.00	ft <sup>3</sup> /s

### Results

Diameter	3.61	ft
Normal Depth	3.61	ft
Flow Area	10.26	ft <sup>2</sup>
Wetted Perimeter	11.35	ft
Top Width	0.00	ft
Critical Depth	2.41	ft
Percent Full	100.0	%
Critical Slope	0.00490	ft/ft
Velocity	5.85	ft/s
Velocity Head	0.53	ft
Specific Energy	4.15	ft
Froude Number	0.00	
Maximum Discharge	64.54	ft <sup>3</sup> /s
Discharge Full	60.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3d - 8 laterals

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.61	ft
Critical Depth	2.41	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00490	ft/ft

## Worksheet for S2 - 27th Ave, Basin to Salt River

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00150	ft/ft
Normal Depth	7.01	ft
Diameter	7.01	ft
Discharge	248.00	ft <sup>3</sup> /s

### Results

Diameter	7.01	ft
Normal Depth	7.01	ft
Flow Area	38.56	ft <sup>2</sup>
Wetted Perimeter	22.01	ft
Top Width	0.00	ft
Critical Depth	4.13	ft
Percent Full	100.0	%
Critical Slope	0.00352	ft/ft
Velocity	6.43	ft/s
Velocity Head	0.64	ft
Specific Energy	7.65	ft
Froude Number	0.00	
Maximum Discharge	266.79	ft <sup>3</sup> /s
Discharge Full	248.01	ft <sup>3</sup> /s
Slope Full	0.00150	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S2 - 27th Ave, Basin to Salt River

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.01	ft
Critical Depth	4.13	ft
Channel Slope	0.00150	ft/ft
Critical Slope	0.00352	ft/ft

## Worksheet for S3a - Pima St, 18th Ave to Basin

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00300 ft/ft
Normal Depth	8.75 ft
Diameter	8.75 ft
Discharge	634.00 ft <sup>3</sup> /s

### Results

Diameter	8.75 ft
Normal Depth	8.75 ft
Flow Area	60.10 ft <sup>2</sup>
Wetted Perimeter	27.48 ft
Top Width	0.00 ft
Critical Depth	6.28 ft
Percent Full	100.0 %
Critical Slope	0.00401 ft/ft
Velocity	10.55 ft/s
Velocity Head	1.73 ft
Specific Energy	10.48 ft
Froude Number	0.00
Maximum Discharge	682.00 ft <sup>3</sup> /s
Discharge Full	634.00 ft <sup>3</sup> /s
Slope Full	0.00300 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for S3a - Pima St, 18th Ave to Basin

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.75	ft
Critical Depth	6.28	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00401	ft/ft

## Worksheet for S3b - Pima St, 17th Ave to 18th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	8.20	ft
Diameter	8.20	ft
Discharge	534.00	ft <sup>3</sup> /s

### Results

Diameter	8.20	ft
Normal Depth	8.20	ft
Flow Area	52.84	ft <sup>2</sup>
Wetted Perimeter	25.77	ft
Top Width	0.00	ft
Critical Depth	5.85	ft
Percent Full	100.0	%
Critical Slope	0.00407	ft/ft
Velocity	10.11	ft/s
Velocity Head	1.59	ft
Specific Energy	9.79	ft
Froude Number	0.00	
Maximum Discharge	574.43	ft <sup>3</sup> /s
Discharge Full	534.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S3b - Pima St, 17th Ave to 18th Ave

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.20	ft
Critical Depth	5.85	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00407	ft/ft

## Worksheet for S5a - Durango St, 19th Ave to Basin

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	5.10	ft
Diameter	5.10	ft
Discharge	150.00	ft <sup>3</sup> /s

### Results

Diameter	5.10	ft
Normal Depth	5.10	ft
Flow Area	20.39	ft <sup>2</sup>
Wetted Perimeter	16.01	ft
Top Width	0.00	ft
Critical Depth	3.49	ft
Percent Full	100.0	%
Critical Slope	0.00452	ft/ft
Velocity	7.36	ft/s
Velocity Head	0.84	ft
Specific Energy	5.94	ft
Froude Number	0.00	
Maximum Discharge	161.36	ft <sup>3</sup> /s
Discharge Full	150.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S5a - Durango St, 19th Ave to Basin

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.10	ft
Critical Depth	3.49	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00452	ft/ft

## Worksheet for S5b - Durango St, 17th Ave to 19th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	3.61	ft
Diameter	3.61	ft
Discharge	60.00	ft <sup>3</sup> /s

### Results

Diameter	3.61	ft
Normal Depth	3.61	ft
Flow Area	10.26	ft <sup>2</sup>
Wetted Perimeter	11.35	ft
Top Width	0.00	ft
Critical Depth	2.41	ft
Percent Full	100.0	%
Critical Slope	0.00490	ft/ft
Velocity	5.85	ft/s
Velocity Head	0.53	ft
Specific Energy	4.15	ft
Froude Number	0.00	
Maximum Discharge	64.54	ft <sup>3</sup> /s
Discharge Full	60.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S5b - Durango St, 17th Ave to 19th Ave

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.61	ft
Critical Depth	2.41	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00490	ft/ft

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]
1048	0	1,136,339	26.09	0.0	0.0
1049	1	1,174,620	26.97	26.5	26.5
1050	1	1,213,466	27.86	27.4	53.9
1051	1	1,252,876	28.76	28.3	82.2
1052	1	1,292,852	29.68	29.2	111.5
1053	1	1,333,392	30.61	30.1	141.6
1054	1	1,374,497	31.55	31.1	172.7
1055	1	1,416,166	32.51	32.0	204.7
1056	1	1,458,401	33.48 ✓	33.0	237.7

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Purchase Land for Storage Basin (61 parcels)	LS	\$10,109,243.00	1	\$ 10,109,243.00
2	Relocation, Admin. Costs (20% of Purchase Price)	LS	\$2,021,848.60	1	\$ 2,021,848.60
3	Demolish and Remove Debris (1 structure/parcel)	EA	\$20,000.00	61	\$ 1,220,000.00
4	Drainage Excavation and Haul	CY	\$9.50	550000	\$ 5,225,000.00
5	Turf and Park Amenities	SF	\$3.00	1600000	\$ 4,800,000.00
6	SD Line 1a, Jefferson to Madison, 6' x 6' CBC	LF	\$1,268.22	300	\$ 380,464.92
7	SD Line 1b, Madison to Jackson, 10' x 6' CBC	LF	\$1,740.25	400	\$ 696,099.36
8	SD Line 1c, Jackson to Harrison, 10' x 8' CBC	LF	\$1,897.79	350	\$ 664,226.64
9	SD Line 1d, Harrison to Lincoln St, 2 - 10' x 6' CBCs	LF	\$2,920.99	1300	\$ 3,797,284.92
10	SD Line 1e, Lincoln St to Buckeye Rd, 2 - 10' x 6' CBCs	LF	\$2,920.99	1650	\$ 4,819,630.86
11	SD Line 1f, Buckeye Rd to Basin, 2 - 10' x 7' CBCs	LF	\$3,052.33	800	\$ 2,441,862.72
12	SD Line 1 Laterals, Jefferson - Harrison, 6' x 6' CBC	LF	\$1,268.22	2000	\$ 2,536,432.80
13	SD Line 1 Lateral, Lincoln St., 60" Pipe	LF	\$759.41	1500	\$ 1,139,113.80
14	SD Line 1 Lateral, Buckeye Rd., 60" Pipe	LF	\$759.41	1500	\$ 1,139,113.80
15	SD Line 3a, Pima Street, Basin to 19th Ave, 108" Pipe	LF	\$1,260.61	1500	\$ 1,890,919.80
16	SD Line 3a, Pima Street, 19th Ave to 17th Ave, 102" Pipe	LF	\$1,188.16	1200	\$ 1,425,790.08
17	SD Line 3 Lateral, 18th Ave, 42" Pipe	LF	\$578.17	1000	\$ 578,173.20
18	SD Line 3 Lateral, 17th Ave, 72" Pipe	LF	\$878.70	1700	\$ 1,493,785.92
19	SD Line 3 Lateral, 8 Laterals, 48" Pipes	LF	\$637.14	2000	\$ 1,274,275.20
20	SD Line 5a, Durango St, 19th Ave to Basin, 66" Pipe	LF	\$819.44	1400	\$ 1,147,219.92
21	SD Line 5b, Durango St, 17th Ave to 19th Ave, 48" Pipe	LF	\$637.14	1200	\$ 764,565.12
22	SD Line 6, Basin to Salt River, 84" Pipe	LF	\$997.19	9500	\$ 9,473,343.00
23	Utility Relocation	LM	\$500,000.00	5.5	\$ 2,750,000.00
Sub Total					\$ 61,788,393.66
<i>Contingencies (20%)</i>					\$ 12,357,678.73
<b>TOTAL</b>					<b>\$ 74,146,100.00</b>

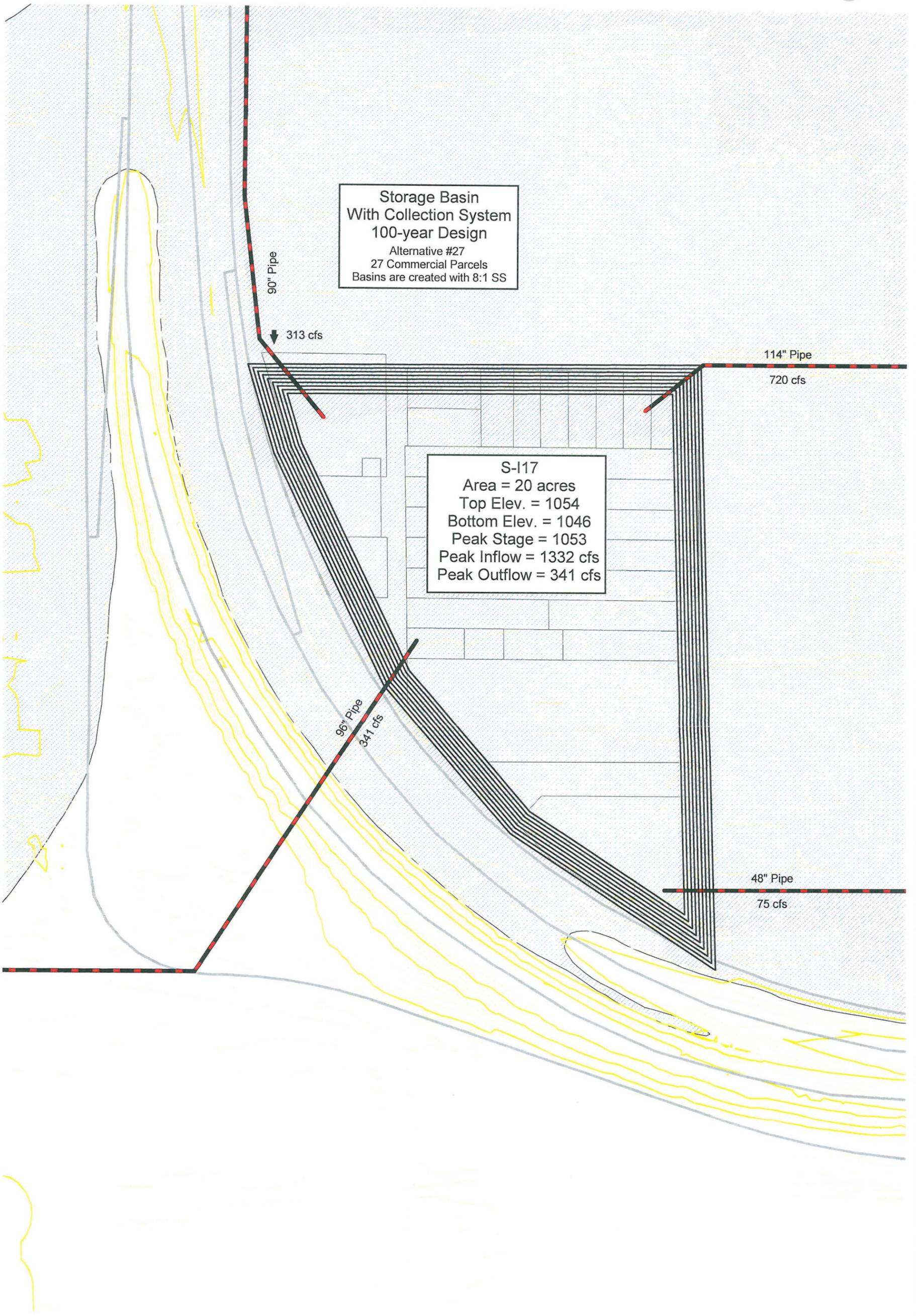
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# Alternative #28 - Multiple 100-Yr Storage Basins with Conveyance to Salt River

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Storage Basin Exhibits	2-3
Cross Sections	4
Hydraulic Calculations for Proposed Storm Drains	5-29
Storage Basin Calculations	30-31
Cost Estimate	32





Storage Basin  
With Collection System  
100-year Design  
Alternative #27  
27 Commercial Parcels  
Basins are created with 8:1 SS

S-I17  
Area = 20 acres  
Top Elev. = 1054  
Bottom Elev. = 1046  
Peak Stage = 1053  
Peak Inflow = 1332 cfs  
Peak Outflow = 341 cfs

Metro Phoenix ADMP - Level II Analysis

Durango Curve  
Alternative #28  
Durango Curve Basin

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Proposed Contour
- Parcel Boundary
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway

N  
Scale: 1" = 200'  
C.I. = 10'



Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

Storage Basin  
With Collection System  
100-year Design  
Alternative #27  
186 Commercial Parcels  
Basins are created with 8:1 SS

S80q  
Area = 28 acres  
Top Elev. = 1068  
Bottom Elev. = 1063  
Peak Stage = 1067  
Peak Inflow = 1345 cfs  
Peak Outflow = 162 cfs

72" Pipe  
162 cfs

Metro Phoenix ADMP - Level II Analysis

Durango Curve  
Alternative #28  
Railroad Basin

-  Study Area Boundary
-  Major Streets
-  Interstate / Highway
-  Local Roads
-  Railroad
-  Proposed Contour
-  Parcel Boundary
-  FEMA Flood Hazard Boundaries
-  Floodplain
-  Floodway

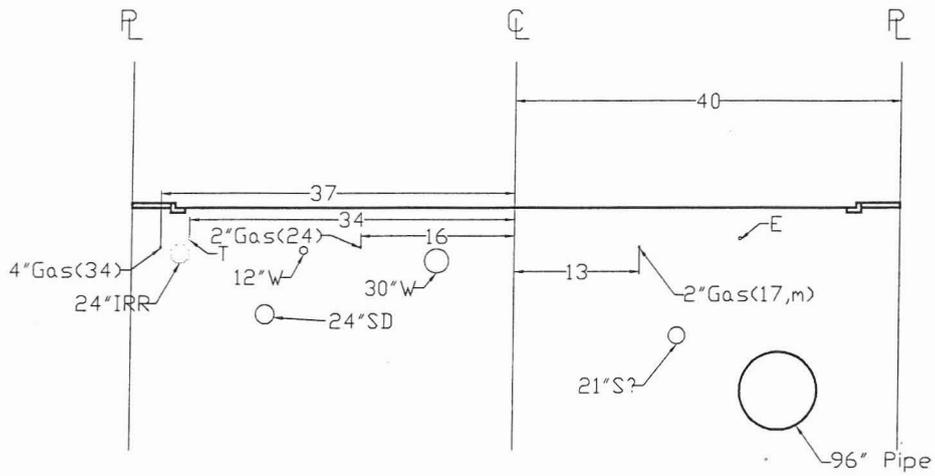


Scale: 1" = 200'  
C.I. = 10'



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3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012

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Durango - I-17 to 27th Ave  
 Proposed 96" Pipe  
 Alternative #28

80' ROW

N:\305008\ALT 26-32 - ST CTIONS.DWG, 8/14/2007 3:15:36 PM, Nphxsvr01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT        OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX        AREA DRAINAGE MASTER PLAN        FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
	DESIGNED	CTG	03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
		<small>Engineering and Environmental Consultants, Inc.        3003 N. Central Avenue, Suite 600        Phoenix, Arizona 85012-2905        TEL:(602)248-7702 FAX:(602)248-7851</small>	
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF <b>4/32</b>

## Worksheet for L1a - Lincoln St.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00300 ft/ft
Normal Depth	3.95 ft
Diameter	3.95 ft
Discharge	76.00 ft <sup>3</sup> /s

### Results

Diameter	3.95 ft
Normal Depth	3.95 ft
Flow Area	12.24 ft <sup>2</sup>
Wetted Perimeter	12.40 ft
Top Width	0.00 ft
Critical Depth	2.65 ft
Percent Full	100.0 %
Critical Slope	0.00480 ft/ft
Velocity	6.21 ft/s
Velocity Head	0.60 ft
Specific Energy	4.55 ft
Froude Number	0.00
Maximum Discharge	81.75 ft <sup>3</sup> /s
Discharge Full	76.00 ft <sup>3</sup> /s
Slope Full	0.00300 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for L1a - Lincoln St.

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.95	ft
Critical Depth	2.65	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00480	ft/ft

### Messages

Notes                      Each Lateral picks up 39 cfs  
  
                                 Lincoln, Grant, Hadley, Tonto and  
                                 Maricopa Streets

## Worksheet for L1b - Buckeye Rd

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	3.93	ft
Diameter	3.93	ft
Discharge	75.00	ft <sup>3</sup> /s

### Results

Diameter	3.93	ft
Normal Depth	3.93	ft
Flow Area	12.12	ft <sup>2</sup>
Wetted Perimeter	12.34	ft
Top Width	0.00	ft
Critical Depth	2.63	ft
Percent Full	100.0	%
Critical Slope	0.00480	ft/ft
Velocity	6.19	ft/s
Velocity Head	0.59	ft
Specific Energy	4.52	ft
Froude Number	0.00	
Maximum Discharge	80.68	ft <sup>3</sup> /s
Discharge Full	75.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L1b - Buckeye Rd

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.93	ft
Critical Depth	2.63	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00480	ft/ft

### Messages

Notes                      Each Lateral picks up 39 cfs  
  
                                 Lincoln, Grant, Hadley, Tonto and  
                                 Maricopa Streets

## Worksheet for L3a - 17th Ave (North of Pima St.)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	6.58	ft
Diameter	6.58	ft
Discharge	297.00	ft <sup>3</sup> /s

### Results

Diameter	6.58	ft
Normal Depth	6.58	ft
Flow Area	34.03	ft <sup>2</sup>
Wetted Perimeter	20.68	ft
Top Width	0.00	ft
Critical Depth	4.61	ft
Percent Full	100.0	%
Critical Slope	0.00427	ft/ft
Velocity	8.73	ft/s
Velocity Head	1.18	ft
Specific Energy	7.77	ft
Froude Number	0.00	
Maximum Discharge	319.48	ft <sup>3</sup> /s
Discharge Full	297.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3a - 17th Ave (North of Pima St.)

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.58	ft
Critical Depth	4.61	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00427	ft/ft

## Worksheet for L3b - 17th Ave (South of Pima St.)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	6.58	ft
Diameter	6.58	ft
Discharge	297.00	ft <sup>3</sup> /s

### Results

Diameter	6.58	ft
Normal Depth	6.58	ft
Flow Area	34.03	ft <sup>2</sup>
Wetted Perimeter	20.68	ft
Top Width	0.00	ft
Critical Depth	4.61	ft
Percent Full	100.0	%
Critical Slope	0.00427	ft/ft
Velocity	8.73	ft/s
Velocity Head	1.18	ft
Specific Energy	7.77	ft
Froude Number	0.00	
Maximum Discharge	319.48	ft <sup>3</sup> /s
Discharge Full	297.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3b - 17th Ave (South of Pima St.)

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.58	ft
Critical Depth	4.61	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00427	ft/ft

## Worksheet for L3C - 17th Ave branches

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	3.91	ft
Diameter	3.91	ft
Discharge	74.00	ft <sup>3</sup> /s

### Results

Diameter	3.91	ft
Normal Depth	3.91	ft
Flow Area	12.00	ft <sup>2</sup>
Wetted Perimeter	12.28	ft
Top Width	0.00	ft
Critical Depth	2.62	ft
Percent Full	100.0	%
Critical Slope	0.00481	ft/ft
Velocity	6.17	ft/s
Velocity Head	0.59	ft
Specific Energy	4.50	ft
Froude Number	0.00	
Maximum Discharge	79.60	ft <sup>3</sup> /s
Discharge Full	74.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3C - 17th Ave branches

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.91	ft
Critical Depth	2.62	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00481	ft/ft

## Worksheet for L3D - 20th Ave (North of Pima St.)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	4.77	ft
Diameter	4.77	ft
Discharge	126.00	ft <sup>3</sup> /s

### Results

Diameter	4.77	ft
Normal Depth	4.77	ft
Flow Area	17.89	ft <sup>2</sup>
Wetted Perimeter	14.99	ft
Top Width	0.00	ft
Critical Depth	3.25	ft
Percent Full	100.0	%
Critical Slope	0.00459	ft/ft
Velocity	7.04	ft/s
Velocity Head	0.77	ft
Specific Energy	5.54	ft
Froude Number	0.00	
Maximum Discharge	135.54	ft <sup>3</sup> /s
Discharge Full	126.00	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L3D - 20th Ave (North of Pima St.)

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.77	ft
Critical Depth	3.25	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00459	ft/ft

## Worksheet for S1a - I17 Frontage - Harrison St. to Lincoln St.

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	5.66	ft
Diameter	5.66	ft
Discharge	162.00	ft <sup>3</sup> /s

### Results

Diameter	5.66	ft
Normal Depth	5.66	ft
Flow Area	25.15	ft <sup>2</sup>
Wetted Perimeter	17.78	ft
Top Width	0.00	ft
Critical Depth	3.53	ft
Percent Full	100.0	%
Critical Slope	0.00395	ft/ft
Velocity	6.44	ft/s
Velocity Head	0.64	ft
Specific Energy	6.30	ft
Froude Number	0.00	
Maximum Discharge	174.28	ft <sup>3</sup> /s
Discharge Full	162.02	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S1a - I17 Frontage - Harrison St. to Lincoln St.

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.66	ft
Critical Depth	3.53	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00395	ft/ft

## Worksheet for S1b - I17 Frontage - Lincoln St. to Buckeye Rd

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	6.54	ft
Diameter	6.54	ft
Discharge	238.00	ft <sup>3</sup> /s

### Results

Diameter	6.54	ft
Normal Depth	6.54	ft
Flow Area	33.56	ft <sup>2</sup>
Wetted Perimeter	20.54	ft
Top Width	0.00	ft
Critical Depth	4.12	ft
Percent Full	100.0	%
Critical Slope	0.00381	ft/ft
Velocity	7.09	ft/s
Velocity Head	0.78	ft
Specific Energy	7.32	ft
Froude Number	0.00	
Maximum Discharge	256.02	ft <sup>3</sup> /s
Discharge Full	238.00	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S1b - I17 Frontage - Lincoln St. to Buckeye Rd

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.54	ft
Critical Depth	4.12	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00381	ft/ft

## Worksheet for S1c - I17 Frontage - Buckeye Rd to Basin 2

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	7.24	ft
Diameter	7.24	ft
Discharge	313.00	ft <sup>3</sup> /s

### Results

Diameter	7.24	ft
Normal Depth	7.24	ft
Flow Area	41.21	ft <sup>2</sup>
Wetted Perimeter	22.76	ft
Top Width	0.00	ft
Critical Depth	4.61	ft
Percent Full	100.0	%
Critical Slope	0.00371	ft/ft
Velocity	7.59	ft/s
Velocity Head	0.90	ft
Specific Energy	8.14	ft
Froude Number	0.00	
Maximum Discharge	336.70	ft <sup>3</sup> /s
Discharge Full	313.00	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S1c - I17 Frontage - Buckeye Rd to Basin 2

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.24	ft
Critical Depth	4.61	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.00371	ft/ft

## Worksheet for S2 - Durango St. - 19th Ave to 22nd Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	4.07	ft
Diameter	4.07	ft
Discharge	75.00	ft <sup>3</sup> /s

### Results

Diameter	4.07	ft
Normal Depth	4.07	ft
Flow Area	12.98	ft <sup>2</sup>
Wetted Perimeter	12.77	ft
Top Width	0.00	ft
Critical Depth	2.61	ft
Percent Full	100.0	%
Critical Slope	0.00453	ft/ft
Velocity	5.78	ft/s
Velocity Head	0.52	ft
Specific Energy	4.58	ft
Froude Number	0.00	
Maximum Discharge	80.68	ft <sup>3</sup> /s
Discharge Full	75.00	ft <sup>3</sup> /s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

**Worksheet for S2 - Durango St. - 19th Ave to 22nd Ave**

---

**GVF Output Data**

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.07	ft
Critical Depth	2.61	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00453	ft/ft

## Worksheet for S3a - Pima St. - 20th Ave to 21st Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00250 ft/ft
Normal Depth	9.49 ft
Diameter	9.49 ft
Discharge	720.00 ft <sup>3</sup> /s

### Results

Diameter	9.49 ft
Normal Depth	9.49 ft
Flow Area	70.80 ft <sup>2</sup>
Wetted Perimeter	29.83 ft
Top Width	0.00 ft
Critical Depth	6.55 ft
Percent Full	100.0 %
Critical Slope	0.00370 ft/ft
Velocity	10.17 ft/s
Velocity Head	1.61 ft
Specific Energy	11.10 ft
Froude Number	0.00
Maximum Discharge	774.51 ft <sup>3</sup> /s
Discharge Full	720.00 ft <sup>3</sup> /s
Slope Full	0.00250 ft/ft
Flow Type	SubCritical

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	100.00 %

---

## Worksheet for S3a - Pima St. - 20th Ave to 21st Ave

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	9.49	ft
Critical Depth	6.55	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00370	ft/ft

## Worksheet for S3b - Pima St. - 17th Ave to 20th Ave

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	8.83	ft
Diameter	8.83	ft
Discharge	594.00	ft <sup>3</sup> /s

### Results

Diameter	8.83	ft
Normal Depth	8.83	ft
Flow Area	61.29	ft <sup>2</sup>
Wetted Perimeter	27.75	ft
Top Width	0.00	ft
Critical Depth	6.06	ft
Percent Full	100.0	%
Critical Slope	0.00377	ft/ft
Velocity	9.69	ft/s
Velocity Head	1.46	ft
Specific Energy	10.29	ft
Froude Number	0.00	
Maximum Discharge	638.97	ft <sup>3</sup> /s
Discharge Full	594.00	ft <sup>3</sup> /s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

**Worksheet for S3b - Pima St. - 17th Ave to 20th Ave**

---

GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.83	ft
Critical Depth	6.06	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00377	ft/ft

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## Worksheet for S1d - Basin 2 to Salt River

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00150	ft/ft
Normal Depth	7.90	ft
Diameter	7.90	ft
Discharge	341.00	ft <sup>3</sup> /s

### Results

Diameter	7.90	ft
Normal Depth	7.90	ft
Flow Area	48.96	ft <sup>2</sup>
Wetted Perimeter	24.80	ft
Top Width	0.00	ft
Critical Depth	4.70	ft
Percent Full	100.0	%
Critical Slope	0.00341	ft/ft
Velocity	6.97	ft/s
Velocity Head	0.75	ft
Specific Energy	8.65	ft
Froude Number	0.00	
Maximum Discharge	366.83	ft <sup>3</sup> /s
Discharge Full	341.01	ft <sup>3</sup> /s
Slope Full	0.00150	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for S1d - Basin 2 to Salt River

---

### GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.90	ft
Critical Depth	4.70	ft
Channel Slope	0.00150	ft/ft
Critical Slope	0.00341	ft/ft

#28 - Lower Retention Basin

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	Depth [ft]	Area [ft <sup>2</sup> ]	Area [acres]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]
1046	0	554,863	12.74	0.0	0.00
1047	1	588,485	13.51	13.1	13.12
1048	1	615,823	14.14	13.8	26.94
1049	1	643,750	14.78	14.5	41.40
1050	1	672,263	15.43	15.1	56.51
1051	1	701,366	16.10	15.8	72.27
1052	1	731,054	16.78	16.4	88.71
1053	1	761,332	17.48	17.1	105.84
1054	1	792,197	18.19	17.8	123.67
1055	1	823,649	18.91	18.5	142.22
1056	1	855,689	19.64	19.3	161.49

#28 - Upper Retention Basin

Metro Phoenix ADMP  
EEC Job No. 305008

Local Detention Basin Volume

$$V_{\text{provided}} = D/3 \times [A_{\text{top}} + A_{\text{bottom}} + \text{sqrt}(A_{\text{top}} \times A_{\text{bottom}})]$$

Contour Elevation	length [ft]	width [ft]	area [ft <sup>2</sup> ]	area [acres]	depth [ft]	Volume Provided [acre-ft]	Accumulative Volume [acre-ft]
1063	1000	1000	1,000,000	23.0	0	0.0	0.0
1064	1020	1020	1,040,400	23.9	1	23.4	23.4
1065	1040	1040	1,081,600	24.8	1	24.4	47.8
1066	1060	1060	1,123,600	25.8	1	25.3	73.1
1067	1080	1080	1,166,400	26.8	1	26.3	99.4
1068	1100	1100	1,210,000	27.8	1	27.3	126.7

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Purchase Land for Upper Basin	LS	\$14,179,558.00	1	\$ 14,179,558.00
2	Relocation, Admin. Costs (20% of Purchase Price)	LS	\$2,835,911.60	1	\$ 2,835,911.60
3	Demolish Existing Structures and Remove Debris	EA	\$20,000.00	117	\$ 2,340,000.00
4	Drainage Excavation and Haul for Upper Basin	CY	\$9.50	205,000	\$ 1,947,500.00
5	Turf and Park Amenities for Upper Basin	ACRES	\$150,000.00	28	\$ 4,200,000.00
6	Purchase Land for Lower Basin	LS	\$4,544,281.00	1	\$ 4,544,281.00
7	Relocation, Admin. Costs (20% of Purchase Price)	LS	\$908,856.20	1	\$ 908,856.20
8	Demolish Existing Structures and Remove Debris	EA	\$20,000.00	27	\$ 540,000.00
9	Drainage Excavation and Haul for Lower Basin	CY	\$9.50	260,600	\$ 2,475,700.00
10	Turf and Park Amenities for Lower Basin	ACRES	\$150,000.00	20	\$ 3,000,000.00
11	SD Line 1a, Basin 1 to Lincoln St., 72" Pipe	LF	\$878.70	1,250	\$ 1,098,372.00
12	SD Line 1b, Lincoln St. to Buckeye Rd., 78" Pipe	LF	\$937.95	1,650	\$ 1,547,621.46
13	SD Line 1c, Buckeye Rd to Basin 2, 90" Pipe	LF	\$1,056.45	2,000	\$ 2,112,897.60
14	SD Line 1 Lateral, Lincoln St, 48" Pipe	LF	\$637.14	3,100	\$ 1,975,126.56
15	SD Line 1 Lateral, Buckeye Rd, 48" Pipe	LF	\$637.14	3,000	\$ 1,911,412.80
16	SD Line 3a, Pima St - 21st Ave to Basin, 114" Pipe	LF	\$1,333.21	750	\$ 999,909.90
17	SD Line 3b, Pima St - 17th Ave to 21st Ave, 108" Pipe	LF	\$1,260.61	1,950	\$ 2,458,195.74
18	SD Line 3 Lateral, 21st Ave, 60" Pipe	LF	\$759.41	900	\$ 683,468.28
19	SD Line 3 Lateral, 17th Ave (North), 78" Pipe	LF	\$937.95	1,200	\$ 1,125,542.88
20	SD Line 3 Lateral, 17th Ave (South), 78" Pipe	LF	\$937.95	1,000	\$ 937,952.40
21	SD Line 3 Lateral, 7 laterals, 48" Pipe	LF	\$637.14	2,100	\$ 1,337,988.96
22	SD Line 5, Durango St, 48" Pipe	LF	\$637.14	1,250	\$ 796,422.00
23	SD Line 6, Basin 2 to Salt River, 96" Pipe	LF	\$1,115.70	9,500	\$ 10,599,184.20
24	Utility Relocation	LM	\$500,000.00	5.6	\$ 2,800,000.00
	Sub Total				\$ 67,355,901.58
	Contingencies (20%)				\$ 13,471,180.32
	<b>TOTAL</b>				<b>\$ 80,827,100.00</b>

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**Alternative #29 - New 10-year Storm Drain in Thomas Road,  
Old Cross Cut Canal to 62nd St.**

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<b>Plan View Exhibit</b>	<b>1</b>
<b>Cross Sections</b>	<b>2</b>
<b>Hydraulic Calculations for Proposed Storm Drains</b>	<b>3-5</b>
<b>Cost Estimate</b>	<b>6</b>

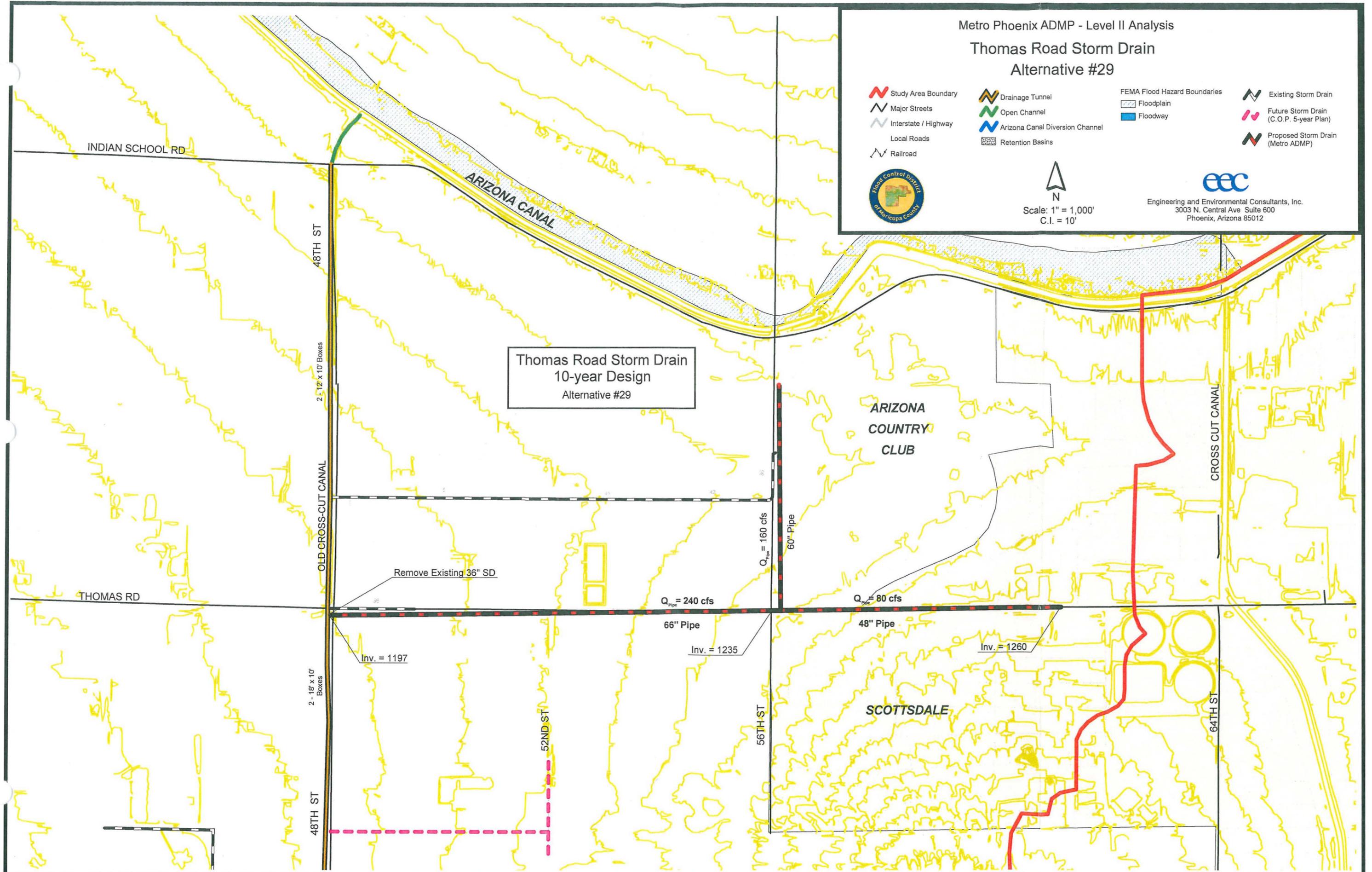
### Thomas Road Storm Drain Alternative #29

- Study Area Boundary
- Major Streets
- Interstate / Highway
- Local Roads
- Railroad
- Drainage Tunnel
- Open Channel
- Arizona Canal Diversion Channel
- Retention Basins
- FEMA Flood Hazard Boundaries
- Floodplain
- Floodway
- Existing Storm Drain
- Future Storm Drain (C.O.P. 5-year Plan)
- Proposed Storm Drain (Metro ADMP)



N  
Scale: 1" = 1,000'  
C.I. = 10'

**eec**  
Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



Thomas Road Storm Drain  
10-year Design  
Alternative #29

48TH ST  
2 - 12' x 10' Boxes  
OLD CROSS-CUT CANAL  
2 - 18' x 10' Boxes  
48TH ST

52ND ST

56TH ST

CROSS CUT CANAL  
64TH ST

Remove Existing 36" SD

Inv. = 1197

$Q_{Pipe} = 240$  cfs

66" Pipe

Inv. = 1235

$Q_{Pipe} = 160$  cfs

60" Pipe

$Q_{Pipe} = 80$  cfs

48" Pipe

Inv. = 1260

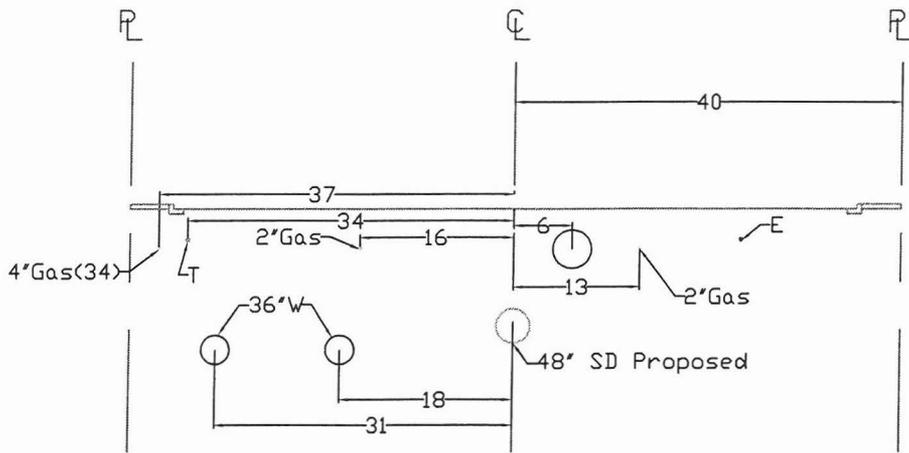
INDIAN SCHOOL RD

THOMAS RD

ARIZONA CANAL

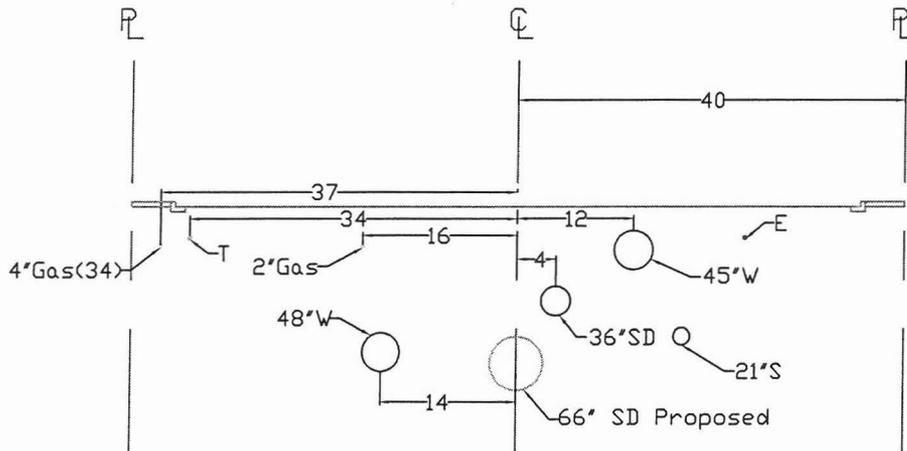
ARIZONA  
COUNTRY  
CLUB

SCOTTSDALE



Thomas - 60th St to 56th St  
Proposed 48" Storm Drain  
Alternative #29

80' ROW



Thomas - 56th St to Old Cross Cut Canal  
Proposed 66" Storm Drain  
Alternative #29

80' ROW

 FLOOD CONTROL DISTRICT OF MARICOPA COUNTY			
METRO PHOENIX AREA DRAINAGE MASTER PLAN FCD CONTRACT NO. FCD 2004C040			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	DATE 03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
	 Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85017-2905 TEL: (602) 248-7702 FAX: (602) 248-7851		
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF 2/6

## Worksheet for S1 - Thomas Rd - 60th to 56th

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Normal Depth	3.66	ft
Diameter	3.66	ft
Discharge	80.00	ft <sup>3</sup> /s

### Results

Diameter	3.66	ft
Normal Depth	3.66	ft
Flow Area	10.51	ft <sup>2</sup>
Wetted Perimeter	11.49	ft
Top Width	0.00	ft
Critical Depth	2.77	ft
Percent Full	100.0	%
Critical Slope	0.00587	ft/ft
Velocity	7.61	ft/s
Velocity Head	0.90	ft
Specific Energy	4.56	ft
Froude Number	0.00	
Maximum Discharge	86.06	ft <sup>3</sup> /s
Discharge Full	80.00	ft <sup>3</sup> /s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for S2 - Thomas Rd - 56th to 48th

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00800	ft/ft
Normal Depth	5.06	ft
Diameter	5.06	ft
Discharge	240.00	ft <sup>3</sup> /s

### Results

Diameter	5.06	ft
Normal Depth	5.06	ft
Flow Area	20.08	ft <sup>2</sup>
Wetted Perimeter	15.88	ft
Top Width	0.00	ft
Critical Depth	4.36	ft
Percent Full	100.0	%
Critical Slope	0.00738	ft/ft
Velocity	11.95	ft/s
Velocity Head	2.22	ft
Specific Energy	7.28	ft
Froude Number	0.00	
Maximum Discharge	258.17	ft <sup>3</sup> /s
Discharge Full	240.00	ft <sup>3</sup> /s
Slope Full	0.00800	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

---

## Worksheet for L1 - 56th St - Osborn Rd to Thomas Rd

---

### Project Description

Friction Method	Manning Formula
Solve For	Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00200	ft/ft
Normal Depth	5.63	ft
Diameter	5.63	ft
Discharge	160.00	ft <sup>3</sup> /s

### Results

Diameter	5.63	ft
Normal Depth	5.63	ft
Flow Area	24.92	ft <sup>2</sup>
Wetted Perimeter	17.70	ft
Top Width	0.00	ft
Critical Depth	3.51	ft
Percent Full	100.0	%
Critical Slope	0.00396	ft/ft
Velocity	6.42	ft/s
Velocity Head	0.64	ft
Specific Energy	6.27	ft
Froude Number	0.00	
Maximum Discharge	172.13	ft <sup>3</sup> /s
Discharge Full	160.02	ft <sup>3</sup> /s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

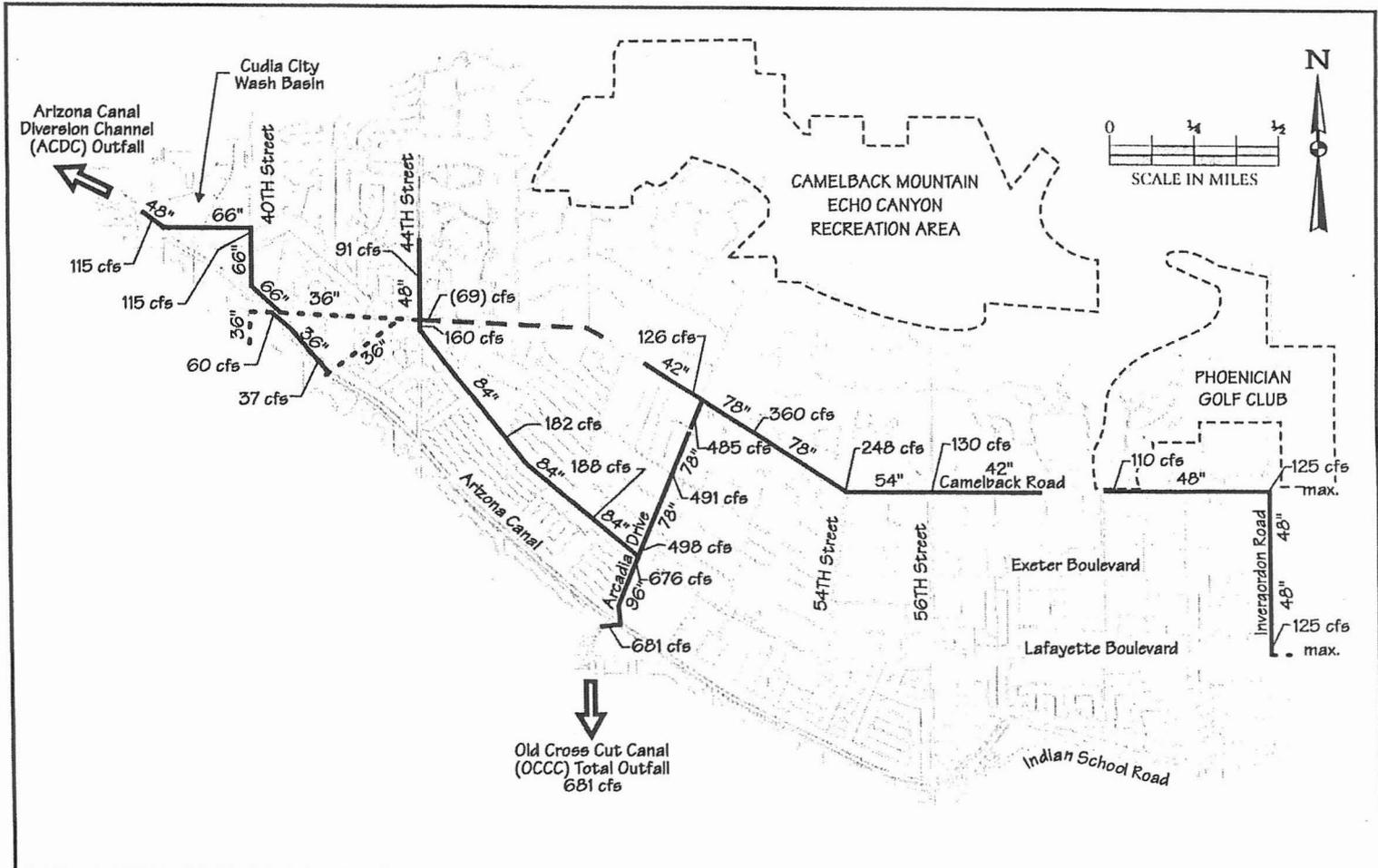
Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" SD in Thomas Rd., 61st St. to 56th St.	LF	\$637.14	3380	\$ 2,153,525.09
2	66" SD in Thomas Rd., 56th St. to 48th St.	LF	\$819.44	5280	\$ 4,326,657.98
3	60" SD in 56th St., Osborn Rd. to Thomas Rd.	LF	\$759.41	2750	\$ 2,088,375.30
4	Utility Relocation (Remove 1000' of Existing 36" SD)	LM	\$50,000.00	2.4	\$ 120,000.00
Sub Total					\$ 8,688,558.37
<i>Contingencies (20%)</i>					\$ 1,737,711.67
<b>TOTAL</b>					<b>\$ 10,426,300.00</b>

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**Alternative #30 - 10-year Camelback Road Collection System  
(Huitt-Zollars Alternate 2)**

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<b>Plan View Exhibit</b>	<b>1</b>
<b>Cost Estimate</b>	<b>2</b>



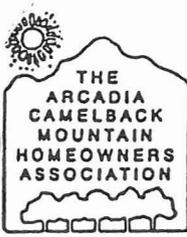
FEATURES	LEGEND	ARCADIA AREA DRAINAGE PROJECT FCD 94-21	
10-Year Camelback Road Alternate	681 10-Year Flows (69) 2-Year Flows — FCDMC 10-Year S.D. - - - C.O.P. 2-Year S.D. ····· Existing S.D.	<b>CAMELBACK ROAD ALTERNATE</b>	
		ALTERNATE 2	FIGURE IV-3

1/2

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" Pipe, CCWSB East to 40th Street	LF	\$637.14	1160	\$ 739,079.62
2	66" Pipe, CCWSB East to 40th Street	LF	\$819.44	670	\$ 549,026.68
3	66" Pipe, 40th Street South to Canal	LF	\$819.44	1025	\$ 839,928.87
4	66" Pipe, Canal - 40th Street to Camelback	LF	\$819.44	561	\$ 459,707.41
5	66" Pipe, Camelback - Canal East to Existing Pipe	LF	\$819.44	295	\$ 241,735.63
6	36" Pipe, Camelback - Castille Condos to Existing Pipe	LF	\$506.89	1300	\$ 658,961.16
7	78" Pipe, Arcadia - OCCC to Camelback	LF	\$937.95	2659	\$ 2,494,015.43
8	96" Pipe, Arcadia - OCCC to Camelback	LF	\$1,115.70	1366	\$ 1,524,051.12
9	78" Pipe, Camelback - Arcadia to 56th Street East to End	LF	\$937.95	1897	\$ 1,779,295.70
10	72" Pipe, Camelback - Arcadia to 56th Street East to End	LF	\$878.70	796	\$ 699,443.29
11	54" Pipe, Camelback - Arcadia to 56th Street East to End	LF	\$698.29	1323	\$ 923,841.90
12	36" Pipe, Camelback - Arcadia to 56th Street East to End	LF	\$506.89	1725	\$ 874,390.77
13	42" Pipe, Camelback - Arcadia West to End	LF	\$578.17	692	\$ 400,095.85
14	78" Pipe, Lafayette - 44th Street to Arcadia	LF	\$937.95	5013	\$ 4,701,955.38
15	48" Pipe, 44th Street - Lafayette North to End	LF	\$637.14	1157	\$ 737,168.20
16	48" Pipe, Invergordon - Lafayette to Camelback	LF	\$637.14	2552	\$ 1,625,975.16
17	48" Pipe, Camelback - Invergordon West to the End	LF	\$637.14	2632	\$ 1,676,946.16
	Sub Total				\$ 20,925,618.33
	Contingencies (20%)				\$ 4,185,123.67
	<b>TOTAL</b>				<b>\$ 25,110,700.00</b>

Pipe quantities are taken from Huitt-Zollars Report

Exhibit "C"



Arcadia/Camelback Mountain Homeowners Association  
4730 E. Indian School Road, Suite 120 • Phoenix, Arizona 85018

October 10, 1996

Richard M. Spiegel  
President  
Paul Barnes  
Vice-President  
John Warner  
Treasurer  
Margaret Steblay  
Responding Secretary  
Clyde Lewis  
Secretary  
Board of Directors  
John Applewhite  
Blackberry  
Bonadio  
Graham Cookson  
Dodge  
Geyer  
Jarvis  
Montgomery  
Ogden  
Phalen  
Reinstein  
Salzmann  
Strauss  
Traaen  
Van Sickle  
Presidents  
Dodge  
Phalen  
Smith  
Steenblik

Perry Baker  
Flood Control District  
Maricopa County  
2801 W. Durango  
Phoenix, AZ 85009

Dear Mr. Baker,

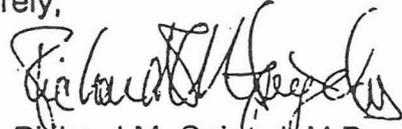
Thank-you for attending our Board meeting last week, and for the presentation by you and the Flood Control staff concerning the alternatives proposed to alleviate the drainage problems in the Arcadia area. As you are well aware, our association has been eager, for some time, to find a way to eliminate the existing 100 year floodplain on the north side of the Arizona Canal.

The Board of Directors emphatically feels, however, that alternatives 4 and 5 to accomplish this are not only prohibitively expensive, but represent a cure worse than the ill. We urge any consideration of these measures to be abandoned completely.

The Board, on the other hand, feels that alternative #2, concerning a storm drain system primarily along Camelback and Lafayette, represents a reasonable and appropriate response to the more regular drainage problems, and strongly endorses this alternative. Alternative #1 is an inadequate answer to the situation, and alternative #3 not only seems less efficiently designed, but also much more disruptive of the community, particularly in view of the City of Phoenix's plans to redo Camelback Road in the near future.

We look forward for your advice on how we can best get the funds to implement alternative #2 prioritized by our City and County, and, also, how we can get the floodplain reevaluated once the drains are emplaced, to potentially deminish, at least, its area.

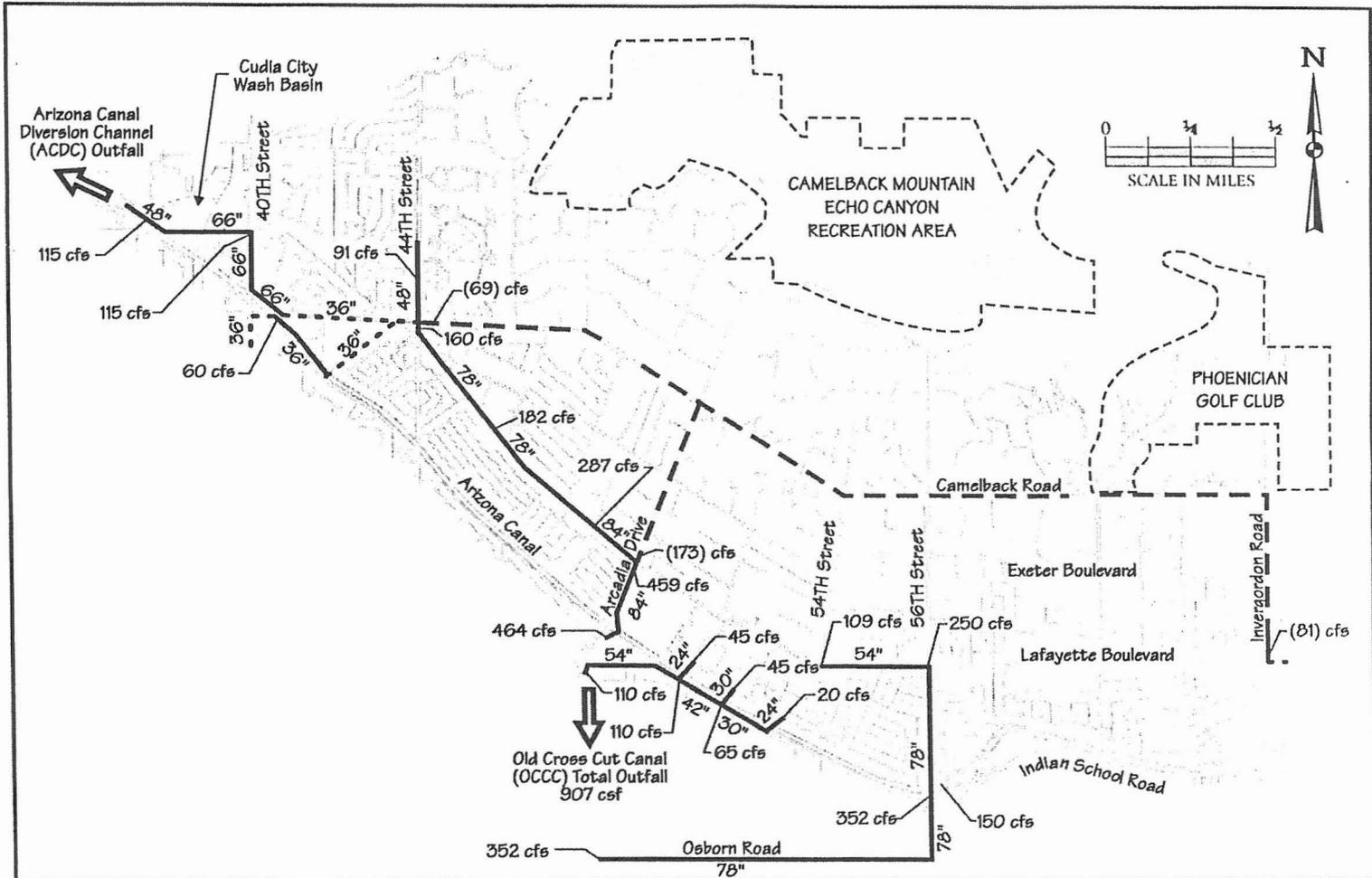
Sincerely,

  
Richard M. Spiegel, M.D.  
President  
Arcadia/Camelback Mtn. H.A.

**Alternative #31 - 10-year Lafayette Interceptor System (Huitt-Zollars Alternate 3)**

**Table of Contents**

	<u>Page</u>
<b>Plan View Exhibit</b>	<b>1</b>
<b>Cost Estimate</b>	<b>2</b>



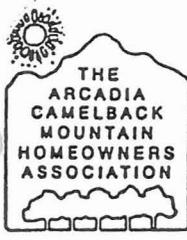
FEATURES	LEGEND	ARCADIA AREA DRAINAGE PROJECT FCD 94-21	
10-Year LaFayette Interceptor Drain System	91 10-Year Flows (173) 2-Year Flows — FCDMC 10-Year S.D. - - - COP 2-Year S.D. ····· Existing S.D.	L.I.D. ALTERNATE	
		ALTERNATE 3	FIGURE IV-4

1/2

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	48" Pipe, CCSWB East to 40th Street	LF	\$637.14	1160	\$ 739,079.62
2	66" Pipe, CCWSB East to 40th Street	LF	\$819.44	670	\$ 549,026.68
3	66" Pipe, 40th Street South to Canal	LF	\$819.44	1025	\$ 839,928.87
4	66" Pipe, Canal - 40th Street to Camelback	LF	\$819.44	561	\$ 459,707.41
5	66" Pipe, Camelback - Canal East to Existing Pipe	LF	\$819.44	295	\$ 241,735.63
6	36" Pipe, Camelback - Castille Condo to Existing Pipe	LF	\$506.89	1300	\$ 658,961.16
7	84" Pipe, Arcadia - Canal to Lafayette	LF	\$997.19	1365	\$ 1,361,169.81
8	84" Pipe Siphon	EA	\$200,000.00	1	\$ 200,000.00
9	84" Pipe, Lafayette - Arcadia to 44th Street	LF	\$997.19	1320	\$ 1,316,296.08
10	78" Pipe, Lafayette - Arcadia to 44th Street	LF	\$937.95	3963	\$ 3,717,105.36
11	48" Pipe, 44th Street - Lafayette North to End	LF	\$637.14	1157	\$ 737,168.20
12	54" Pipe, Indian School Road - OCCC East to End	LF	\$698.29	1320	\$ 921,747.02
13	42" Pipe, Indian School Road - OCCC East to End	LF	\$578.17	772	\$ 446,349.71
14	30" Pipe, Indian School Road - OCCC East to End	LF	\$448.81	1299	\$ 583,008.35
15	24" Pipe, Indian School Road - OCCC East to End	LF	\$448.81	650	\$ 291,728.58
16	78" Pipe, Osborn Road - OCCC to 56th Street	LF	\$937.95	5277	\$ 4,949,574.81
17	78" Pipe, 56th Street - Osborn Road to Lafayette	LF	\$937.95	2596	\$ 2,434,924.43
18	48" Pipe, 56th Street - Osborn Road to Lafayette	LF	\$637.14	80	\$ 50,971.01
19	54" Pipe, Lafayette - 56th Street West to End	LF	\$698.29	1637	\$ 1,143,105.97
	Sub Total				\$ 21,641,588.70
	Contingencies (20%)				\$ 4,328,317.74
	<b>TOTAL</b>				<b>\$ 25,969,900.00</b>

Pipe quantities are taken from Huitt-Zollars Report

Exhibit 'C'



Arcadia/Camelback Mountain Homeowners Association  
4730 E. Indian School Road, Suite 120 • Phoenix, Arizona 85018

October 10, 1996

- Richard M. Spiegel  
*President*
- Paul Barnes  
*Vice-President*
- John Warner  
*Recording Secretary*
- Greg Steblay  
*Corresponding Secretary*
- Therese Lewis  
*Treasurer*
- Board of Directors:
  - John Applewhite
  - Blackberry
  - Bonadio
  - Oral Cookson
  - Ed Dodge
  - Geyer
  - Jar
  - M. Lette
  - My Montgomery
  - Ogden
  - Paul Phalen
  - Reinstein
  - Salzmann
  - Strauss
  - I. Traaen
  - Van Sickle
- Presidents:
  - Dodge
  - Paul Phalen
  - Smith
  - Steenblik

Perry Baker  
Flood Control District  
Maricopa County  
2801 W. Durango  
Phoenix, AZ 85009

Dear Mr. Baker,

Thank-you for attending our Board meeting last week, and for the presentation by you and the Flood Control staff concerning the alternatives proposed to alleviate the drainage problems in the Arcadia area. As you are well aware, our association has been eager, for some time, to find a way to eliminate the existing 100 year floodplain on the north side of the Arizona Canal.

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We look forward for your advice on how we can best get the funds to implement alternative #2 prioritized by our City and County, and, also, how we can get the floodplain reevaluated once the drains are emplaced, to potentially deminish, at least, its area.

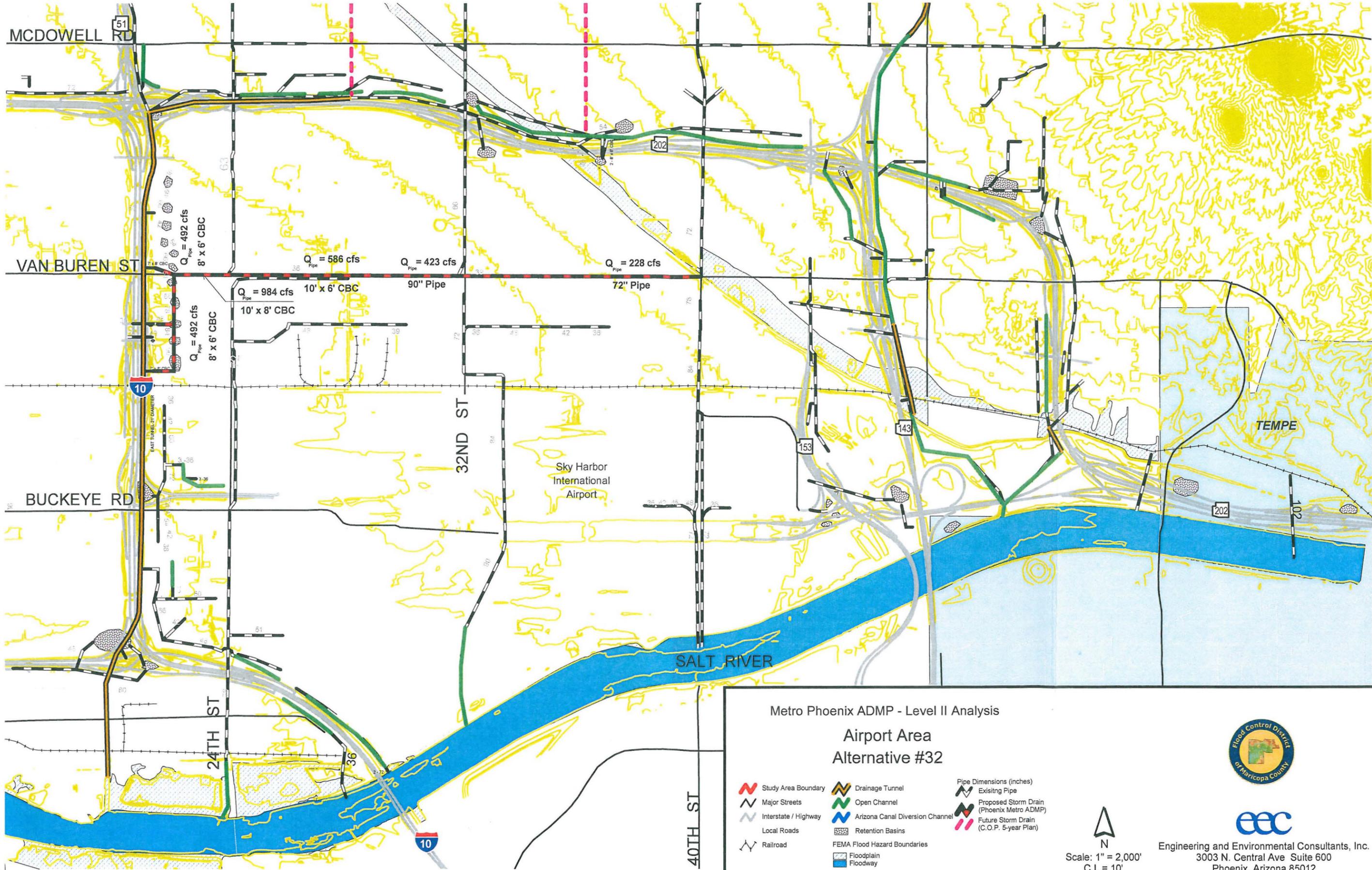
Sincerely,

Richard M. Spiegel, M.D.  
President  
Arcadia/Camelback Mtn. H.A.

**Alternative #32 - 10-year Storm Drain in Van Buren Street,  
I-10 to 40th Street**

**Table of Contents**

	<u>Page</u>
<b>Plan View Exhibit</b>	<b>1</b>
<b>Cross Sections</b>	<b>2</b>
<b>Hydraulic Calculations for Proposed Storm Drains</b>	<b>3-8</b>
<b>Cost Estimate</b>	<b>9</b>



Metro Phoenix ADMP - Level II Analysis

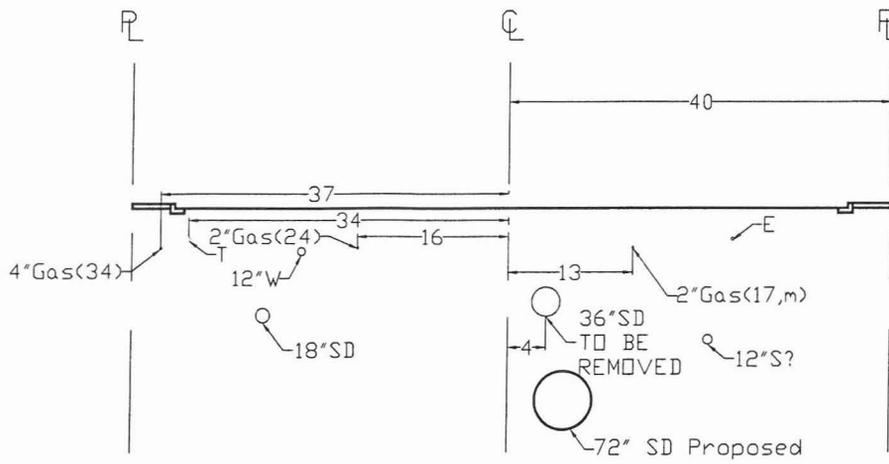
Airport Area  
Alternative #32

- |  |                      |  |                                 |  |   |
|--|----------------------|--|---------------------------------|--|---|
|  | Study Area Boundary  |  | Drainage Tunnel                 |  | Existing Pipe                             |
|  | Major Streets        |  | Open Channel                    |  | Proposed Storm Drain (Phoenix Metro ADMP) |
|  | Interstate / Highway |  | Arizona Canal Diversion Channel |  | Future Storm Drain (C.O.P. 5-year Plan)   |
|  | Local Roads          |  | Retention Basins                |  |   |
|  | Railroad             |  | FEMA Flood Hazard Boundaries    |  |   |
|  |                      |  | Floodplain                      |  |   |
|  |                      |  | Floodway                        |  |   |

N  
Scale: 1" = 2,000'  
C.I. = 10'

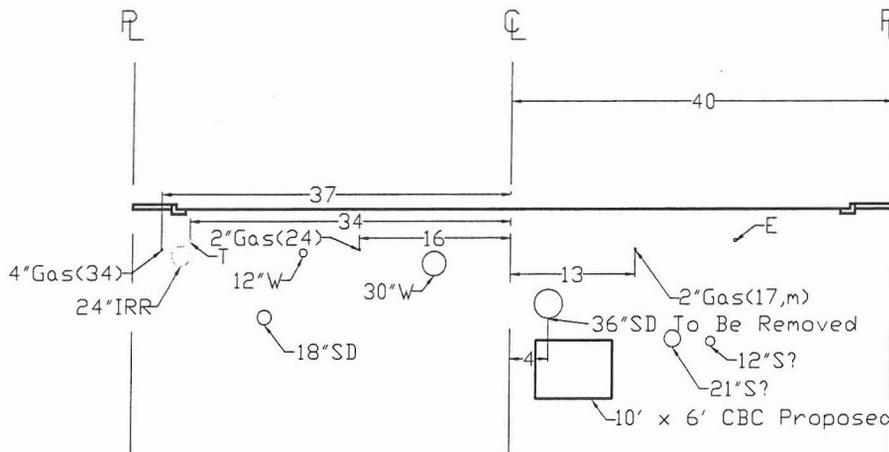


Engineering and Environmental Consultants, Inc.  
3003 N. Central Ave Suite 600  
Phoenix, Arizona 85012



Van Buren - 40th St to 32nd St  
 Proposed 72" SD  
 Alternative #32

80' ROW



Van Buren - 32nd St to East Tunnel  
 Proposed 10' x 6' CBC  
 Alternative #32

80' ROW

N:\305008\ALT 26-32 - ST 2\TIONS.DWG, 8/13/2007 4:43:50 PM, \pbrsv01\HP LaserJet 4050

 <b>FLOOD CONTROL DISTRICT        OF MARICOPA COUNTY</b>			
<b>METRO PHOENIX        AREA DRAINAGE MASTER PLAN        FCD CONTRACT NO. FCD 2004C040</b>			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	CTG	DATE 03/2007
	DRAWN	KLH	03/2007
	CHECKED	LAV	03/2007
 Engineering and Environmental Consultants, Inc. 3003 N. Central Avenue, Suite 600 Phoenix, Arizona 85012-2905 TEL: (602) 248-7702 FAX: (602) 248-7851			
DRAWING NO.	METRO PHOENIX ADMP LEVEL II PLANS		SHEET OF <b>2/9</b>

## Worksheet for SD 1a, Van Buren, 24th St to East Tunnel

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00300 ft/ft  
Bottom Width                                10.00 ft  
Discharge                                    984.00 ft<sup>3</sup>/s

### Results

Normal Depth                                7.54 ft  
Flow Area                                    75.44 ft<sup>2</sup>  
Wetted Perimeter                            25.09 ft  
Top Width                                    10.00 ft  
Critical Depth                                6.70 ft  
Critical Slope                                0.00406 ft/ft  
Velocity                                      13.04 ft/s  
Velocity Head                                2.64 ft  
Specific Energy                              10.19 ft  
Froude Number                                0.84  
Flow Type                                    Subcritical

### GVF Input Data

Downstream Depth                            0.00 ft  
Length                                        0.00 ft  
Number Of Steps                                0

### GVF Output Data

Upstream Depth                                0.00 ft  
Profile Description  
Profile Headloss                                0.00 ft  
Downstream Velocity                            Infinity ft/s  
Upstream Velocity                                Infinity ft/s  
Normal Depth                                7.54 ft  
Critical Depth                                6.70 ft  
Channel Slope                                0.00300 ft/ft  
Critical Slope                                0.00406 ft/ft

## Worksheet for SD 1a1, Van Buren, 24th St to East Tunnel

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Bottom Width	8.00	ft
Discharge	492.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.59	ft
Flow Area	44.70	ft <sup>2</sup>
Wetted Perimeter	19.17	ft
Top Width	8.00	ft
Critical Depth	4.90	ft
Critical Slope	0.00421	ft/ft
Velocity	11.01	ft/s
Velocity Head	1.88	ft
Specific Energy	7.47	ft
Froude Number	0.82	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.59	ft
Critical Depth	4.90	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00421	ft/ft

## Worksheet for SD 1a2, Van Buren, 24th St to East Tunnel

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Bottom Width	8.00	ft
Discharge	492.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.59	ft
Flow Area	44.70	ft <sup>2</sup>
Wetted Perimeter	19.17	ft
Top Width	8.00	ft
Critical Depth	4.90	ft
Critical Slope	0.00421	ft/ft
Velocity	11.01	ft/s
Velocity Head	1.88	ft
Specific Energy	7.47	ft
Froude Number	0.82	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.59	ft
Critical Depth	4.90	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00421	ft/ft

## Worksheet for SD 1b, Van Buren, 28th St to 24th St

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Bottom Width	10.00	ft
Discharge	586.00	ft <sup>3</sup> /s

### Results

Normal Depth	5.06	ft
Flow Area	50.61	ft <sup>2</sup>
Wetted Perimeter	20.12	ft
Top Width	10.00	ft
Critical Depth	4.74	ft
Critical Slope	0.00357	ft/ft
Velocity	11.58	ft/s
Velocity Head	2.08	ft
Specific Energy	7.14	ft
Froude Number	0.91	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.06	ft
Critical Depth	4.74	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00357	ft/ft

6/9

## Worksheet for SD 1c, Van Buren, 32nd St to 28th St

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	7.52	ft
Diameter	7.52	ft
Discharge	423.00	ft <sup>3</sup> /s

### Results

Diameter	7.52	ft
Normal Depth	7.52	ft
Flow Area	44.37	ft <sup>2</sup>
Wetted Perimeter	23.61	ft
Top Width	0.00	ft
Critical Depth	5.33	ft
Percent Full	100.0	%
Critical Slope	0.00415	ft/ft
Velocity	9.53	ft/s
Velocity Head	1.41	ft
Specific Energy	8.93	ft
Froude Number	0.00	
Maximum Discharge	455.04	ft <sup>3</sup> /s
Discharge Full	423.02	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

## Worksheet for SD 1d, Van Buren, 40th St to 32nd St

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Diameter

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	5.96	ft
Diameter	5.96	ft
Discharge	228.00	ft <sup>3</sup> /s

### Results

Diameter	5.96	ft
Normal Depth	5.96	ft
Flow Area	27.91	ft <sup>2</sup>
Wetted Perimeter	18.73	ft
Top Width	0.00	ft
Critical Depth	4.14	ft
Percent Full	100.0	%
Critical Slope	0.00436	ft/ft
Velocity	8.17	ft/s
Velocity Head	1.04	ft
Specific Energy	7.00	ft
Froude Number	0.00	
Maximum Discharge	245.27	ft <sup>3</sup> /s
Discharge Full	228.01	ft <sup>3</sup> /s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

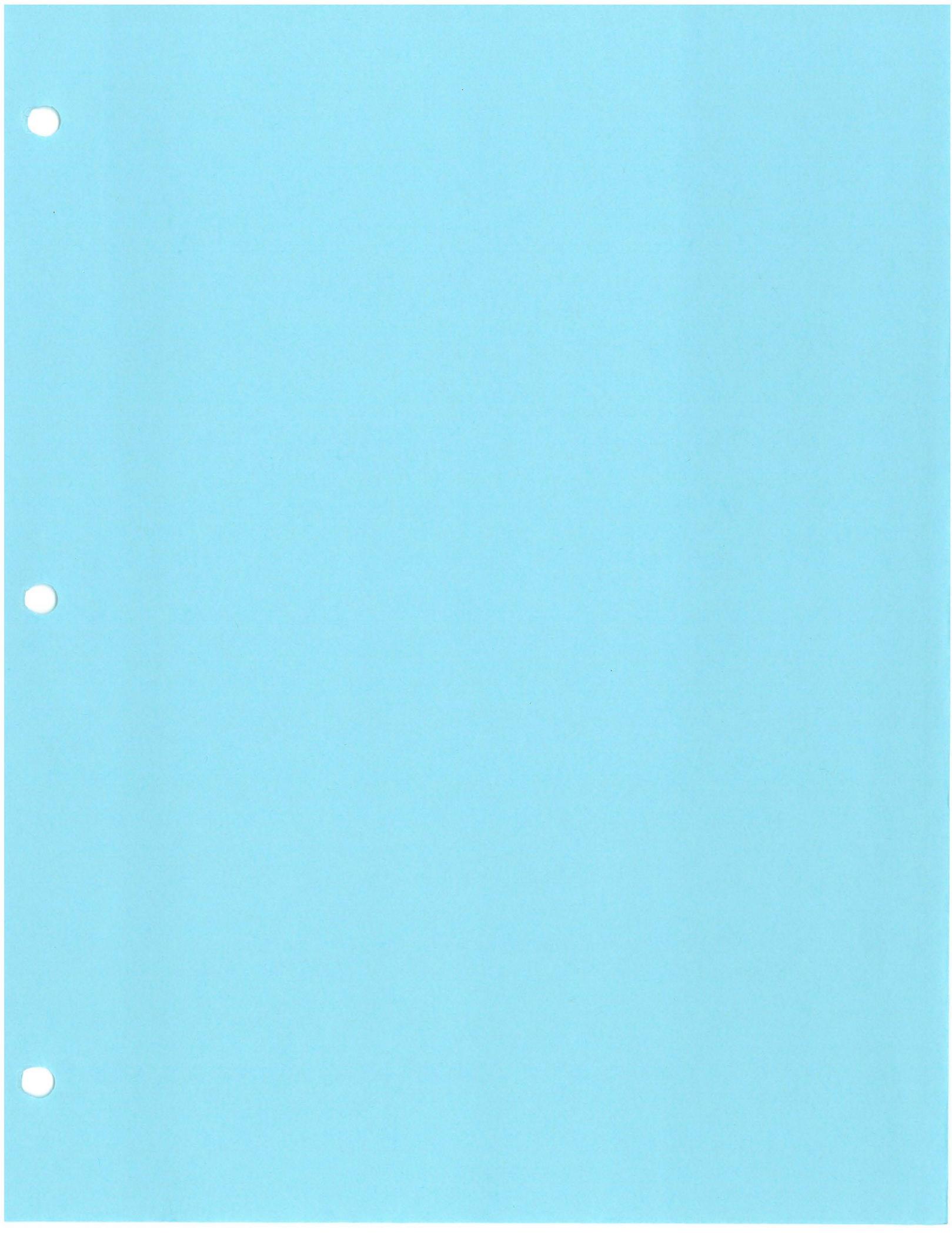
### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
1	Van Buren connection to East Tunnel, 8'x6' CBC	LF	\$1,502.91	750	\$ 1,127,184.30
2	Jackson St. connection to East Tunnel, 8'x6' CBC	LF	\$1,502.91	2800	\$ 4,208,154.72
3	Washinton St. connection to East Tunnel, 8'x6' CBC	LF	\$1,502.91	400	\$ 601,164.96
4	Van Buren, 22nd St to 24th St, 10'x8' CBC	LF	\$1,897.79	1200	\$ 2,277,348.48
5	Van Buren, 28th St to 24th St, 10'x6' CBC	LF	\$1,740.25	2640	\$ 4,594,255.78
6	Van Buren, 32nd St to 28th St, 90" Pipe	LF	\$1,056.45	2640	\$ 2,789,024.83
7	Van Buren, 40th St to 32nd St, 72" Pipe	LF	\$878.70	5280	\$ 4,639,523.33
8	Utility Relocation (Includes removal of Existing 30" SD)	LM	\$250,000.00	3.0	\$ 750,000.00
	Sub Total				\$ 20,986,656.40
	Contingencies (20%)				\$ 4,197,331.28
	<b>TOTAL</b>				<b>\$ 25,184,000.00</b>



**Maricopa County Area Drainage Master Plan  
Flood Control District of Maricopa County  
Recommended Alternatives Analysis  
Environmental Considerations**

**Introduction**

The Flood Control District (FCD) of Maricopa County is in the process of developing the Metro Phoenix Area Drainage Master Plan (ADMP) (Figure 1). Known and potential flooding hazards within the Metro Phoenix area have been identified. The ADMP will review the flood hazard areas and drainage problems identified in the ADMP and then provide an alternatives analysis. Thirty-two alternatives (28 structural and 4 nonstructural) are being studied for inclusion in the ADMP (Figures 2–4). The following sections identify hazardous materials sites and facilities and previously identified cultural resources within portions of the overall study area. Identification of these factors will aid in the selection of preferred alternatives for the ADMP. The study team will use this information to help in the selection of cost-effective solutions to alleviate or manage flooding in the Metro Phoenix study area.



Source: Arizona Transportation System GIS Coverage (2006)

**Key**

-  Study area
-  Alternative detail area (see figures 2-4)

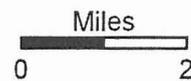
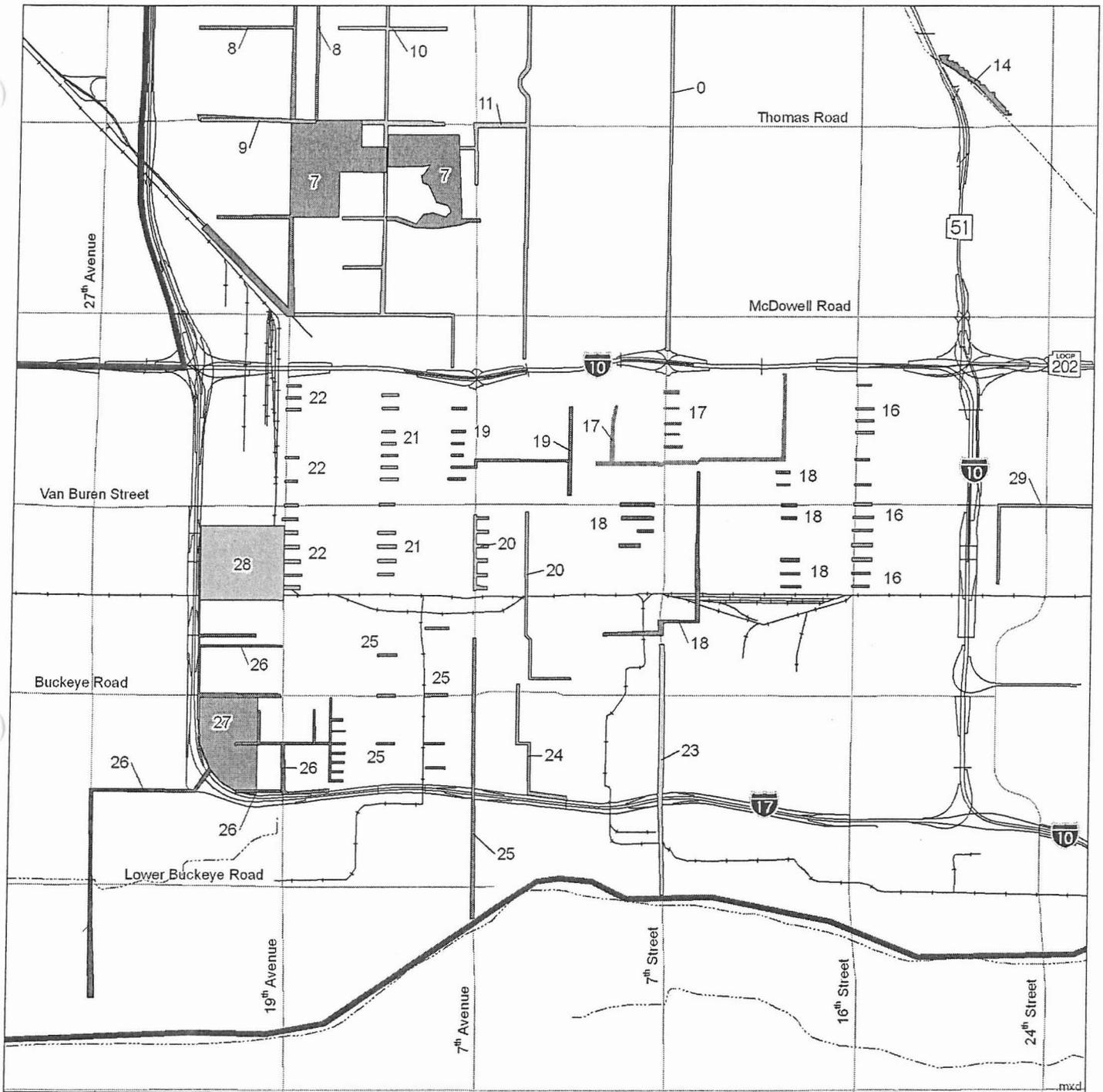


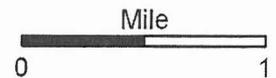
Figure 1. ADMP study area



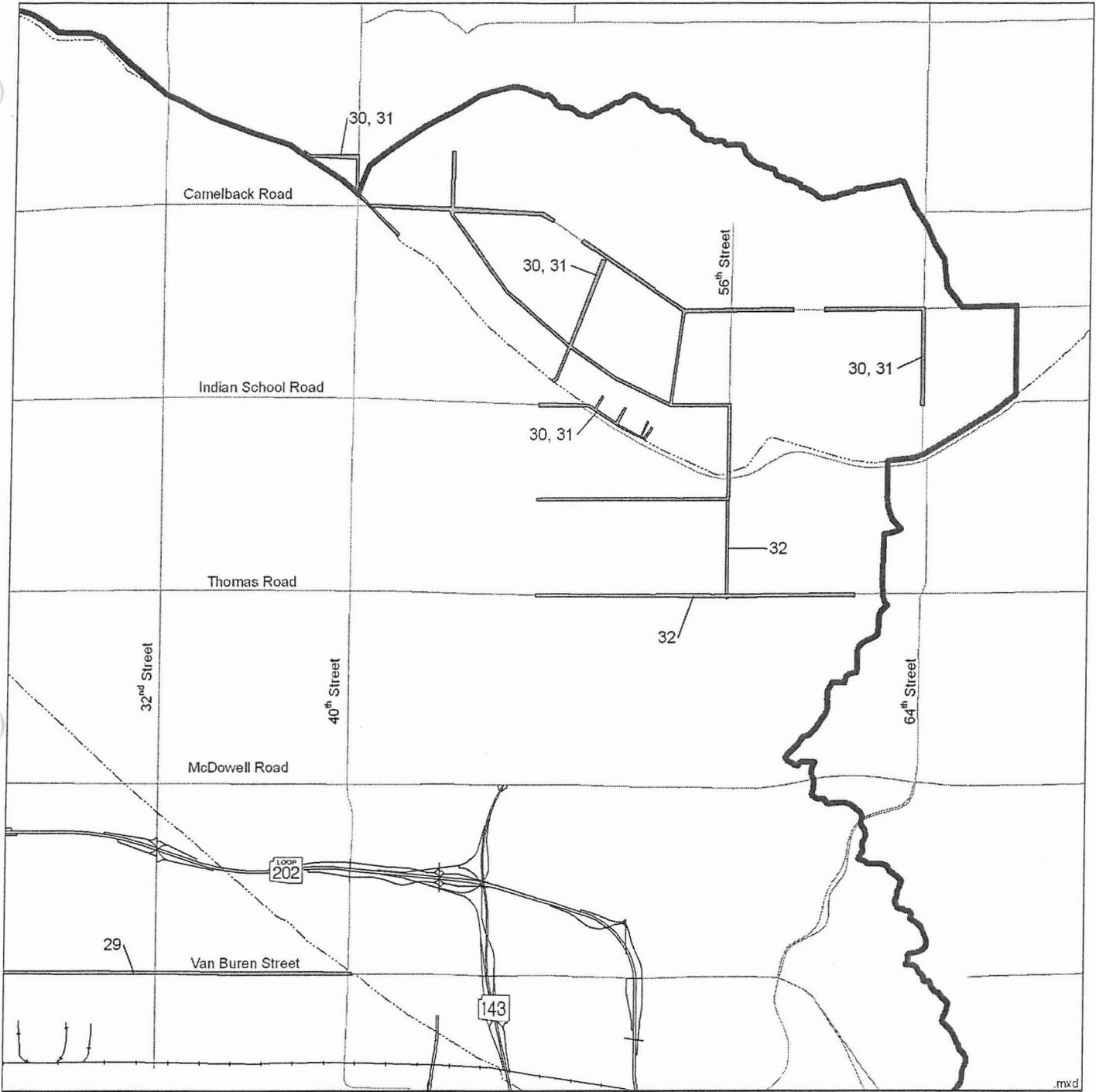
Source: Arizona Transportation System GIS Coverage (2006)

**Key**

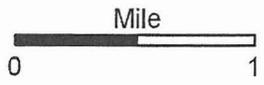
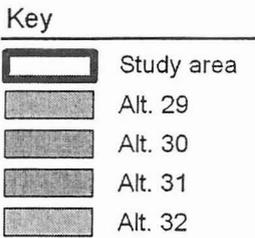
	Study area		Alt. 10		Alt. 18		Alt. 23		Alt. 28
	Alt. 0		Alt. 11		Alt. 19		Alt. 24		Alt. 29
	Alt. 7		Alt. 14		Alt. 20		Alt. 25		
	Alt. 8		Alt. 16		Alt. 21		Alt. 26		
	Alt. 9		Alt. 17		Alt. 22		Alt. 27		



**Figure 2. Project alternatives in the southern portion of the study area**



Source: Arizona Transportation System GIS Coverage (2006)



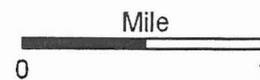
**Figure 3.** Project alternatives in the eastern portion of the study area



Source: Arizona Transportation System GIS Coverage (2006)

Key

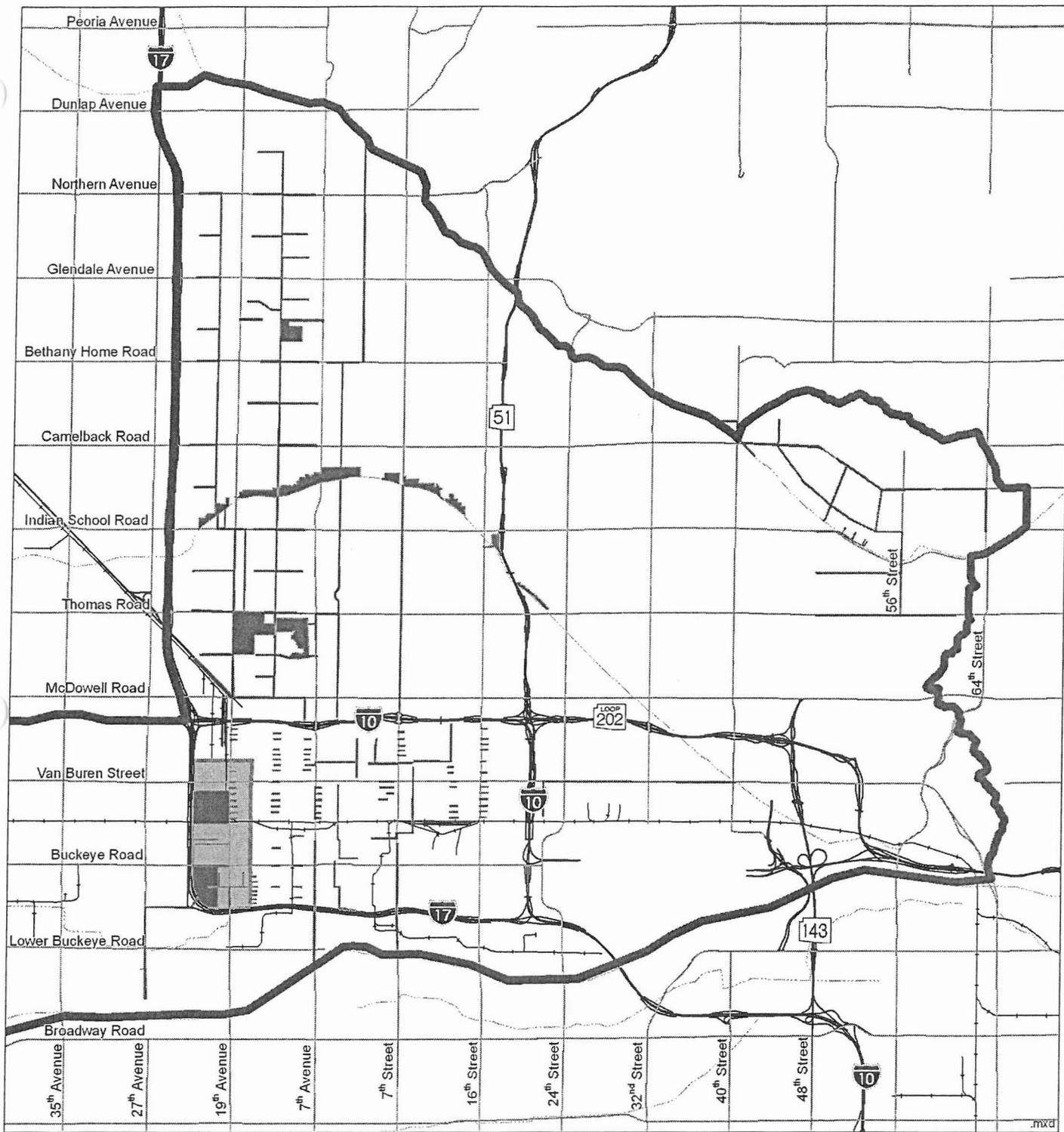
	Study area		Alt. 3		Alt. 10
	Alt. 0		Alt. 4		Alt. 11
	Alt. 1		Alt. 5		Alt. 14
	Alt. 2		Alt. 8		



**Figure 4.** Project alternatives in the northern portion of the study area

## 1. Hazardous Materials Investigation

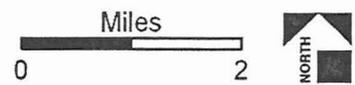
The FCD identified a hazardous materials area of concern (HMAC) that was used to conduct a hazardous materials investigation. The HMAC is located in downtown Phoenix bounded by Polk Street to the north; 17th Street to the east; Interstate 17 (I-17)/United States (US 60), the Maricopa Freeway, to the south; and, Interstate 10 (I-10)/US 60, the Black Canyon Highway, to the west. The project is located to the northeast of the I-17/US 60 Durango Curve from approximately mileposts 200.0 to 197.7 (Figure 5).



Source: Arizona Transportation System GIS Coverage (2006)

**Key**

-  Study area
-  Environmental Analysis limits
-  Flood Control District hazardous materials area of concern



**Figure 5.** Location of HMAC within overall project study area

## 1.1 Results of Hazardous Materials Database Review

Logan Simpson Design Inc. reviewed information provided by the Arizona Department of Environmental Quality (ADEQ) and the Environmental Protection Agency (EPA) to identify facilities or sites that have reported incidents involving hazardous materials, such as improper storage, use, or transportation. Results from the database search can be found in Tables 1–15 of Section 3.1, Hazardous Materials Database Review. The HMAC includes FCD Alternatives 27 and 28 and portions of Alternatives 22 and 26 (Figure 2).

## 1.2 Hazardous Materials Database Review

A review of the ADEQ databases was performed in March 2007:

- The Arizona Directory of Open Municipal Solid Waste Landfills reported no sites within the HMAC.
- The Arizona Directory of Inactive and Closed Solid Waste Landfills reported no sites within the HMAC.
- The Arizona Directory of Septic Landfills reported one site within the HMAC (Table 1).

**Table 1.** ADEQ septic waste landfills

Facility name	Owner	Address	Location	Zip code
Western Hydrovac	Allwaste Inc.	510 S 18th Ave	Within HMAC	85007

Source: ADEQ, <<http://www.azdeq.gov/environ/waste/solid/download/septic.pdf>>

- The ADEQ Directory of Septage Haulers reported two licensed septage hauler vehicles within the HMAC (Table 2).

**Table 2.** ADEQ licensed septage hauler vehicles

ADEQ#	Owner	DBA	Address	Location	Vehicle VIN number
1458	Not listed	Pro Pipe	2222 W Grant St	Within HMAC	1FDZW90T3PVA32373
1588	Hoffman Southwest Corp.	Professional Pipe Services	2222 W Grant St	Within HMAC	2F2HAZASB3AL76168

Source: ADEQ, <<http://www.azdeq.gov/environ/water/permits/download/haulers-num.pdf>>

- The Directory of Arizona's Waste Tire Collection Sites and Waste Tire Processing Facilities reported no sites within the HMAC.
- The ADEQ Water Quality Assurance Revolving Fund (WQARF) Registry reported one facility within the HMAC (Table 3).

**Table 3.** WQARF sites

Site name	City	Location	Type of risk
West Van Buren	Phoenix	The site is bounded by McDowell Rd to the north, 7th Ave to the east, Buckeye Rd to the south and 75th Ave between Buckeye and Lower Buckeye Rd. A finger-shaped plume exists between 7th Ave and 27th Ave between Buckeye and Lower Buckeye Rd.	Groundwater contamination from multiple sources. Contaminants include tetrachloroethene (PCE); trichloroethene (TCE); 1,1-dichloroethane (DCA); cis-1,2-dichloroethene (cis1,2-DCE); 1,1-dichloroethene (DCE); and chromium. Contaminants of concern may change as new data become available.

Source: ADEQ, <<http://www.azdeq.gov/environ/waste/sps/download/registry.pdf>>

- The Arizona Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs) database reported no facilities within the HMAc.
- The ADEQ Drywell Registration list reported 37 facilities within the HMAc (Table 4).

**Table 4. AZDEQ drywells**

Facility name	Registration number	Address	Location	Number of drywells
Burke Company Warehouse Addition	1284	1515 S 22nd Ave Phoenix AZ 85009	Within HMAc	5
COP Streets	8256	21st Ave & Jefferson St Phoenix AZ 85009	Within HMAc	1
Canyon State Auto Care	29498	202 N 19th Ave Phoenix AZ 85009	Within HMAc	1
CMC Brost	33808	601 S 19th Ave Phoenix AZ 85009	Within HMAc	3
Donaldson Equipment Sales	4409	2149 W Buckeye Rd Phoenix AZ 85009	Within HMAc	2
Former Warehouse Building (Vacant)	14468	520 S 19th Ave Phoenix AZ 85009	Within HMAc	1
Hamilton School	28836	2020 W Durango Phoenix AZ 85009	Within HMAc	2
Jose's Pallets	18853	2135 W Buckeye Rd Phoenix AZ 85009-5934	Within HMAc	1
V. E. M.	11212	715 N Black Canyon Highway Phoenix AZ 85009	Within HMAc	1
Verde Industries	31549	3812 W Washington Phoenix AZ 85009	Within HMAc	1
Whataburger Restaurant	4458	1840 S 19th Ave Phoenix AZ 85009	Within HMAc	5
ADHS–State Health Lab	29112	250 N 17th Ave Phoenix, AZ 85007	Within HMAc	2
ADOT–Engineering Building	10032	205 S 17th Ave Phoenix, AZ 85007	Within HMAc	1
ADOT Sign Factory	16195	2104 S 22nd Ave Phoenix, AZ 85007	Within HMAc	4
Advanced Electrical Sales	17179	1717 W Grant Phoenix, AZ 85007	Within HMAc	2
COP Streets	8249	351 N 21st Ave Phoenix, AZ 85007	Within HMAc	1
COP Streets	8250	2035 W Monroe St Phoenix, AZ 85007	Within HMAc	1
COP Streets	8251	2145 W Monroe St Phoenix, AZ 85007	Within HMAc	1
COP Streets	8252	2043 W Washington St Phoenix, AZ 85007	Within HMAc	1
COP Streets	8253	2137 W Washington St Phoenix, AZ 85007	Within HMAc	1
COP Streets	8254	203 ft W of RR tracks, 1900 W Monroe Phoenix, AZ 85007	Within HMAc	1
COP Streets	8255	1940 W Washington St Phoenix, AZ 85007	Within HMAc	1
COP Streets	8390	50 ft N of Van Buren on 17th Dr Phoenix, AZ 85007	Within HMAc	1
COP Streets	8391	401 N 18th Ave Phoenix, AZ 85007	Within HMAc	1
COP Streets	8392	50 ft N of Van Buren on 18th Ave Phoenix, AZ 85007	Within HMAc	1

*continued*

**Table 4. AZDEQ drywells**

Facility name	Registration number	Address	Location	Number of drywells
COP Streets	8393	401 N 17th Drive Phoenix, AZ 85007	Within HMAC	1
COP Streets	8416	94 ft E of 19th Ave on Monroe Phoenix, AZ 85007	Within HMAC	1
COP Streets	8417	18th Ave & Jackson N of intersec Phoenix, AZ 85007	Within HMAC	1
COP Streets	8418	1820 W Washington St Phoenix, AZ 85007	Within HMAC	1
COP Streets	8421	68 ft E of 18th Ave on Monroe Phoenix, AZ 85007	Within HMAC	1
COP Streets	8422	1701 W Monroe St Phoenix, AZ 85007	Within HMAC	1
Capitol Executive Tower Parking Lot	13133	NE corner of 19th Ave & Jefferson St Phoenix, AZ 85007	Within HMAC	3
Econo Lube N' Tune Shop #101	6732	202 N 19th Ave Phoenix, AZ 85007	Within HMAC	1
LRS Investments	24038	1831-1839 W Buckeye Phoenix, AZ 85007	Within HMAC	1
Southwest Environmental Construction	11205	1717 - 1719 W Grant St Phoenix, AZ 85007	Within HMAC	2
State Capitol Parking Lot	25301	17th Ave & Van Buren Phoenix, AZ 85007	Within HMAC	2
Two Office Buildings	13730	1833 W Buchanan St Phoenix, AZ 85007	Within HMAC	1

Source: ADEQ, <<http://www.azdeq.gov/databases/drywellsearch.html>>

- The ADEQ Hazardous Material Incident Logbook (HMIL) reported 27 incidents within the HMAC. An additional 6 incidents occurred along the Union Pacific Rail line; however, precise locations for these incidents is unknown (Table 5).

**Table 5. HMIL incidents**

Incident no.	Incident Date	Name	Address	Location	Chemical/ Material	Quantity
92-003-E	10/20/1992	Ari-Tex Tires	1701 So. 22nd Ave Phoenix	Within HMAC	Tires (used)	Unknown
97-003-B	01/23/1997	Unknown/DEA	1900 W Jefferson Phoenix	Within HMAC	Drug lab chemicals	Unknown
85-006	01/10/1985	Capital Day Care Center	1937 W Jefferson Phoenix	Within HMAC	Unknown (toxic)	Unknown
00-109-B	04/03/00	Union Pacific Railroad	RRMP* 911.77 Phoenix	Unknown location along rail line	Diesel	N/A
93-060-B	12/10/1993	Disposal Control Services	19 Ave & Buckeye Rd Phoenix	Within HMAC	Flammable liquid NOS	50 gals.
88-299	09/28/1988	Unknown	2200 W Van Buren Phoenix	Within HMAC	Perchloric acid (70%)	4 gals.
01-115-E	03/26/2001	Unknown/COP	21 Ave & Harrison Phoenix	Within HMAC	Solvents, used oil	4-55 gals. each
89-098	04/12/1989	AZ Dept. of Administration	1981 W Madison Phoenix	Within HMAC	Surflan herbicide	50 gals.
94-033-C	06/13/1994	Unknown	1841 W Sonora, Alley Behind Phoenix	Within HMAC	Oil (used)	55 gals.
94-003-E	04/08/1994	Ayres Brothers Trucking	1810 S 19th Ave Phoenix	Within HMAC	Diesel fuel	200 gals.

*continued*

**Table 5. HMIL incidents**

Incident no.	Incident Date	Name	Address	Location	Chemical/ Material	Quantity
89-353	11/15/1989	Brian Holt Contractors	1880 E Buchanan Phoenix	Within HMAc	Oil (mineral, poss PCB)	2 gal.
01-094-D	11/24/2000	Unknown	1702 S 19 Ave Phoenix	Within HMAc	Carpets & pads	Unknown
92-147-C	10/12/1992	AGO Impound Lot	1810 W Lincoln Phoenix	Within HMAc	Pesticides (dimethoate)	5 gals.
99-018-D	09/01/1998	North American Van Lines	18 Ave & Buckeye Phoenix	Within HMAc	Diesel	20 gals.
00-085-E	02/11/2000	Union Pacific Railroad	RRMP 900.4 Phoenix	Unknown location along rail line	Denatured alcohol	<100 lbs.
95-043-B	07/24/1995	Santa Fe Railroad	19th Ave & Van Buren Phoenix	Within HMAc	Oil (lube)	50 gals.
96-012-G	03/28/1996	Lopez Residence	2022 W Tonto Phoenix	Within HMAc	Tires	50+
97-029-C	05/08/1997	Union Pacific Railroad	RRMP 907 Phoenix	Unknown location along rail line	Carbon dioxide	Unknown
89-070	03/06/1989	City of Phoenix	1708 E Mohave Phoenix	Within HMAc	Styrene, vinyl toluene	One 55- gal drum
90-046-B	05/17/1990	ADOT	1800 E Mohave Phoenix	Within HMAc	Unknown	Unknown
01-053-E	11/16/2000	Union Pacific Railroad	RRMP 907.5, Tracks 19-20 Phoenix	Unknown location along rail line	Diesel	Unknown
87-075	04/03/1987	National Metals	320 So. 19th Ave Phoenix	Within HMAc	PCB	<40 ppm
90-121-C	09/13/1990	Re-Bar Inc.	2101 W Jackson Phoenix	Within HMAc	Oil (used)	>100 gals.
84-014	03/07/1984	APS	20 St & Washington Phoenix	Within HMAc	PCB	3-5 gals.
00-158-B	06/20/2000	Unknown/COP	1703 W Sonora (in alley) Phoenix	Within HMAc	Unknown (possibly oil)	3 55-gals.
00-102-E	02/29/2000	Unknown/COP	22 Ave & Harrison (NW corner) Phoenix	Within HMAc	Isocyanate resin	~30 gals.
91-124-B	11/13/1991	KWS Trucking	I-17, 19 Ave & Buckeye Phoenix	Within HMAc	Diesel	100 gals.
91-122-B	11/08/1991	Armor Safe	18 St & Mohave Phoenix	Within HMAc	D001, F003, F005	5-gal. containers
90-038-D	03/27/1990	Unknown	1917 W Monroe Phoenix	Within HMAc	Drug Lab Chemicals	1 gal.
89-132	05/09/1989	Unknown	18 St & Mohave Phoenix	Within HMAc	Diesel Fuel	40 gals.
00-146-E	05/19/2000	Union Pacific Railroad	RRMP 906 Phoenix	Unknown location along rail line	Sulfuric Acid	5 gals.
00-066-D	10/31/1999	Union Pacific Railroad	RRMP 907 Phoenix	Unknown location along rail line	Alcohol (denatured)	1 gal.
99-035-B	10/01/1998	Union Pacific Railroad	RRMP 906 Phoenix	Unknown location along rail line	Isopropanol alcohol	1 pint

Source: ADEQ, <<http://www.azdeq.gov/databases/hwssearch.html>>

\*RRMP = Railroad milepost

- The ADEQ Underground Storage Tank (UST) list reported 123 tanks at 51 facilities within the HMAc (Table 6).

**Table 6. UST facilities**

Facility ID	Facility name	Facility address	Owner name	No. of tanks	Location	Tank status
0-009653	JH Rose Truck Lines	1717 W Buckeye Rd Phoenix, AZ 85007	Kenneth & Ollie Mae Baker Trust	1	Within HMAC	Tank Removed 6/28/2000
0-008022	ADOA State Personnel Office	1871 W Jefferson St Phoenix, AZ 85007	Arizona Department of Administration	5	Within HMAC	Tanks Removed 2/13/1990
0-007658	DG & P Trucking	1601 W Grant St Phoenix, AZ 85007	Don Phillips	3	Within HMAC	Tanks Removed
0-006091	Wahler Corporation	1860 W Sherman St Phoenix, AZ 85007	Wahler Construction	1	Within HMAC	Tank Removed 10/19/1990
0-005891	Circle K #2701998	1834 W Grant St Phoenix, AZ 85007	Circle K Stores Inc.	3	Within HMAC	Tanks In Use
0-004876	Parcel 112-09-23	1706 W Buchanan St Phoenix, AZ 85007	Estate of Esther Nunneley	2	Within HMAC	Tanks Removed 1/1/1991
0-004713	Steiner Corp.	1875 W Buckeye Rd Phoenix, AZ 85007	Steiner Corp.	2	Within HMAC	Tanks Removed 5/5/1988
0-004256	Texaco Self Serve	517 S 17th Ave Phoenix, AZ 85007	Canyon State Oil Co.	4	Within HMAC	Tank Removed 1/6/2006
0-002601	Rammer Rents	1102 S 17th Ave Phoenix, AZ 85007	Aero Rentals	3	Within HMAC	Tanks Removed 6/15/1989
0-001750	Arizona Department of Administration	1700 W Washington St Phoenix, AZ 85007	Arizona Department of Administration	1	Within HMAC	Tank In Use
0-000732	Bloomquist Pump Services Inc.	1729 W. Lincoln St Phoenix, AZ 85007	Bloomquist Pump Services	1	Within HMAC	Tank Closed in Place
0-008114	Arizona Department of Economic Security	1720 W Madison St Phoenix, AZ 85007	1720 W Madison St	1	Within HMAC	Tanks Removed 4/30/1993
0-007585	ADOA	1831 W Jefferson St Phoenix, AZ 85007	Arizona Department of Administration	5	Within HMAC	Tanks Removed 2/15/1990
0-007403	Tyndall Motor	615 S 17th Ave Phoenix, AZ 85007	Louie Tyndall	2	Within HMAC	Tanks Removed 10/2/1991
0-004699	Western Fuel Inc.	1895 W Buckeye Rd Phoenix, AZ 85007	Steiner Corp.	3	Within HMAC	Tanks Removed 10/1/1987
0-001487	Circle K #1795	1732 W Van Buren St Phoenix, AZ 85007	Circle K Stores Inc.	3	Within HMAC	Tanks In Use
0-000906	Texaco #60-349-0309	1837 W Van Buren St Phoenix, AZ 85007	Texaco Refining & Marketing Inc.	4	Within HMAC	Tanks Removed 12/21/1992
0-000346	ADOA Administration	206 S 17th Ave Phoenix, AZ 85007	ADOT Equipment Services	1	Within HMAC	Tanks In Use
0-009288	Duncan Pump Co.	1820 S 19th Ave Phoenix, AZ 85009	A.L. Duncan Pump	1	Within HMAC	Tank Removed 5/15/1998
0-009077	Vacant Industrial Site	2121 W Lincoln St Phoenix, AZ 85009	Howard Sumpter Trust	1	Within HMAC	Tank Removed 4/23/1997
0-008783	Farm & Home Foods Inc.	351 S Black Canyon Hwy Phoenix, AZ 85009	Farm & Home Foods Inc.	1	Within HMAC	Tanks Removed 11/12/1998

*continued*

**Table 6. UST facilities**

<b>Facility ID</b>	<b>Facility name</b>	<b>Facility address</b>	<b>Owner name</b>	<b>No. of tanks</b>	<b>Location</b>	<b>Tank status</b>
0-008617	Allied Industries	301 S 19th Ave Phoenix, AZ 85009	Allied Industries	1	Within HMAC	Tanks Removed 5/5/1995
0-008379	Irving & Loretta Thomsen	2121 W Buckeye Rd Phoenix, AZ 85009	Irving & Loretta Thomsen	1	Within HMAC	Tank Removed 1/1/1984
0-008269	Besst Auto Parts & Transmission	1601 S 19th Ave Phoenix, AZ 85009	Stankovich, George	3	Within HMAC	Tanks Removed 1/1/1977
0-007725	Donaldson Equipment Sales Inc.	2149 W Buckeye Rd Phoenix, AZ 85009	Donaldson, Tom	2	Within HMAC	Tanks Removed 8/5/1993
0-007459	HW Johnson Inc.	1824 S 19th Ave Phoenix, AZ 85009	H W Johnson Inc.	2	Within HMAC	Tanks Removed 5/31/1991
0-006580	Canyon State Auto Care	202 N 19th Ave Phoenix, AZ 85009	Canyon State Auto Care LLC	1	Within HMAC	Tanks In Use
0-006330	Valley Feed And Seed	1918 W Van Buren St Phoenix, AZ 85009	FCC Investors	3	Within HMAC	Tanks Removed 1/10/1990
0-006098	Amigo Truck Sales Inc.	2201 W Buckeye Rd Phoenix, AZ 85009	Virgil Vance	1	Within HMAC	Tanks Removed 5/8/2004
0-006072	Truck Salvage Company	1433 S 19th Ave Phoenix, AZ 85009	Truck Sale Co.	3	Within HMAC	Tanks Removed 4/1/1988
0-006053	Sumpter Trust	2106 W Grant St Phoenix, AZ 85009	Howard Sumpter Trust	2	Within HMAC	Tanks Removed 4/23/1997
0-006051	Advance Roofing & Supply	1921 W Grant St Phoenix, AZ 85009	Advance Roofing & Supply Inc.	3	Within HMAC	Tanks Removed 8/11/1992
0-005093	Wefab Corporation	2101 W Pima St Phoenix, AZ 85009	Wefab Corp.	1	Within HMAC	Tanks Removed 7/12/1989
0-004555	Circle K #2708829	2041 W Van Buren St Phoenix, AZ 85009	Circle K Stores Inc.	3	Within HMAC	Tanks In Use
0-003568	O'Malley Glass & Millwork	620 S 19th Ave Phoenix, AZ 85009	O'Malley Glass & Millwork	3	Within HMAC	Tanks Removed 10/15/1988
0-003112	Burke Co.	1515 S 22nd Ave Phoenix, AZ 85009	Burke Co.	4	Within HMAC	Tanks Closed In Place 9/1/1987
0-002605	W Friedman & S Lazerson	2101 W Van Buren St Phoenix, AZ 85009	W Friedman & S Lazerson	1	Within HMAC	Tanks Removed 5/10/1989
0-002177	Francies Date Co.	2125 W Jackson St Phoenix, AZ 85009	Sidney Francies	1	Within HMAC	Tanks Removed 5/1/1989
0-001356	Roofing Wholesale Co. Inc.	720 S 19th Ave Phoenix, AZ 85009	Roofing Wholesale Co. Inc.	1	Within HMAC	Tanks Removed 6/2/1989
0-000859	C & H Roofing Inc.	2018 W Jackson St Phoenix, AZ 85009	C & H Roofing Inc.	1	Within HMAC	Tanks Removed 12/8/1998
0-000161	Ardis	2101 W Jackson St Phoenix, AZ 85009	Ardis	2	Within HMAC	Tanks Removed 11/1/1989

*continued*

**Table 6. UST facilities**

Facility ID	Facility name	Facility address	Owner name	No. of tanks	Location	Tank status
0-005311	Unocal #6020	2225 W Grant St Phoenix, AZ 85009	Unocal Corp.	3	Within HMAC	Tanks Removed 1/21/1992
0-004423	Brost Forming Supply	601 S 19th Ave Phoenix, AZ 85009	Robert Brost	5	Within HMAC	Tanks Removed 12/15/1992
0-004382	Schuff Steel Co.	420 S 19th Ave Phoenix, AZ 85009	David Schuff	2	Within HMAC	Tanks Removed 12/2/1988
0-004336	LMH Auto Sales	303 N Black Canyon Hwy Phoenix, AZ 85009	William Wallace Rogers	5	Within HMAC	Tanks Removed 2/5/1997
0-004189	Roofing Wholesale Co. Inc.	1918 W Grant St Phoenix, AZ 85009	Roofing Wholesale Co. Inc.	8	Within HMAC	Tanks Removed 6/20/1989
0-003467	National Metals	320 S 19th Ave Phoenix, AZ 85009	National Metals Company	2	Within HMAC	Tanks Removed 12/1/1988
0-002214	Jaguays Equipment Co.	1219 S 19th Ave Phoenix, AZ 85009	Jacqueline Gannan	2	Within HMAC	Tanks Removed 5/25/1986
0-002081	Arizona Woodcraft	715 N Black Canyon Hwy Phoenix, AZ 85009	Kalil Bottling Co.	3	Within HMAC	Tanks Removed 3/28/1995
0-001721	Arizona Awnings & Window Shade Systems	1409 S 21Dr Phoenix, AZ 85009	Da-Ro Properties	2	Within HMAC	Tanks Removed 3/26/1990
0-000833	AFCO #020214	1851 S 19th Ave Phoenix, AZ 85009	Micor Energy	6	Within HMAC	5 Tanks Removed 5/25/2005; 1 Tank Removed 8/15/1989

Source: ADEQ, <<http://www.azdeq.gov/databases/ustsearch.html>>

- The ADEQ Leaking Underground Storage Tank (LUST) list reported three facilities within the HMAC (Table 7).

**Table 7. LUST facilities**

Facility ID	Leak ID	Facility name	Address	Location	Date reported	Priority status code*
0-004256	5474.01	Texaco Self Serve	517 S 17th Ave Phoenix, AZ 85007	Within HMAC	1/6/2006	3
0-004336	297.01	LMH Auto Sales	303 N Black Canyon Hwy Phoenix, AZ 85009	Within HMAC	3/11/1987	1D
0-004336	297.03	LMH Auto Sales	303 N Black Canyon Hwy Phoenix, AZ 85009	Within HMAC	3/11/1987	1D

Source: ADEQ, <<http://www.azdeq.gov/databases/lustsearch.html>>

\*Priority status codes: 1D = Defined soil and groundwater (GW) requires remediation (levels exceed standards for one or more media); 3 = Defined soil requires remediation

A review of the US Environmental Protection Agency (EPA) databases was performed in March 2007:

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) list reported no facilities within the HMAc.
- The Resource Conservation and Recovery Act (RCRA) database reported 27 facilities within the HMAc (Table 8).

**Table 8. RCRA sites**

Handler name	Handler ID	Street address	Location
ADOT	AZD980814354	1745 W Madison	Within HMAc
American Linen	AZE000125001	1875 W Buckeye Rd	Within HMAc
Econo Lube N Tune 101	AZR000002097	202 N 19th Ave	Within HMAc
Manco Inc.	AZD982401796	1738 W Lincoln St	Within HMAc
Matrix Industries Inc.	AZE990622009	1824 S 17th Ave	Within HMAc
Metro Mechanical Inc.	AZD982436958	1714 W Lincoln St	Within HMAc
O And M Envir Remediation	AZE991108022	1755 W Hadley	Within HMAc
O And M Envir Remediation	AZE991109001	1809 W Hadley	Within HMAc
State Health Laboratory	AZR000500462	250 N 17th Ave	Within HMAc
Arizona Dept Of Administration	AZD982051955	211 S 20th Ave	Within HMAc
Arizona Mack Sales Inc.	AZD981573686	1795 S 19th Ave	Within HMAc
AZ Carburetor Mfg	AZR000041160	2046 W Buckeye	Within HMAc
Capitol Collision Repair	AZD982483513	902 S 19th Ave	Within HMAc
Copper State Truck	AZD981975063	1700 S 19th Ave	Within HMAc
Eller Media Co.	AZR000038778	1825 S Black Canyon Hwy	Within HMAc
Louies Black Oxide	AZ0001004944	2008 W Jackson St	Within HMAc
National Metals Co.	AZD007961741	320 S 19th Ave	Within HMAc
Northland Trucking Inc.	AZR000040691	1515 S 22nd Ave	Within HMAc
O And M Environmental Remediation	AZE991109004	2103 W Sherman	Within HMAc
O And M Environmental Remediation	AZE991109005	2201 W Sherman	Within HMAc
Para Plate Arizona	AZD981694417	349 N Black Canyon Hwy	Within HMAc
Phoenix Metal Trading Inc.	AZR000030338	610 S 19th Ave	Within HMAc
Safer Recycling	AZ0000449702	741 S Black Canyon Hwy	Within HMAc
Safety Engineering And Supply Co.	AZD983476771	1409 S 21st Dr	Within HMAc
Schuff Steel Co. Phoenix Facility	AZD982489312	420 S 19th Ave	Within HMAc
Terrell Battery Corporation	AZD982480410	802 S 19th Ave	Within HMAc
Valley Seed Co. DBA Valley America	AZD007961873	1918 W Van Buren	Within HMAc

Source: EPA, <[http://www.epa.gov/enviro/html/rcris/rcris\\_query\\_java.html](http://www.epa.gov/enviro/html/rcris/rcris_query_java.html)>

- The Toxic Release Inventory (TRI) database reported one site within the HMAc (Table 9).

**Table 9. TRI facilities**

TRI facility ID	Facility name	Address	Location	Submissions
85009SCHFF420S1	Schuff Steel Co.	420 S 19th Ave Phoenix, AZ 85009	Within HMAc	47

Source: EPA, <[http://www.epa.gov/enviro/html/tris/tris\\_query.html](http://www.epa.gov/enviro/html/tris/tris_query.html)>

- The Aerometric Information Retrieval System/AIRS Facility Subsystem (AIRS/AFS) database reported one site within the HMAC and one site at an unknown location along US 60. An additional 60 portable operations may operate within or adjacent to the HMAC (Table 10).

**Table 10. AIRS/AFS facilities**

Plant name	Street address	City	Location
Arizona Department of Transportation	205 S 17th Ave- 612E	Phoenix	Within HMAC
Granite/Sundt	US 60 project	Phoenix	Unknown area along US 60

Source: EPA, [http://www.epa.gov/enviro/html/airs/airs\\_query\\_java.html](http://www.epa.gov/enviro/html/airs/airs_query_java.html)

- The Facility Registry System (FRS) reported three facilities, with a total of four records, within the HMAC (Table 11).

**Table 11. FRS facilities**

Facility name	Location address	Information system	Information system ID	Environmental interest type
Mary Mcleod Bethune School	1310 S 15th Ave	NCES	40630000518	Unspecified Universe
Arthur M. Hamilton School	2020 W Durango	NCES	40540000446	Unspecified Universe
Schuff Steel Company	420 S 19th Ave	ICIS	8028448	Enforcement/ Compliance Activity
Schuff Steel Company	420 S 19th Ave	NEI	NEI18572	Criteria And Hazardous Air Pollutant Inventory

Source: EPA, <[http://www.epa.gov/enviro/html/fil/fii\\_query\\_java.html](http://www.epa.gov/enviro/html/fil/fii_query_java.html)>

- The Enforcement and Compliance History Online (ECHO) database search reported 13 facilities within the HMAC and one facility at an unknown location along US 60, which may or may not fall within the project area (Table 12).

**Table 12. ECHO facilities**

Facility name	Location address	FRS ID	Program ID	Location
AZ Dept. of Transportation	205 S 17th St Ave- 612E Phoenix, AZ 85007	110001694417	AFS: 04013R9711	Within HMAC
State Health Laboratory	250 N 17th Ave Phoenix, AZ 85007	110021005348	RCR: AZR000500462	Within HMAC
Ahern Rentals	1403 S Black Canyon Hwy Phoenix, AZ 85009	110024869551	RCR: AZR000502773	Within HMAC
AZ Carburator Mfg	2046 W Buckeye Phoenix, AZ 85009	110012204587	RCR: AZR000041160	Within HMAC
Capitol Collision Repair	902 S 19th Ave Phoenix, AZ 85009	110002584338	RCR: AZD982483513	Within HMAC
Copper State Truck	1700 S 19th Ave Phoenix, AZ 85009	110002574964	RCR: AZD981975063	Within HMAC
Eller Media Co.	1825 S Black Canyon Hwy Phoenix, AZ 85009	110002609623	RCR: AZR000038778	Within HMAC
Granite/Sundt	US 60 Project Phoenix, AZ 85009	110012150340	AFS: 04013R9830	Unknown
Louies Black Oxide	2008 W Jackson St Phoenix, AZ 85009	110002565750	RCR: AZ0001004944	Within HMAC
National Metals Co.	320 S 19th Ave Phoenix, AZ 85009	110001697575	RCR: AZD007961741	Within HMAC
Northland Trucking Inc.	1515 S 22nd Ave Phoenix, AZ 85009	110012244561	RCR: AZR000040691	Within HMAC

*continued*

**Table 12. ECHO facilities**

Facility name	Location address	FRS ID	Program ID	Location
Phoenix Metal Trading Inc.	610 S 19th Ave Phoenix, AZ 85009	110002604833	RCR: AZR000030338	Within HMAC
Schuff Steel Co.	420 S 19th Ave Phoenix, AZ 85009	110000470320	RCR: AZD982489312	Within HMAC
Terrell Battery Corp.	802 S 19th Ave Phoenix, AZ 85009	110002584070	RCR: AZD982480410	Within HMAC

Source: EPA, <<http://63.160.3.204/echo/>>

- The National Response Center (NRC) Emergency Response Notification System (ERNS) database reported two facilities within the HMAC (Table 13).

**Table 13. ERNS facilities**

Incident report number:	Report taken:	Incident type:	Incident cause	Incident address	Location	Affected medium	Released materials
313117	11/05/1995	Fixed	Unknown	2405 W Mojave Phoenix, AZ 85009	Within HMAC	Air Atmosphere	Hydrochloric acid, nitric acid, phosphoric acid, sulfuric acid, sodium hydroxide
316189	12/05/1995	Fixed	Other	2405 W Mojave Phoenix, AZ 85009	Within HMAC	Land Concrete	Hydrochloric acid, nitric acid, phosphoric acid, sodium dichromate solution, sulfuric acid

Source: EPA, <<http://www.epa.gov/region4/r4data/erns/index.htm>>

- The No Further Remedial Action Planned (NFRAP) information was searched using the Superfund site information database; four facilities were reported within the HMAC (Table 14).

**Table 14. NFRAP facilities**

EPA ID number	Site name	Site address	Location	NPL status
AZD007961741	National Metals Co.	320 S 19th Ave Phoenix, AZ 85007	Within HMAC	Not NPL
AZ0001038413	Ari-Tex Tires	1707 S 22nd Ave Phoenix, AZ 85009	Within HMAC	Not NPL
AZD009017989	Jaquays Equipment Company	1219 S 19th Ave Phoenix, AZ 85009	Within HMAC	Not NPL
AZD983476771	Safety Engineering	1409 S 21st Drive Phoenix, AZ 85009	Within HMAC	Not NPL

Source: EPA, <<http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm>>

- The Permit Compliance System (PCS) database that contains data for water discharge permits showed one ADOT facility with an unknown location along 21st Street. (Table 15).

**Table 15. PCS facilities**

NPDES ID	Facility name	Address
AZU000013	ADOT	21st St Phoenix, AZ 85009

Source: EPA <[http://www.epa.gov/enviro/html/pes/pes\\_query\\_java.html](http://www.epa.gov/enviro/html/pes/pes_query_java.html)>

### 1.3 Hazardous Materials Summary

Review of appropriate ADEQ and EPA databases is summarized in Table 16.

**Table 16. Hazardous Materials Summary**

Type	Quantity within HMAc
Active solid waste landfills	0
Inactive solid waste landfills	0
Septic landfills	1
Septage hauler vehicles	2
Waste tire collection facilities	0
WQARF facilities	1
TSDFs	0
Drywells	58 (at 37 locations)
HMIL incidents	27
USTs	123 (at 51 locations)
LUSTs	3
CERCLA facilities	0
RCRA sites	27
TRIS'	1
AIRS/AFS sites	1
Portable AIRS/AFS operators	60
FRS facilities	3 (with a total of 4 incidents)
ECHO facilities	13
NRC ERNS facilities	2
NFRAP facilities	4

An additional 6 HMIL incidents occurred along the Union Pacific Rail line; however, attempts to contact Union Pacific regarding more precise locations for the railroad mileposts have not been successful. Additionally, 1 ECHO incident, 1 AIRS/AFS operator and 1 Permit Compliance System (PCS) water discharge permit at unknown locations along US 60 and along 21st Street. Further investigation is needed to determine if these incidents lie within the HMAc.

### 1.4 Hazardous Materials Comments and Recommendations

Hazardous materials incidents and facilities within the HMAc are listed to assist the FCD with the Metro Phoenix ADMP Recommended Alternatives Analysis. Alternatives that lie within the HMAc are identified in Section 1.1. This information should be used to aid in the selection of cost-effective solutions to alleviate or manage flooding in the Metro Phoenix Study Area. The final ADMP project area and selected alternative(s) will need to be evaluated for specific hazardous materials impacts before plan implementation.

## 2. Cultural Resources Investigation

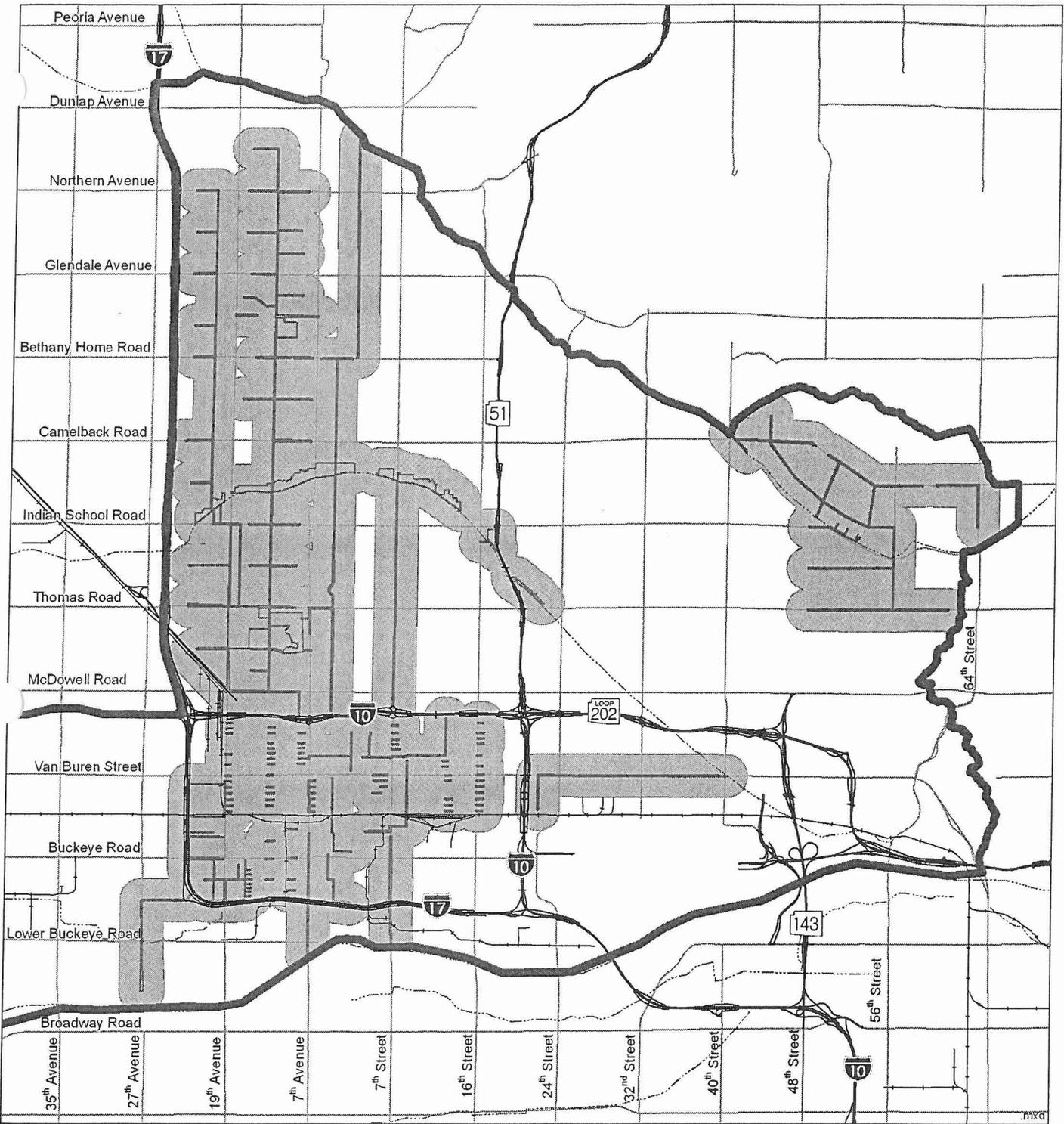
Several federal, state, and local laws have been enacted to preserve cultural resources. The National Historic Preservation Act (NHPA) of 1966 (Title 16 United States Code [USC] § 470 et seq.) requires that projects defined in Title 36 Code of Federal Regulations (CFR) § 800.16(y) as federal undertakings be evaluated for their impacts on historic properties. Section 106, which is implemented under 36 CFR Part 800 of the NHPA, defines a process of consultation that federal agencies follow to evaluate impacts on historic properties. The National Environmental Policy Act of 1969 (40 CFR § 1500) requires projects with a federal action to be evaluated for impacts on the human and natural environment. Other acts, including the Archaeological Resources Protection Act of 1979 (16 USC §§ 470aa–470mm), the Native American Graves Protection and Repatriation Act of 1990 (25 USC §§ 3001–3013), the American Indian Religious Freedom Act (42 USC §§ 1996 and 1996a), and Section 4(f) of the Department of Transportation Act of 1966 (23 USC § 138) also ensure the proper treatment of cultural resources for projects that occur on federal lands, are funded by federal monies, or that require a federally issued permit. Similarly, Arizona Revised Statutes (ARS) sections §§ 41-841 through 41-847 and §§ 41-861 through 41-881 have been enacted to protect cultural resources and Native American graves during undertakings in Arizona that do not fall under federal jurisdiction. The Arizona State Historic Preservation Act of 1982 directs state agencies to consider impacts that their projects or funding may have on historic properties owned or controlled by the agency.

Cultural resources inventory data include records of prehistoric and historic properties that are greater than 50 years old. Prehistoric and historic properties are classified as sites, buildings, structures, or objects. Properties that possess a significant concentration, linkage or continuity or that are united historically or aesthetically by plan or physical development may be formally recognized as a district. The National Register of Historic Places (NRHP) is an inventory of properties significant in our prehistory and history. To be listed in the NRHP, a property or district must be demonstrably significant under at least one of four criteria and must possess a combination of seven aspects of integrity. The criteria of evaluation for the NRHP are association with an important historic event (Criterion A) or person (Criterion B), embodiment of an important design or method of construction (Criterion C), or the potential to yield scientifically important information about prehistory or history (Criterion D). The aspects of integrity are location, design, setting, materials, workmanship, feeling, and association. Depending on the property type and criteria, some aspects of integrity are weighted more importantly than others when nominating a property to the NRHP.

When future undertakings are identified that may affect specific historic properties that are already listed or eligible for listing in the NRHP under Criterion A, B, or C, avoidance will be recommended. When future projects are identified that may affect specific historic properties that are eligible for listing in the NRHP under Criterion D, avoidance will be recommended, but construction impacts can be mitigated through archaeological testing and data recovery.

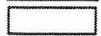
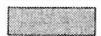
### 2.1 Cultural Resources Inventory

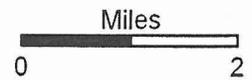
A study was undertaken to identify cultural resources in the project area that could be affected by the drainage improvements. The project area was defined as all of the project alternatives. This cultural resources inventory study consisted of background research to compile the previously documented archaeological and historic sites and surveys conducted within a 0.25-mile radius of the project area (Figure 6). The inventory area is roughly bounded by Butler Drive (0.50 mile north of Northern Avenue) to the north, the Salt River to the south, 27th Avenue to the west, and Invergordon Road to the east. Cultural considerations in the inventory area were identified from information gathered from the Arizona State Historic Preservation Office (SHPO) and the Arizona State Museum (ASM) using AZSITE, the state's electronic inventory of cultural resources. The National Park Service's National Register Information System was accessed to determine whether any NRHP-listed properties are located in the inventory area.



Source: Arizona Transportation System GIS Coverage (2006)

**Key**

-  Study area
-  Project area (alternatives)
-  Cultural resources inventory area



**Figure 6.** Cultural resources inventory area

## 2.2 Summary of Cultural Resources Inventory Results

The records search indicated that 56 surveys were previously conducted in the inventory area, resulting in coverage of approximately 6 percent of the project area. The surveys were conducted for a variety of projects including transmission-line installation, road and flood-control feature improvements, cell-tower construction, airport expansion, as well as a survey of the canals within the Salt River Valley (SRP) system. Numerous archaeological monitoring projects and testing and data recovery projects have also occurred in the project area and vicinity, particularly at large Hohokam habitation sites.

In total, 53 known archaeological sites, 34 historic districts, and numerous NRHP-listed historic properties were previously recorded in the inventory area (Section 2.4, Cultural Resources Information, Tables 17 and 18). Twenty-eight of the archaeological sites overlap the project area. The subsets of those cultural resources that intersect each individual project alternative are shown in Table 19. The sites in the project area include historic canals, buildings, and railway lines; the original Phoenix townsite; large Hohokam village sites; and small artifact scatters. In addition, unnamed prehistoric canal alignments cross the project area at more than 100 locations. Two NRHP-eligible historic canals, the Grand Canal/AZ T:7:167 (ASM) and the Arizona Canal/AZ U:6:303 (ASM), transect the project area. These canals are operated by SRP and owned by the Bureau of Reclamation (Reclamation). The project area also is located within portions of 27 historic districts that are listed in the NRHP, the Phoenix Historic Property Register (PHPR), or both registers, including one multiple resource area. Each of these historic districts is composed of numerous historic buildings, which are considered elements that contribute to the district's significance. Because of the large number of these properties, they are not called out individually in the tables. Much of the project area has not been surveyed for prehistoric and historic resources, and therefore, it is possible that significant resources are located within the project area that have not yet been identified.

## 2.3 Summary of Cultural Resources Recommendations

SD recommends that once the alternatives have been further refined, a more detailed assessment be made of known cultural resources in the vicinity. It is possible that a Class III survey also may be necessary to inventory any potential historic properties in the project area, as well as archival research to identify historic resources. Once the project area and expected impacts have been finalized, it will be possible to identify the level of cultural resources investigation needed. This level will depend on the agencies involved and the type of construction activity proposed. The project will require consultation with SHPO, the City of Phoenix Archaeology Office, the City of Phoenix Historic Preservation Office, and possibly SRP, BOR, and the Arizona Department of Transportation.

Archaeological monitoring may be necessary if construction occurs in the vicinity of a known site. If construction takes place within a historic district, the type of cultural resources work needed will depend on the degree of disturbance and its proximity to contributing properties. The level of investigation may include photographing and documenting historic buildings and conducting cultural resources monitoring. When construction activities occur within a historic district, emphasis must be placed on protecting the character of the district. For example, one proposed alternative includes construction of a storage basin east of 15th Avenue within the Encanto Golf Course, which is part of the NRHP-listed Encanto-Palmcroft Historic District. Encanto Park, which includes the golf course, a lagoon system, picnic areas, and a wide variety of trees, was modeled after large, naturalistic, English-style parks such as New York's Central Park and San Diego's Balboa Park.

Thus, any modification to the Encanto Golf Course should retain the historic character of the landscaping. If it is not possible for proposed construction to proceed without impact to existing or newly discovered NRHP-eligible cultural resources, these resources must be treated in a way consistent with the Secretary of the Interior's Guidelines for the Treatment of Historic Properties and applicable Arizona laws, in consultation with the appropriate agencies.

## 2.4 Cultural Resources Information

**Table 17.** Previously recorded sites within one-quarter mile of the project area

Site number and/or property name	Location <sup>a</sup>	Within project area?	Site type	Affiliation and age	Eligibility status
AZ FF:9:17 (ASM)/SR 80	T1N, R2E, Sec. 12; T1N, R3E, Secs. 1–12 <sup>b</sup>	Yes	Historic road	Euro-American/ A.D. 1920s	Determined eligible
AZ N:3:32 (ASM)/ Santa Fe, Prescott and Phoenix Railway Line	T1N, R2E, Secs. 1 & 12; T1N, R3E, Sec. 7; T2N, R2E, Sec. 36 <sup>b</sup>	Yes	Historic railroad	Euro-American/ A.D. 1893–1983	Determined eligible
AZ T:10:83 (ASM)/ Roosevelt Canal	T1N, R2E, Secs. 13, 14, & 24 <sup>b</sup>	Yes	Historic canal	Euro-American/ A.D. 1928	Determined eligible
AZ T:10:84 (ASM)/ Southern Pacific Railroad	T1N, R2E, Sec. 1; T1N, R3E, Secs. 7–10 <sup>b</sup>	Yes	Historic railroad	Euro-American/ A.D. 1926–present	Determined eligible
AZ T:12:1 (ASM)/ AZ T:12:11 (ASU)/ NA10688/La Ciudad	T1N, R3E, Secs. 2, 3, & 10; T2N, R3E, Sec. 34	Yes	Prehistoric village	Hohokam or Salado/ A.D. 450–1100	Determined eligible
AZ T:12:2 (ASM)/ Dr. Ronald Rosson Home	T1N, R3E, Sec. 8	No	Historic home	Euro-American/ A.D. 1892	Determined eligible
AZ T:12:4 (ASM)/ State Capitol Grounds	T1N, R3E, Sec. 7	Yes	Historic buildings	Euro-American/ Historic	Not evaluated
AZ T:12:7 (ASU)	T1N, R2E, Sec 12	No	Unknown	Unknown	Unknown
AZ T:12:10 (ASM)/ Las Colinas	T2N, R2E, Secs. 25, 35, & 36; T1N, R2E, Secs. 1 & 2	Yes	Prehistoric village	Hohokam/ A.D. 1000–1500	Determined eligible
AZ T:12:14 (ASU)	T2N, R3E, Sec. 27	No	Prehistoric artifact scatter	Hohokam/ A.D. 1300–1440	Determined eligible
AZ T:12:16 (ASU)	T2N, R3E, Sec. 27	No	Canals	Unknown	Not evaluated
AZ T:12:32 (ASM)/ Arizona State Capitol Building	T1N, R3E, Sec. 7	No	Historic building	Euro-American/ A.D. 1900	Determined eligible
AZ T:12:33 (ASM)/Phoenix Carnegie Library and Park	T1N, R3E, Sec. 7	No	Historic building	Euro-American/ A.D. 1908	Determined eligible
AZ T:12:34 (ASM)/ Evans House	T1N, R3E, Sec. 7	No	Historic building	Euro-American/ A.D. 1893	Determined eligible
AZ T:12:39 (ASM)/Block 14	T1N, R3E, Sec. 8	Yes	Block 14 of original Phoenix Townsite	Euro-American/ Historic	Considered eligible
AZ T:12:40 (ASM)/ Adams School	T1N, R3E, Sec. 7	No	Historic school	Euro-American/ Historic	Considered eligible
AZ T:12:41 (ASM)/ Monroe School	T1N, R3E, Sec. 9	No	Historic school	Euro-American/ A.D. 1914	Determined eligible
AZ T:12:42 (ASM)/ Phoenix Townsite	T1N, R3E, Secs. 8 & 9	Yes	Original Phoenix Townsite	Euro-American/ A.D. 1800s–1950s	Determined eligible
AZ T:12:43 (ASM)/ Murphy's Addition	T1N, R3E, Sec. 9	Yes	Prehistoric artifact scatter	Hohokam/ A.D. 200–1500	Unknown
AZ T:12:44 (ASM)/ First Baptist Church	T1N, R3E, Sec. 8	Yes	Historic church	Euro-American/ A.D. 1905	Considered eligible
AZ T:12:45 (ASM)/ Hotel Westward Ho	T1N, R3E, Sec. 5	Yes	Historic hotel	Euro-American/ A.D. 1927	Listed
AZ T:12:46 (ASM)/ St. Mary's Church	T1N, R3E, Sec. 8	No	Historic church	Euro-American/ A.D. 1913	Considered eligible

*continued*

**Table 17.** Previously recorded sites within one-quarter mile of the project area

Site number and/or property name	Location <sup>a</sup>	Within project area?	Site type	Affiliation and age	Eligibility status
AZ T:12:50 (ASM)/ AZ T:12:12 (ASU)/ Los Solares	T1N, R3E, Sec. 3	No	Northern locus of La Ciudad	Hohokam or Salado/ A.D. 450–1100	Determined eligible
AZ T:12:53 (ASM)/ AZ P:2:8 (GP)	T1N, R3E, Sec. 18	No	Prehistoric/ historic artifact scatter	Hohokam/ A.D. 200–1500; Euro-American/ Historic	Not evaluated
AZ T:12:55 (ASM)	T1N, R3E, Sec. 17	No	Historic artifact scatter	Euro-American/ Historic	Determined ineligible
AZ T:12:56 (ASM)	T1N, R3E, Secs. 16 & 17	Yes	Trash dump	Euro-American/ Unknown	Not evaluated
AZ T:12:57 (ASM)	T1N, R3E, Sec. 21	No	Trash dump	Euro-American/ Unknown	Not evaluated
AZ T:12:60 (ASU)/Track Site	T2N, R3E, Sec. 20	No	Historic trash dump	Euro-American/ Historic	Considered eligible
AZ T:12:62 (ASM)/ Dutch Canal Ruin	T1N, R3E, Secs. 9–11	Yes	Prehistoric village	Hohokam/ A.D. 450–1450	Determined eligible
AZ T:12:65 (ASM)/China Alley	T1N, R3E, Sec. 8	No	Phoenix Chinatown	Chinese-American/ A.D. 1880s–1940s	Unknown
AZ T:12:69 (ASM)	T1N, R3E, Sec. 8	No	Prehistoric artifact scatter	Hohokam/ A.D. 450–1450	Not evaluated
AZ T:12:70 (ASM)/ Pueblo Patricio	T1N, R3E, Secs. 4, 5, 8, & 9	Yes	Prehistoric village	Hohokam/ A.D. 450–1450	Determined eligible
AZ T:12:72 (ASM)/Verde Park	T1N, R3E, Sec. 4	Yes	Prehistoric artifact scatter and historic buildings	Hohokam/ A.D. 200–1500; Euro-American/ A.D. 1887–1936	Not evaluated
AZ T:12:85 (ASM)	T2N, R3E, Sec. 32	No	Petroglyphs at Heard Museum	Unknown/ Prehistoric	Not evaluated
AZ T:12:86 (ASM)/ Arvizu's El Fresnal Grocery Store	T1N, R3E, Sec. 8	No	Petroglyph and historic building	Unknown/ Prehistoric; Euro-American/ Historic	Not evaluated
AZ T:12:95 (ASM)	T1N, R3E, Sec. 8	Yes	Prehistoric habitation and historic buildings	Hohokam/ A.D.200–1500; Euro-American/ Historic	Considered eligible
AZ T:12:96 (ASM)	T1N, R3E, Sec. 8	No	Prehistoric artifact scatter and historic buildings	Hohokam/ A.D.200–1500; Euro-American/ Historic	Considered eligible
AZ T:12:97 (ASM)/ First Presbyterian Church	T1N, R3E, Sec. 8	Yes	Historic church	Euro-American/ A.D. 1889–1927	Not considered eligible
AZ T:12:113 (ASM)/ Blocks 87 and 88	T1N, R3E, Sec. 8	Yes	Blocks 87 and 88 of original Phoenix Townsite	Euro-American/ A.D. 1880s–1920s	Considered eligible
AZ T:12:131 (ASM)/ Canal Patricio System	T1N, R3E, Sec. 10	No	Prehistoric canal system	Hohokam/ A.D. 450–1450	Considered eligible
AZ T:12:144 (ASM)	T1N, R3E, Sec. 4	No	Historic canal	Euro-American/ A.D. 1874–1930	Considered eligible
AZ T:12:148 (ASM)/La Villa	T1N, R3E, Secs. 7 & 8	Yes	Prehistoric village	Hohokam/ A.D. 450–1100	Determined eligible

*continued*

**Table 17. Previously recorded sites within one-quarter mile of the project area**

Site number and/or property name	Location <sup>a</sup>	Within project area?	Site type	Affiliation and age	Eligibility status
AZ T:7:167 (ASM)/ Grand Canal	T2N, R2E, Secs. 24 & 25; T2N, R3E, Secs. 19–21, 27, 28; T1N, R3E, Sec. 1 <sup>b</sup>	Yes	Historic/modern canal	Euro-American/ A.D. 1879	Determined eligible
AZ T:12:214 (ASM)	T1N, R2E, Secs. 23 & 24	Yes	Unknown	Unknown	Unknown
AZ T:12:222 (ASM)/ Salt River Valley Canal	T1N, R2E, Sec. 1; T1N, R3E, Secs. 2–6, 11 & 12 <sup>b</sup>	Yes	Historic canal	Euro-American/ A.D. 1868	Considered eligible
AZ T:12:244 (ASM)/ Phoenix St Railway	T2N, R2E, Sec. 36; T2N, R3E, Secs. 28, 29, & 32; T1N, R3E, Secs. 5, 6, 8, & 9 <sup>b</sup>	Yes	Historic street railway	Euro-American/ A.D. 1912	Considered eligible
AZ U:6:303 (ASM)/ Arizona Canal	T2N, R3E, Sec. 13; T2N, R4E, Secs. 18, 19, 20, 22, 27, 28, & 29; T3N, R3E, Sec. 32 <sup>b</sup>	Yes	Historic/modern canal	Euro-American/ A.D. 1885	Determined eligible
AZ U:9:67 (ASM)/ AZ T:12:24 (ASU)/ La Lomita	T1N, R3E, Sec. 1; T1N, R4E, Sec. 6	No	Prehistoric village	Hohokam/ A.D. 950–1100	Determined eligible
P:2:3 (GP)/Casa Chica	T1N, R2E, Sec. 12	Yes	Unknown	Unknown	Unknown
Cloverdale Site	T1N, R2E, Sec. 23	Yes	Unknown	Unknown	Unknown
Dos Casas	T1N, R3E, Sec. 12	No	Unknown	Unknown	Unknown
El Higo	T2N, R2E, Sec. 25	Yes	Unknown	Unknown	Unknown
Tierra Delta	T2N, R2E, Secs. 24 & 25	No	Unknown	Unknown	Unknown

<sup>a</sup> USGS Sunnyslope, Ariz., 7.5' 1965/1982; USGS Phoenix, Ariz., 7.5' 1952/1982; USGS Paradise Valley, Ariz., 7.5' 1965/1982; and Tempe, Ariz., 7.5' 1952/1982; <sup>b</sup> Location in project area vicinity.

**Table 18. Historic districts within one-quarter mile of the project area**

Historic district name	Location <sup>a</sup>	In project area?	Period of significance	Eligibility listing
Alvarado	T2N, R3E, Sec. 32	No	1900–1924, 1925–1949, 1950–1974	NRHP and PHPR
Brentwood	T1N, R3E, Sec. 3	No	1926–1956	PHPR
Campus Vista	T2N, R3E, Sec. 30	Yes	1939–1956	PHPR
Coronado	T2N, R3E, Sec. 33	Yes	1900–1924, 1925–1949	NRHP and PHPR
Country Club Park	T1N, R3E, Sec. 5	No	1925–1949	NRHP and PHPR
Del Norte Place	T2N, R3E, Sec. 31	Yes	1925–1949, 1950–1974	NRHP and PHPR
Earl Place	T2N, R3E, Sec. 27	No	1927–1942	PHPR
East Alvarado	T2N, R3E, Sec. 32	No	1925–1949	NRHP and PHPR
East Evergreen	T1N, R3E, Sec. 5	No	1909–1929	PHPR
Eastlake Park	T1N, R3E, Sec. 9	Yes	1890–1949	PHPR
Encanto Manor	T2N, R3E, Sec. 31	Yes	1945–1959	PHPR
Encanto Vista	T2N, R3E, Sec. 31	Yes	1943–1953	PHPR
Encanto-Palmcroft	T2N, R3E, Sec. 31	Yes	1925–1949	NRHP and PHPR
F. Q. Story Neighborhood	T1N, R3E, Sec. 6	Yes	1900–1924, 1925–1949	NRHP and PHPR
Fairview Place	T2N, R3E, Sec. 31	Yes	1925–1949	NRHP
Garfield	T1N, R3E, Sec. 4	Yes	1883–1942	PHPR
La Hacienda	T2N, R3E, Sec. 29	No	1926–1954	PHPR
Los Olivos	T2N, R3E, Sec. 32	Yes	1906–1935	PHPR
Margarita Place	T2N, R3E, Sec. 31	Yes	1927–1949	PHPR
Mathew Henson Public Housing Project	T1N, R3E, Sec. 7	Yes	1940–1941	PHPR
Medlock Place	T2N, R3E, Sec. 17	Yes	1926–1956	PHPR
North Encanto	T2N, R3E, Sec. 30	Yes	1939–1950	PHPR
North Garfield	T1N, R3E, Sec. 4	Yes	1887–1942	PHPR
Jakland/University Park	T1N, R3E, Sec. 6	Yes	1875–1899, 1900–1924, 1925–1949	NRHP and PHPR
Phoenix Commercial MRA	T2N, R2E, Sec. 36; T2N, R3E, Secs. 31–34; T1N, R2E, Secs. 1, 12, & 13; T1N, R3E, Secs. 7–10 & 15–18	Yes	1870–1947	NRHP
Phoenix Townsite	T1N, R3E, Sec. 8	Yes	1875–1899, 1900–1924	NRHP
Phoenix Union High School	T1N, R3E, Sec. 4	Yes	1900–1924, 1925–1949	NRHP and PHPR
Pierson Place	T2N, R3E, Sec. 20	Yes	1924–1956	PHPR
Roosevelt	T1N, R3E, Sec. 5	Yes	1875–1899, 1900–1924, 1925–1949	NRHP and PHPR
Villa Verde	T2N, R2E, Sec. 36	Yes	1928–1940	PHPR
Willo	T2N, R3E, Sec. 32	Yes	1900–1924, 1925–1949	NRHP and PHPR
Woodland	T1N, R3E, Sec. 7	Yes	1875–1899, 1900–1924, 1925–1949	NRHP and PHPR
Woodlea	T2N, R3E, Sec. 19	Yes	1928–1949	PHPR
Yaple Park	T2N, R3E, Sec. 20	Yes	1928–1940	PHPR

<sup>a</sup> USGS Sunnyslope, Ariz., 7.5' 1965/1982; USGS Phoenix, Ariz., 7.5' 1952/1982; USGS Paradise Valley, Ariz., 7.5' 1965/1982; and Tempe, Ariz., 7.5' 1952/1982.

**Table 19.** Cultural resources sites intersecting project alternatives

<b>Alternative</b>	<b>Site</b>	<b>Canal intersection</b>	<b>Historic district and properties</b>
0	None	AZ T:7:167 (ASM)/Grand Canal; 6 prehistoric	Los Olivos, Coronado
1	None	AZ T:7:167 (ASM)/Grand Canal	None
2	None	AZ U:6:303 (ASM)/Arizona Canal	None
3	None	AZ T:7:167 (ASM)/Grand Canal	Medlock Place, Pierson Place
4	None	AZ T:7:167 (ASM)/Grand Canal	None
5	None	None	None
6, nonstructural	N/A	N/A	N/A
7	AZ N:3:32 (ASM), AZ T:12:10 (ASM)	2 prehistoric	Encanto-Palmcroft, Margarita Place, Del Norte Place, North Encanto, Encanto Manor, Encanto Vista, Villa Verde
8	AZ T:12:10 (ASM), El Higo	AZ T:7:167 (ASM)/Grand Canal; 6 prehistoric	North Encanto
9	None	None	North Encanto
10	None	AZ T:7:167 (ASM)/Grand Canal; 7 prehistoric	Woodlea, Campus Vista, North Encanto, Margarita Place, Del Norte Place, Encanto Manor, F.Q. Story Neighborhood, Encanto-Palmcroft, Fairview Place
11	None	AZ T:7:167 (ASM)/Grand Canal; 6 prehistoric	Yaple Park, Willo, Roosevelt, Kenilworth, Encanto Vista
12, nonstructural	N/A	N/A	N/A
13, nonstructural	N/A	N/A	N/A
14	None	AZ T:7:167 (ASM)/Grand Canal; 2 prehistoric	Pierson Place
15, nonstructural	N/A	N/A	N/A
16	AZ FF:9:17 (ASM), AZ T:12:62 (ASM), AZ T:12:244 (ASM)	2 prehistoric	North Garfield, Garfield, Eastlake Park
17	AZ T:12:70 (ASM)	AZ T:12:222 (ASM)/Salt River Valley Canal; 3 prehistoric	North Garfield, Garfield, Phoenix Union High School
18	AZ FF:9:17 (ASM), AZ T:10:84 (ASM), AZ T:12:43 (ASM), AZ T:12:70 (ASM), AZ T:12:72 (ASM), AZ T:12:244 (ASM)	5 prehistoric	Garfield, Phoenix Union High School, Phoenix Townsite
19	AZ T:12:45 (ASM), AZ T:12:244 (ASM)	1 prehistoric	F.Q. Story Neighborhood, Roosevelt
20	AZ T:10:84 (ASM), AZ T:12:33 (ASM), AZ T:12:34 (ASM), AZ T:12:39 (ASM), AZ T:12:42 (ASM), AZ T:12:44 (ASM), AZ T:12:97 (ASM), AZ T:12:113 (ASM), AZ T:12:148 (ASM)	4 prehistoric	None
21	AZ FF:9:17 (ASM), AZ T:12:148 (ASM), AZ T:12:4 (ASM), AZ T:12:244 (ASM)	AZ T:12:222 (ASM)/Salt River Valley Canal; 2 prehistoric	F.Q. Story Neighborhood, Oakland, Woodland
22	AZ FF:9:17 (ASM), AZ N:3:32 (ASM)	AZ T:12:222 (ASM)/Salt River Valley Canal; 6 prehistoric	Medlock Place, Pierson Place, Oakland
23	AZ T:12:56 (ASM)	5 prehistoric	None
24	None	1 prehistoric	None

*continued*

**Table 19. Cultural resources sites intersecting project alternatives**

<b>Alternative</b>	<b>Site</b>	<b>Canal intersection</b>	<b>Historic district and properties</b>
25	AZ T:12:148 (ASM)	3 prehistoric	Mathew Henson Public Housing Project
26	AZ T:10:84 (ASM), Cloverdale Site, AZ T:12:214 (ASM), P:2:3 (GP)	AZ T:10:83 (ASM)/Roosevelt Canal; 13 prehistoric	None
27	None	4 prehistoric	None
28	AZ FF:9:17 (ASM), AZ T:10:84 (ASM)	3 prehistoric	Cisney House
29	AZ FF:9:17 (ASM), AZ T:12:1 (ASM), AZ T:12:50 (ASM), AZ T:12:62 (ASM)	AZ T:12:222 (ASM)/Salt River Valley Canal; 7 prehistoric	None
30/31	None	AZ U:6:303 (ASM)/Arizona Canal	Pratt House
32	None	None	None