

**DRAINAGE RECOMMENDATIONS
OF
LOCAL DRAINAGE PROBLEMS
NORTH AND CENTRAL SERVICE CENTERS**

INDEX NO. ST-955237

Prepared

for

City of Phoenix



by

**PRIMATECH ENGINEERS
2929 N. 44th Street, Suite 228
Phoenix, Arizona, 85018**

February 28, 1997

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INTRODUCTION

The City of Phoenix originally identified 45 sites in the North and Central Service Districts with local drainage problems. Eight of these sites were ultimately eliminated from this study because the problems were already resolved, or they would be resolved under other ongoing improvement projects.

The problems varied from site to site and included house flooding, right-of-way flooding, and/or street flooding. This project encompassed a study and assessment of each drainage problem. The work at each site involved investigation, research of existing City of Phoenix files, identification of alternative solutions, determination of sites programmed for future construction or study, and selection of the recommended alternative. Preliminary drawings and cost estimates were prepared for each recommended alternative to determine order of magnitude or budgetary costs.

Table 1 lists the project site numbers, their address, and drainage problem experienced.

DATA GATHERING AND METHODOLOGY

Available City quarter-section maps showing water, wastewater, storm drain, right-of-way, and topography were acquired from the City's Central Records Department. A search was also performed for projects which were programmed for future study, design and/or construction which impacted any of the 38 sites studied under this contract. These project types included major streets, sewer, storm drain, paving, landscape, drainage, and water.

Information on some of the sites was not available due to their location in older portions of the City. In these instances, the Flood Control District of Maricopa County (FCDMC) and Maricopa County Department of Transportation (MCDOT) were contacted for information.

Property owners were contacted and historic flooding conditions documented to properly assess the problem and recommend the appropriate alternative solutions.

As an alternative source of information, US Geological Survey (USGS) 7.5 minute quadrangle maps were acquired for the sites and their upstream contributing drainage areas were delineated.

Where possible, discharges were taken directly from approved drainage reports or Federal Emergency Management Agency (FEMA) Flood Insurance Studies. When no discharge values were available, the *City of Phoenix Storm Drain Design Manual, Subdivision Drainage Design, Development Services Infrastructure Review, July 1988*, was used to identify and quantify the factors used in the rational equation to estimate the runoff discharge. Runoff coefficients were selected based on probable future land use. The City's intensity-duration-frequency curves (page 26 of the Manual) were used to select the intensity value when the duration was set to the time of concentration.

**CITY OF PHOENIX
PRELIMINARY STUDY OF LOCAL DRAINAGE PROBLEMS
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TABLE 1

CENTRAL SERVICE AREA

PRIORITY	SITE NO.	LOCATION	DRAINAGE PROBLEM EXPERIENCED
Normal Drainage Problem / Site			
*1	23 <i>all?</i>	917 East McLellan	House Floods
2	24	1307 West Lawrence	House Floods
3	40	East Side of Central, Butler to Bethany Home Road	Driveways Washout
4	25	525 West Hayward	2-Inch Pipe Too Small
5	22	11th Avenue and Tuckey	Drain Too Small
Complex Drainage Problem / Site			
1	17	1327 East Cheryl	4-Inch Pipe Too Small
2	39	Central and Bethany Home Road, NE Corner	8-Inch Drain Too Small
3	29	11th Place South of Griswold	Yard Floods
4	30	11th Place South of Harmont	Yard Floods
*5	34	10th Street and Dunlap	Street Floods
*6	35	10th Street and Townley	Street Floods
*7	36	10th Street and Alice	Street Floods
8	27	23rd Avenue, Dunlap to Northern	Storm Drain has Baffles
Very Complex Drainage Problem / Site			
1	19	10210 North 15th Avenue	House Floods
2	37	16th Street and Myrtle	Street Floods
3	43	24th Avenue and Camelback	Property Floods
4	18	10035 North 13th Place	Drainage Way Too Small

PRIORITY	SITE NO.	LOCATION	DRAINAGE PROBLEM EXPERIENCED
5	21	5608 North 9th Street	House Floods
6	20	2504 West San Miguel	House Floods
7	28	10th Street and El Caminito	Need New Pump
8	31	12th Street and Kaler	Street Floods
9	26	6516, 6528, 6542 North 17th Avenue	Condominiums Flood
10	33	Hatcher East of Cave Creek	Street Floods
11	32	13th Street and Belmont	Street Floods
12	38	36th Street North of Lincoln Drive	Rock Slide
13	42	4505 North 11th Avenue	Property Floods

NORTH SERVICE AREA

PRIORITY	SITE NO.	LOCATION	DRAINAGE PROBLEM EXPERIENCED
Normal Drainage Problem / Site			
*1	44	1410 East Sandra Terrace	Property Flooding
Complex Drainage Problem / Site			
1	4	2500 East John Cabot	ROW / Street Flooding
2	14	7th Street, Beardsley Road to Deer Valley	ROW / Street Flooding
3	12	7th Avenue and Union Hills	ROW / Street Flooding
4	15	13201 North 21st Place	ROW / Private Property Flooding
5	16	35th Avenue South of Mohawk	ROW/ Street Flooding
*6	7	3400 East Bell Road	ROW / Street Flooding
*7	13	7th Street, Bell to Union Hills	ROW / Street Flooding
8	41	2200 East Everett	Private Property Flooding

<i>PRIORITY</i>	<i>SITE NO.</i>	<i>LOCATION</i>	<i>DRAINAGE PROBLEM EXPERIENCED</i>
<i>Very Complex Drainage Problem / Site</i>			
1	9	2800 West Louise	ROW / Street Flooding
2	3	2501 East Hartford	ROW / Private Property Flooding
3	1	16240 North 15th Avenue	Private Property Flooding
4	6	16640 North 25th Street	ROW / Private Property Flooding
5	45	19th Avenue From Rose Garden to Pinnacle Peak	ROW / Street Flooding
6	10	Coral Gables North of Thunderbird	ROW / Street Flooding
7	11	7th Avenue North of Coral Gables	ROW / Street Flooding
*8	8	2631 East Behrend	Private Property Flooding
9	2	1800 East Campobello	ROW / Street Flooding
10	5	2500 East Bell Road	ROW / Street Flooding

*Sites eliminated because drainage problems were already resolved or would be resolved under other ongoing improvement projects.

NORTH DISTRICT SITES

1. Site 1 — 17240 North 15th Avenue

1.1 Location and Site Description

This site is a house located on 15th Avenue, north of Bell Road and west of Cave Creek Wash in a residential neighborhood (see Site 1- Vicinity Map, Figure 1). An 18-inch storm drain with inlets begins approximately 150 feet north of Bell Road and connects to the 36-inch storm drain at Bell Road.

1.2 Problem Identification

Water flows south from Grovers Avenue, exceeds the capacity of the gutter, and overtops the curb and floods the property. The situation is aggravated by berms which have been placed across the side streets which intersect with 15th Avenue from the west between Grovers Avenue and Bell Road. These berms prevent flows from diverting onto the side streets from 15th Avenue, increasing the demand on the gutter. The topography shown on City of Phoenix maps suggests that flows would divert to the side streets if these berms were not in place (see Site 1 - Problem Identification, Figure 2).

1.3 History

Residents have stated that when the City of Phoenix installed a sewer line in 15th Avenue, the road was changed from an inverted crown to a normal crown. Prior to this change, there were no flooding problems. The property owner has erected a brick border at the front of his yard which blocks the flow from entering his property.

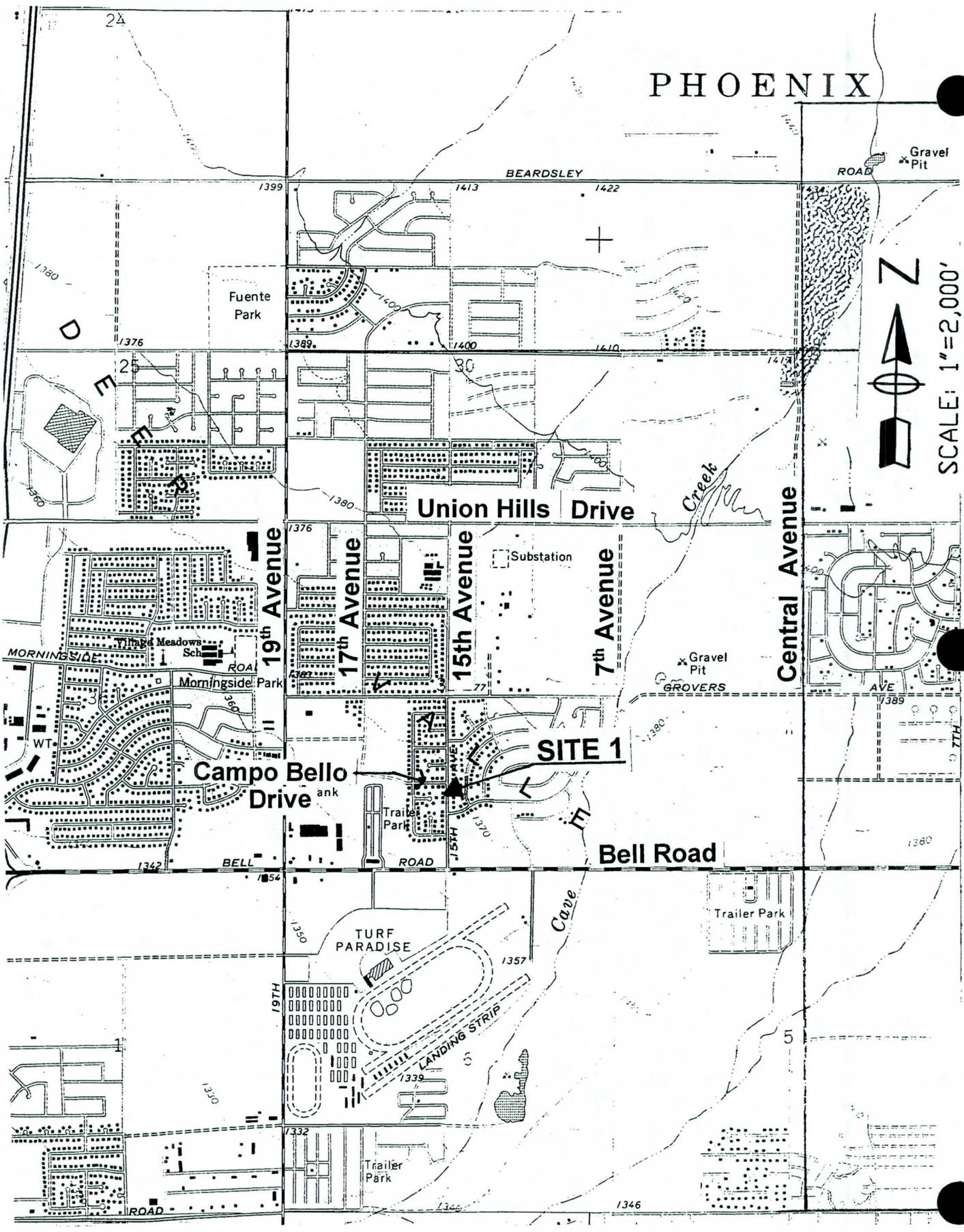
The City of Phoenix has reported that the house directly south of Site 1 has also experienced flooding. This property owner has constructed walls to prevent water inflows.

1.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

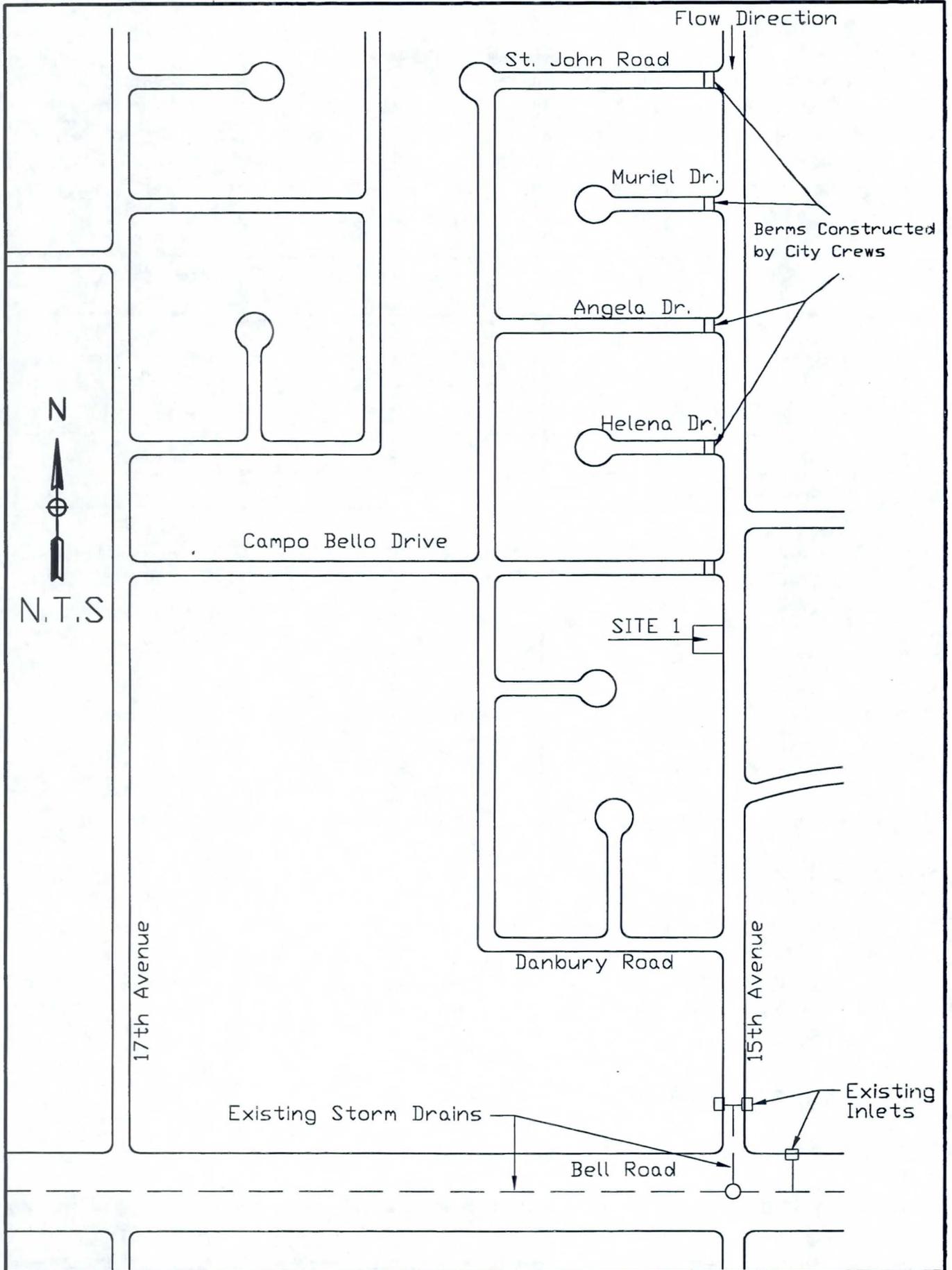
- USGS 7.5-minute quadrangle map for Union Hills which contains Site 1 and its upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Maps M-7 and M-8.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.
- City of Phoenix Quarter Section Wastewater Maps.

PHOENIX



SITE 1 - VICINITY MAP

FIGURE 1



SITE 1 - PROBLEM IDENTIFICATION

FIGURE 2

1.5 Hydrology

The values for the runoff amount for the different design periods were calculated using the Rational Method. For the purpose of this study, engineering judgments were used to make assumptions required to facilitate calculations. A detailed hydrologic study of the area was not performed. Local discharge is the portion of flow on 15th Avenue which originates from the drainage area south of Grovers Avenue. Distant discharge is the flow which originates from the drainage area north of Grovers Avenue and may not be intercepted by Grovers Avenue.

<i>Frequency (yr)</i>	<i>Local Discharge (cfs)</i>	<i>Distant Discharge (cfs)</i>	<i>Total Discharge (cfs)</i>
100	29.5	38	68
50	26.3	33.6	60
25	23.7	29.2	53
10	20.6	24.8	45
2	12.6	15.4	28

The gutter capacity of 15th Avenue was determined to be sufficient to carry the local discharge from the 2-year storm event without overtopping. The storm drain on 15th Avenue is sized to carry this flow.

1.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no projects planned which will impact this site.

1.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1215 H, revised September 30, 1995. The area is designated as Shaded Zone X, which denotes areas within the 500-year floodplain.

1.8 Alternative Solutions

Alternative 1 — Construct a Storm Drain from Campo Bello Drive to Bell Road

This alternative proposes to extend the existing storm drain that runs below 15th Avenue from

Bell Road to approximately 150 feet north of Bell Road. The 18-inch storm drain will be extended an additional 1,100 feet to the Campo Bello Drive intersection. Two Type A Inlets, per MAG Detail #530, will be constructed on either side of 15th Avenue south of the Campo Bello Drive intersection. The storm drain will intercept the flow from the 2-year storm event.

Alternative 2 — Repave 15th Avenue with an Inverted Crown

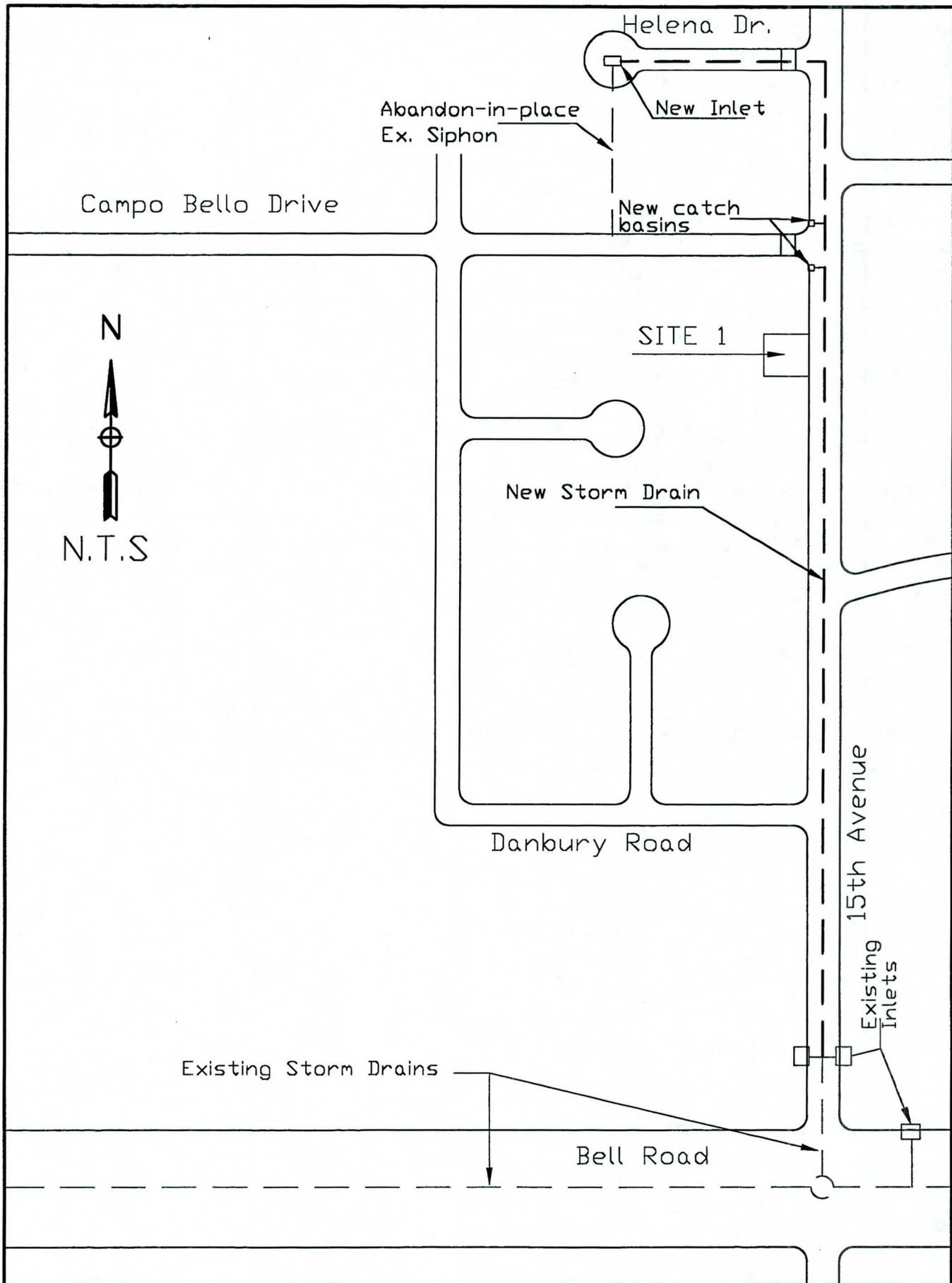
This alternative proposes to repave 15th Avenue from Grovers Avenue to Bell Road to create an inverted crown to carry the flow down the street centerline. A new at-grade, grated catch basin inlet on the centerline will be added to the two existing inlets located approximately 150 feet north of Bell Road. The center of the roadway will have a 4-foot concrete center channel to carry the flow. The roadway will transition back to a crowned road at the Bell Road intersection.

Alternative 3 — Construct Berms Around the Property at Site 1

This alternative proposes to construct a protective berm in front of the property at Site 1 so that flows do not enter the property. The gutter capacity was determined to be sufficient to carry the 2-year flow. This suggests that the flooding is site specific to Site 1. This alternative will require the property owner's approval for the construction. A 4-inch berm will prevent flows from the 2-year storm event from entering the property. In addition, a short section of the sidewalk and gutter north of the property will be modified to remove an unused driveway entrance. The driveway for the property at Site 1 will also be regraded to create a berm across the entrance.

1.9 Recommended Alternative

The City of Phoenix has requested that Alternative 1 be implemented (see Site 1 - Preferred Alternative, Figure 3). This alternative will be revised to extend the new storm drain section to Helena Drive. The existing siphon in Helena Drive will be abandoned and an additional catch basin installed.



SITE 1 - PREFERRED ALTERNATIVE

FIGURE 3

1.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Structural Excavation	2,000 YD ³	\$9.00/YD ³	\$ 18,000
Backfill	2,000 YD ³	\$15.00/YD ³	30,000
30" Concrete Pipe	1,100 LF	\$45.00/LF	49,500
Type A Inlets	2 Each	\$1,200/Each	2,400
Modify Storm Drain	1 Each	\$2,000/Each	2,000
Asphalt Paving	150 Tons	\$32.00/Ton	4,800
Subtotal			\$106,700
20% Contingency			21,300
Total			\$128,000

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Roadway Excavation	5,000 YD ³	\$2.00/YD ³	\$10,000
Concrete Surfacing	10,000 FT ²	\$2.50/FT ²	25,000
Asphalt Paving	3,000 Ton	\$32.00/Ton	96,000
Subtotal			\$131,000
20% Contingency			26,200
Total			\$157,200

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Modify Sidewalk & Gutter	1 Each	\$800/Each	\$800
Modify Driveway	1 Each	\$800/Each	800
Berm Construction	1 Each	\$400/Each	400
Subtotal			\$2,000
20% Contingency			400
Total			\$2,400

2. SITE 2 — 1800 East Campo Bello

2.1 Location and Site Description

This site is a portion of Campo Bello Drive that is crossed by a small wash at approximately 18th Street (see Site 2 - Vicinity Map, Figure 1). This location is north of Bell Road in an area that is a partially developed residential neighborhood. A new, fenced apartment complex development is being built on the north side of Campo Bello Drive. The grading for this development has removed the wash. A trailer park community is approximately 100 feet east of the site on the north side of Campo Bello Drive.

2.2 Problem Identification

Due to a local low point in Campo Bello Drive, water ponds where the wash crosses the street. The wash brings flow from the north to Campo Bello Drive. Water passes through openings in a block fence on the south side of Campo Bello Drive and continues through a vacant lot to Bell Road. City of Phoenix topographic maps show that flows from the trailer park are also directed to Campo Bello Drive, which may contribute to the flooding (see Site 2 - Problem Identification, Figure 2).

2.3 History

The portion of Campo Bello Drive at the wash crossing previously experienced flooding. However, the wash which contributed to the flooding has been removed by new development on the north side of Campo Bello Drive. It is no longer clear what path the flow will travel as a result of the new construction. Block fencing separates the new development from Campo Bello Drive and should dam flows from traveling through the development to Campo Bello Drive. Flow from the trailer park community will still travel to the crossing and continue south in the wash to Bell Road.

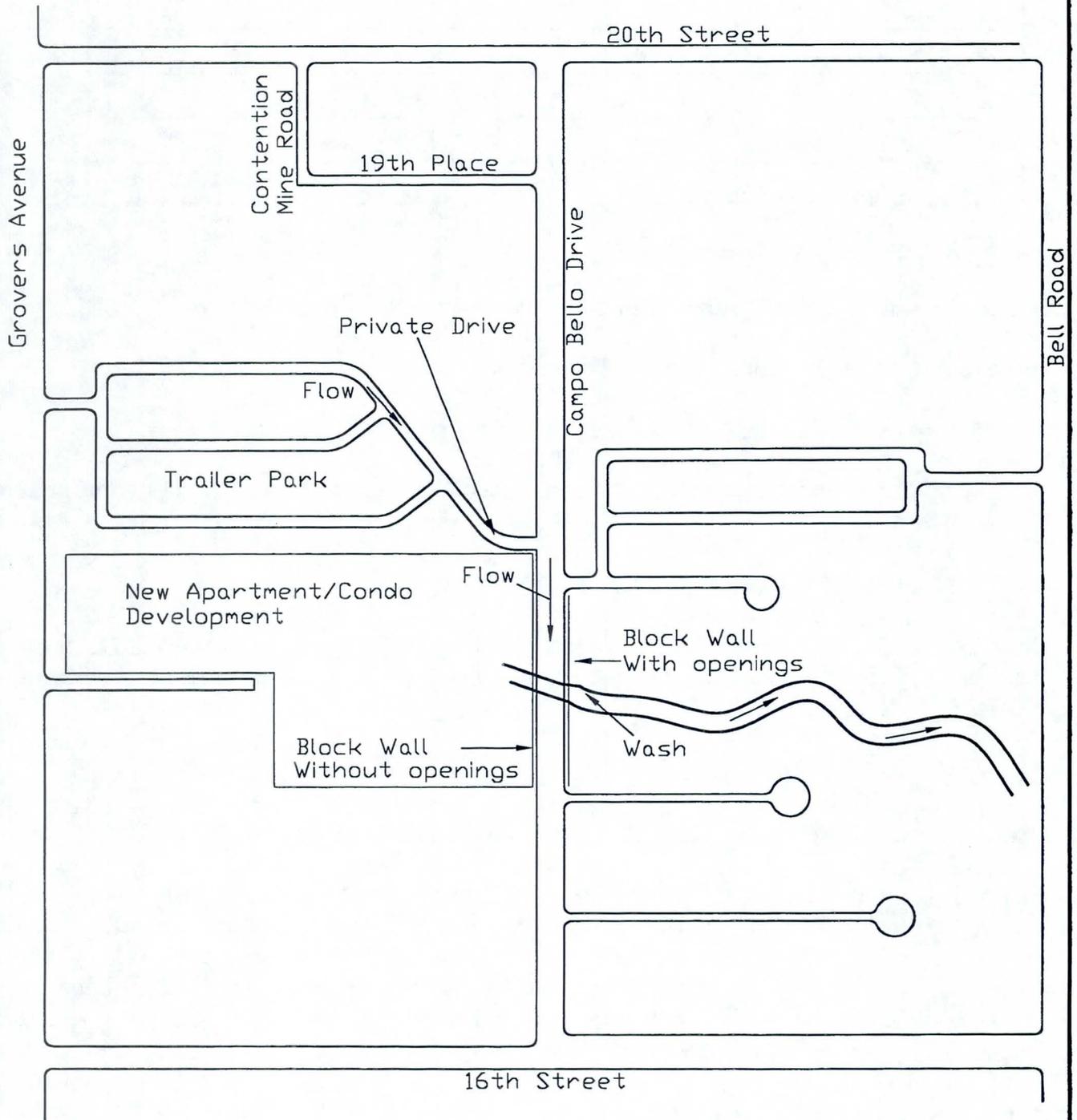
2.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Union Hills which contains Site 2 and its upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Map M-9.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.

2.5 Hydrology

The values for the runoff amount for the different design periods were calculated using the Rational Method. For the purpose of this study, engineering judgments were used to make



SITE 2 - PROBLEM IDENTIFICATION

FIGURE 2

assumptions required to facilitate calculations. A detailed hydrologic study of the area was not performed. Local discharge is the flow that originates in the trailer park community and flows west on Campo Bello Drive to the area of the wash.

<i>Frequency (yr)</i>	<i>Local Discharge (cfs)</i>
100	39
50	35
25	31
10	27
2	16

2.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix has programmed the construction of a storm drain on Bell Road from 20th Street to Cave Creek Road.

2.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1220 G, revised October 4, 1995. The area is designated as Shaded Zone X, which denotes areas within the 500-year floodplain.

2.8 Alternative Solutions

Alternative 1 - Improve Campo Bello Drive to Remove Local Low Point

This alternative proposes to improve flow on Campo Bello Drive by regrading the street to remove the low point and installing gutters. A 1,300-foot section of curb and gutter will be installed from the trailer park entrance to the 16th street intersection on both sides of Campo Bello Drive. Drainage openings in the curb will be constructed at the section of Campo Bello Drive that crosses the wash to allow flow into the wash. Flows could then be diverted from Campo Bello Drive and into their natural flow path in the wash.

2.9 Recommended Alternative

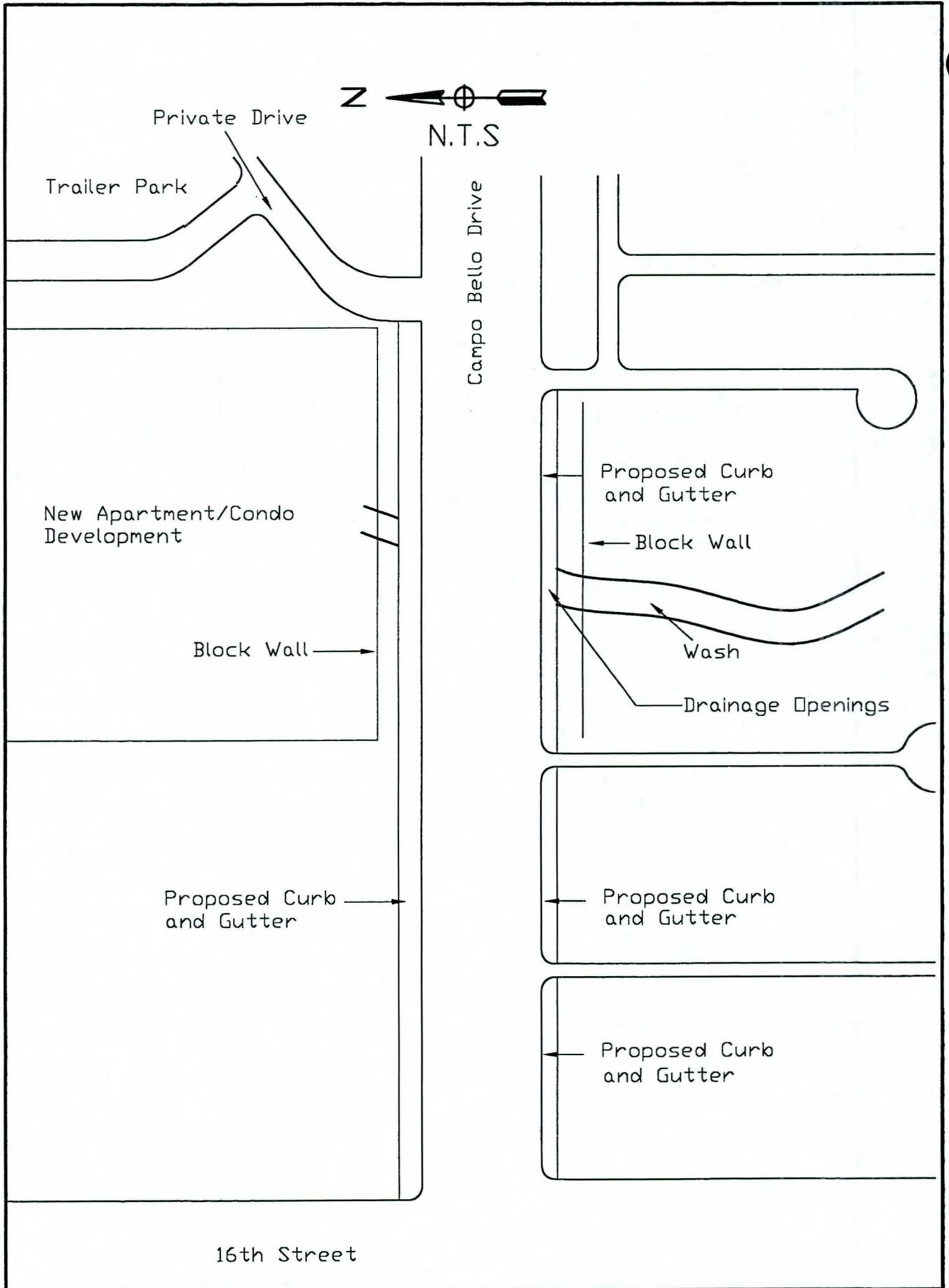
The City of Phoenix has indicated that Alternative 1 is the preferred long-term solution (see Site

2 - Preferred Alternative, Figure 3). However, the City has indicated that the implementation of this alternative should be delayed and coordinated with the future development of the site. The current plan of action at this location is to work with the property owner to improve the existing wash and wall openings.

2.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Roadway Excavation	400 YD ³	\$3.50/YD ³	\$ 1,400
Curb and Gutter	2,600 LF	\$6.50/LF	16,900
Regrade Roadway	6,000 FT ²	\$2.00/FT ²	12,000
Asphalt Paving	156 Tons	\$32.00/Ton	5,000
<i>Subtotal</i>			\$35,300
<i>20% Contingency</i>			7,100
<i>Total</i>			\$42,400



SITE 2 - PREFERRED ALTERNATIVE

FIGURE 3

3. SITE 3 — 2501 East Hartford Avenue SITE 5 — Bell Road at 25th Street

3.1 Location and Site Description

The cause of the flooding problems at these two sites is the same. Site 3 is a private lot that crosses an existing wash south of Hartford Avenue north of Bell Road and east of Cave Creek Road. Site 5 is a private lot on Bell Road at the 25th Street intersection (see Sites 3 & 5 - Vicinity Map, Figure 1). This is a partially developed residential neighborhood with new units being constructed. The site is bound on the south by small businesses and industrial lots on Bell Road.

3.2 Problem Identification

Water flows in an existing wash that begins at Campo Bello Drive and outlets south of Hartford Avenue onto private property which has filled in the wash (see Sites 3 & 5 - Problem Identification, Figure 2). The wash had previously continued on south to Bell Road. City of Phoenix topographic maps show that the Hartford Avenue Wash is the focal point for local drainage. The water which outlets at the end of the wash floods Sites 3 and 5.

Water that remains ponded in the wash may also raise odor and vermin concerns. In addition, the wash has become heavily overgrown with weeds. These conditions create a good breeding site for mosquitoes and rodents.

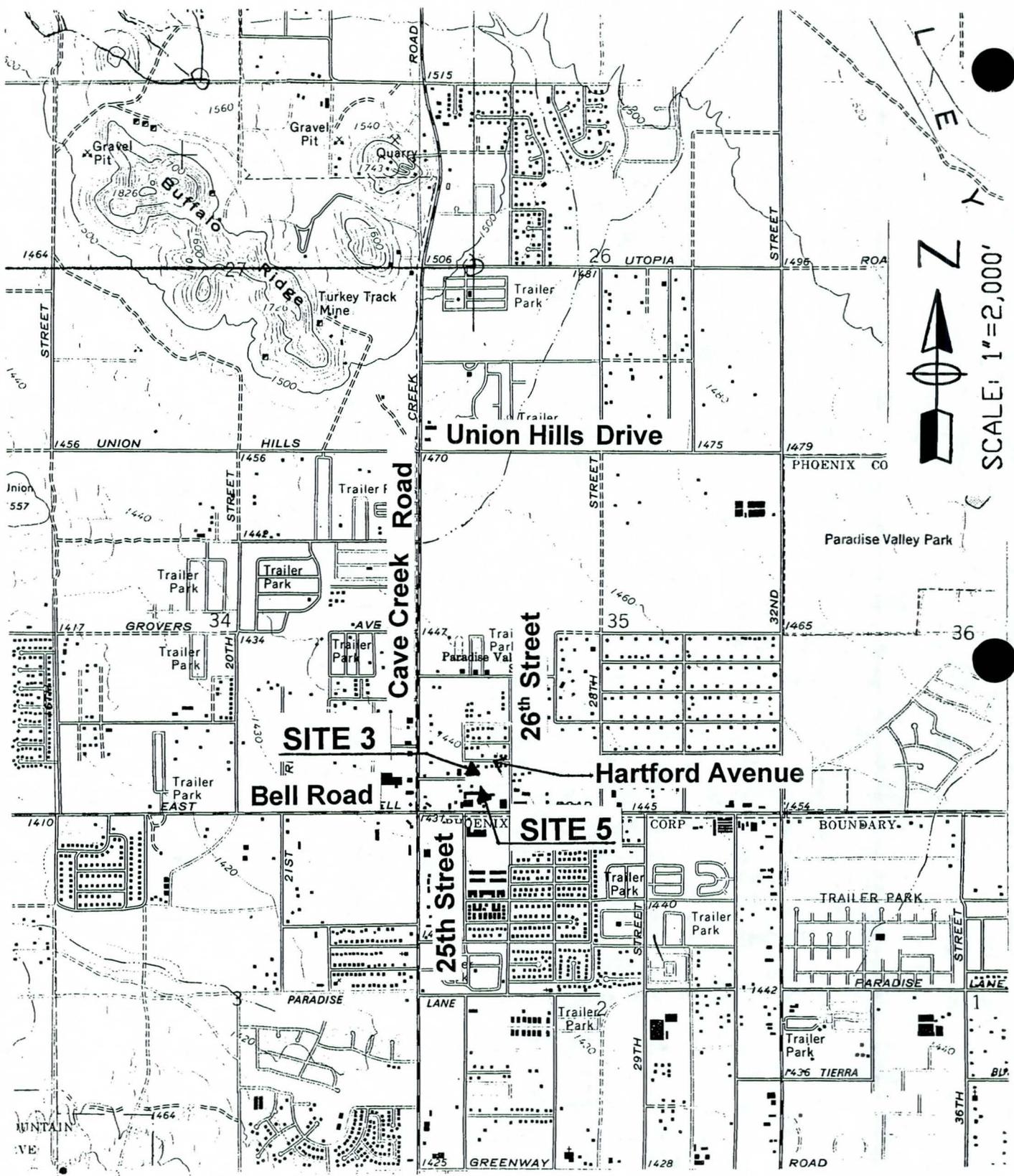
3.3 History

Historically, the wash crossed Bell Road. However, over the years, development has eliminated the continuation of the wash to Bell Road. The property adjacent to the wash on the south prevents flow from traveling to Bell Road as it had done previously. Without a defined outlet, the wash holds the water and floods neighboring properties and Hartford Avenue. Recently, a new storm drain system was installed and street improvements made to Bell Road. A storm drain trunk line to the Bell Road main has also been installed in Cave Creek Road.

3.4 Site Specific Data Acquisition

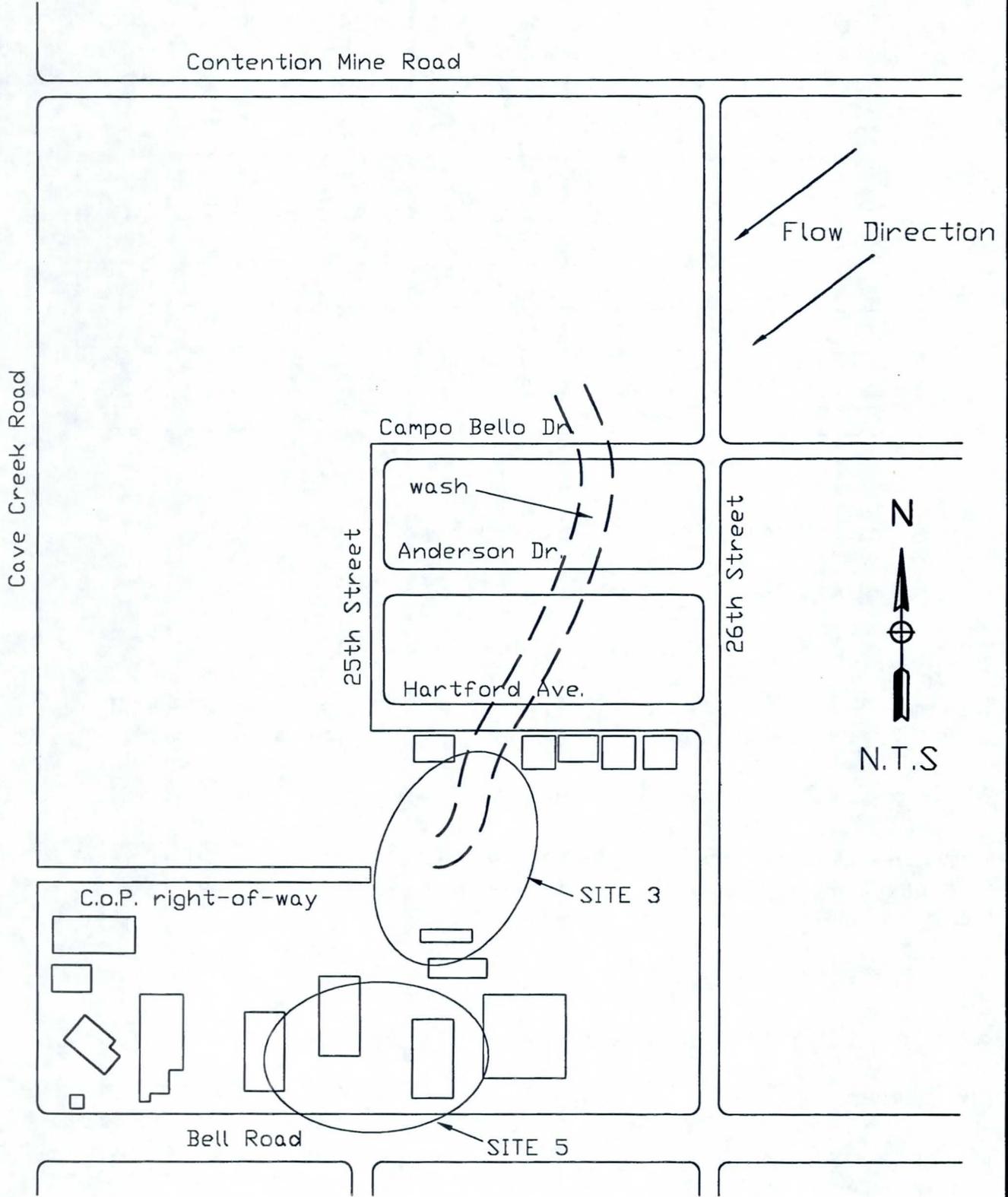
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Union Hills which contains Sites 3 and 5 and the upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Map M-9.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.



SITE 3 & 5 - VICINITY MAP

FIGURE 1



SITES 3 & 5 - PROBLEM IDENTIFICATION

FIGURE 2

3.5 Hydrology

The values for the runoff amount for the different design periods were calculated using the Rational Method. For the purpose of this study, engineering judgments were used to make assumptions required to facilitate calculations. A detailed hydrologic study of the area was not performed. Local discharge is the flow that originates from the drainage area east of 26th Street and south of Contention Mine Road.

<i>Frequency (yr)</i>	<i>Local Discharge (cfs)</i>
100	62
50	55
25	50
10	43
2	26

3.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix has started the construction of a storm drain on Bell Road from 20th Street to 32nd Street. Street improvements are also being done on Bell Road.

3.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1220 G, revised October 4, 1995. The area is designated as Shaded Zone X, which denotes areas within the 500-year floodplain.

3.8 Alternative Solutions

Alternative 1 - Construct a Drainage Swale at 26th Street

This alternative proposes to improve 26th Street to carry the 2-year flow past Hartford to Bell Road. A drainage swale will be dug along 26th Street from Contention Mine Road to Bell Road. Pipes will carry the flow beneath the Campo Bell Drive, Anderson Drive, and Hartford Avenue intersections with 26th Street. A 2-foot-deep, 4-foot-wide channel, with a 24-inch pipe at the intersection crossing, will be sufficient to handle the 2-year flow. Gunitite will be used in the channel for erosion protection.

Alternative 2 - Use City Right-of-Way for a Storm Drain to Cave Creek Road

This alternative proposes the construction of a 24-inch storm drain from the wash to the storm drain trunk line at Cave Creek Road. Right-of-way is shown on City of Phoenix maps from the end of the wash to Cave Creek Road. By sizing the pipe to carry only the 2-year flow, the storm drain capacity is not affected and the wash can be drained of flows from larger storm events.

Alternative 3- Construct a Storm Drain to Bell Road

This alternative proposes to construct a 24-inch storm drain to carry the 2-year flow from the wash to the new storm drain on Bell Road. By sizing the pipe to carry only the 2-year flow, the storm drain capacity is not affected and the wash can be drained of flows from larger storm events. This alternative will require that right-of-way be acquired for the construction of the storm drain. This cost is not included in the estimate.

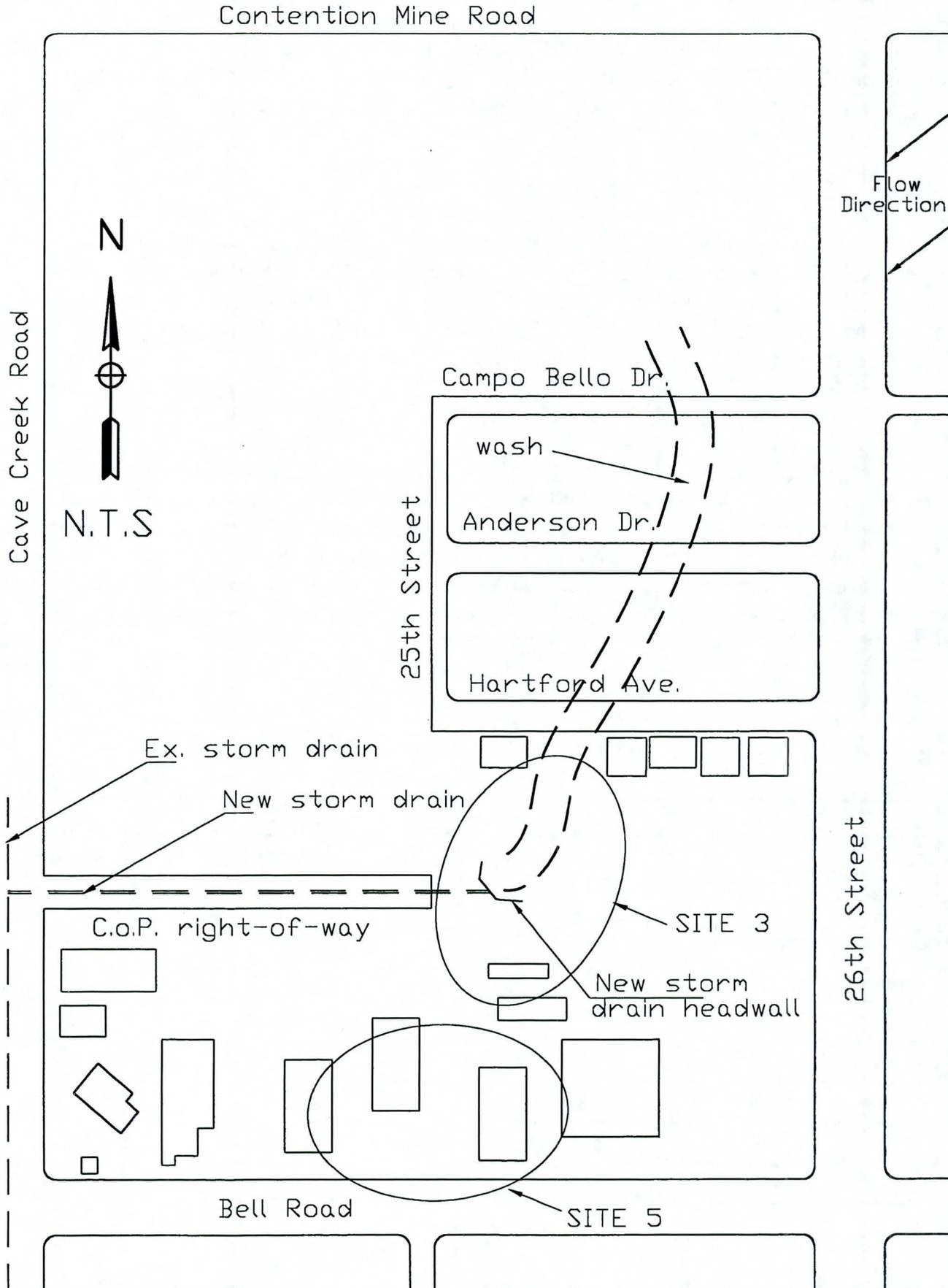
3.9 Recommended Alternative

The City of Phoenix has indicated that Alternative 2 most directly addresses the issues at this site (see Sites 3 & 5 - Alternative 2, Figure 3). The City also indicated that Alternative 1, while reducing the flow that will reach the site, will also address some existing problem locations along 26th Street (see Sites 3 & 5, Alternative 1, Figure 4). Therefore, the City has requested that both alternatives be implemented if adequate funding is available. If funds are not available to implement both, then Alternative 2 is the desired action. If sufficient funding is not available for Alternative 2, then Alternative 1 shall be implemented.

3.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	800 YD ³	\$3.50/YD ³	\$2,800
24" Corrugated Pipe	150 LF	\$35.00/LF	5,300
Roadway Excavation	60 YD ³	\$9.00/YD ³	500
Backfill	60 YD ³	\$15.00/YD ³	900
Gunite	200 YD ³	\$18.00/YD ³	3,600
Asphalt Paving	20 Tons	\$32.00/Ton	600
<i>Subtotal</i>			\$13,700
<i>20% Contingency</i>			2,700
<i>Total</i>			\$16,400



SITES 3 & 5 - ALTERNATIVE 2

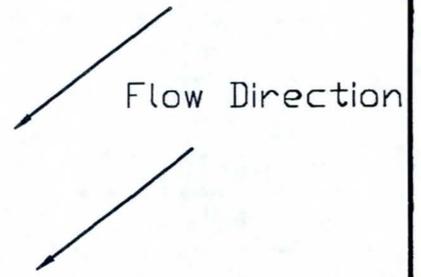
FIGURE 3



Contention Mine Road

New Drainage swale

26th Street



24" pipe for
culvert crossing

Campo Bello Dr.

wash

Anderson Dr.

25th Street

24" pipe for
culvert crossing

Hartford Ave.

24" pipe for
culvert crossing

SITE 3

SITE 5

Bell Road

SITES 3 & 5 - ALTERNATIVE 1

FIGURE 4

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	800 YD ³	\$3.50/YD ³	\$ 2,800
24" Pipe	700 LF	\$40.00/LF	28,000
Headwall & Inlet	1 Each	\$1,700/Each	1,700
Modify Existing Storm Drain	1 Each	\$3,000/Each	3,000
Backfill	800 YD ³	\$15.00/YD ³	12,000
<i>Subtotal</i>			\$47,500
<i>20% Contingency</i>			9,500
<i>Total</i>			\$57,000

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	600 YD ³	\$3.50/YD ³	\$ 2,100
24" Pipe	500 LF	\$40.00/LF	20,000
Headwall & Inlet	1 Each	\$1,700/Each	1,700
Modify Existing Storm Drain	1 Each	\$3,000/Each	3,000
Backfill	600 YD ³	\$15.00/YD ³	9,000
<i>Subtotal</i>			\$35,800
<i>20% Contingency</i>			7,200
<i>Total</i>			\$43,000

4. Site 4 — 2500 E. John Cabot

4.1 Location and Site Description

This site is located south of the Cave Creek Road and Union Hills intersection in Township 4 North, Range 3 East, along the section line between Sections 34 and 35 of the Gila and Salt River Base and Meridian. The East Fork of Cave Creek Wash runs in an east/west direction through this site and drains to Cave Creek Wash Flood Control Detention Basin No. 3. This detention basin also functions as a park. (See Site 4 - Vicinity Map, Figure 1.)

John Cabot runs from east to west along the north side of Detention Basin 3A on the west side of Cave Creek Road. Single family residences are located along its north right-of-way. Grovers Avenue runs from east to west along the south edge of Detention Basin 3A. Single family homes are located along its south right-of-way.

Upstream of the wash is an earthen channel which was improved with the construction of Pepper Ridge Town Homes Unit 1. The south and east banks of the wash are stabilized by placed rip-rap and are adjacent to Pepper Ridge Town Homes Unit 3. Flow from this channel is directed under Cave Creek Road through two 10'x10' concrete box culverts (CBC). A concrete drop inlet is located upstream of the CBC and extends about 50 feet upstream. A U-shaped headwall is located on the upstream end of the CBC. Rip-rap was placed to protect the fill slope and extends north and south of the headwall along the east fill slope of Cave Creek Road. Tract C, part of Pepper Ridge Town Homes Unit 1, is vacant land and serves as temporary storage for flood waters during major storms.

A concrete apron is located at the outlet of the CBC. At the end of the apron is a weir with a lip which is three feet higher than the bottom of the apron. Two 4-inch pipes are installed approximately 1.5 feet from the bottom of the weir. A grated catch basin in the bottom of the concrete apron drains the water which is ponded by the weir. The catch basin is drained by a 4-inch pipe. Flows which fall over the weir tumble down a stair-type energy dissipator. A portion goes through a large grate at the base of the dissipator into an underground pipe and is discharged downstream of the detention basin. Flows in excess of the capacity of the pipe are detained by the detention basin.

A low-flow pipe consisting of 1-72" reinforced concrete pipe (RCP) is designed to convey the 2-year storm under the detention basin. At Grovers Avenue, the pipe splits into 2-54" RCPs and continues to the junction structure located at 20th Street. The outfall of this junction structure is a 108-inch pipe.

4.2 Problem Identification

After each large storm, substantial volumes of sediment are delivered to the site by flood waters. Some of the sediment is deposited on the upstream side of the Cave Creek Road culverts. However, a sufficient quantity of sediment flows through the culverts and is trapped by the weir located downstream from the culvert. The sediment plugs the three 4-inch drain pipes and fills

SITE 4 - VICINITY MAP

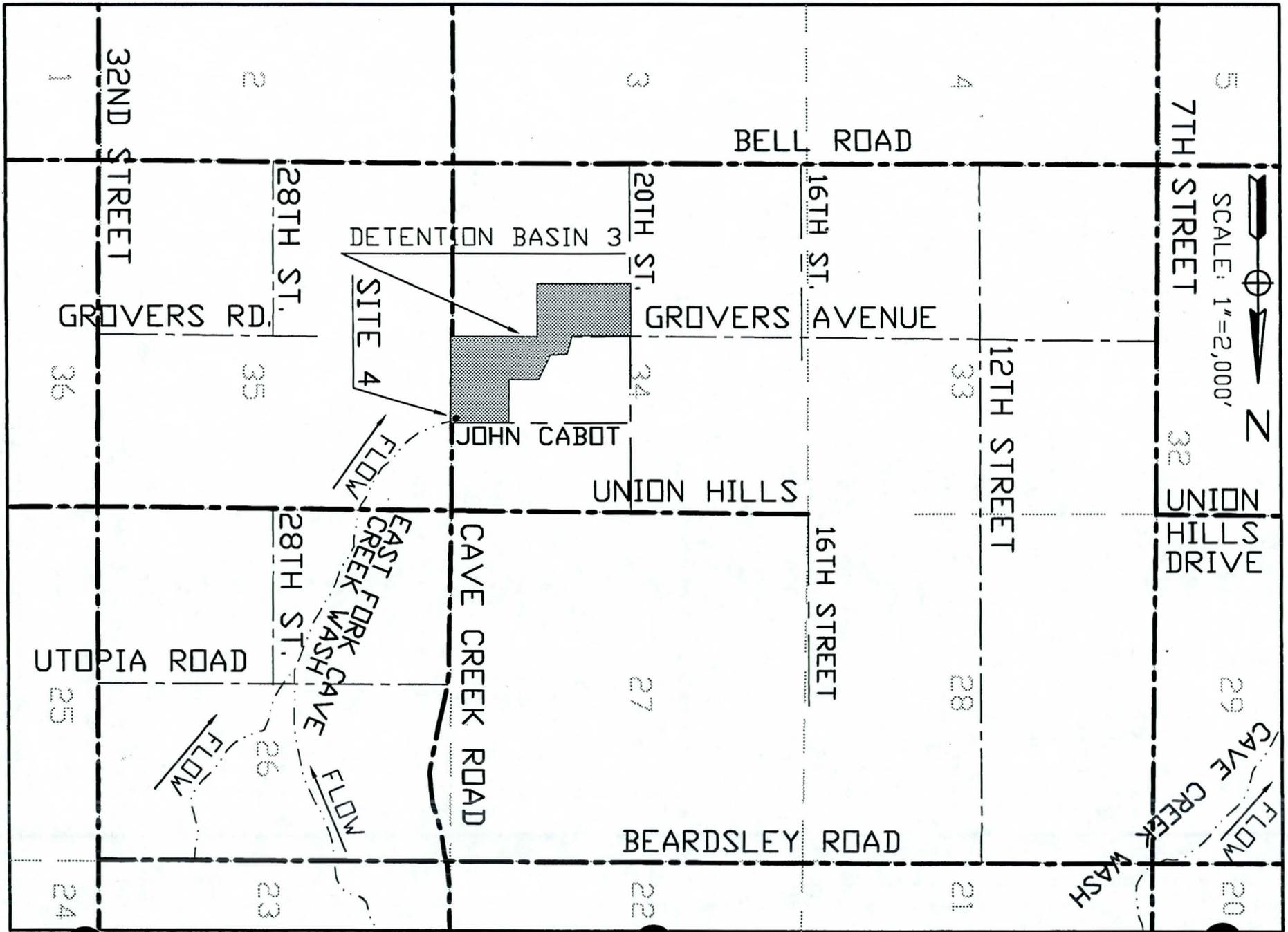


FIGURE 1

the concrete apron. A large volume of sediment is also deposited in the low-flow large culverts located under the detention basin. During large discharges, sediment is also deposited in the park. (See Site 4 - Problem Identification, Figure 2.)

The sediment deposits are difficult for maintenance crews to remove and require substantial effort. Equipment access to the culverts under the detention basin is not available. The majority of the work can only be accomplished through manual labor.

Another problem associated with this site is the embankment slope scour along Cave Creek Road. Currently, there are no catch basins or scuppers to intercept the flow in Cave Creek Road. The flow in excess of the curb height weirs over the curb, flows down the side slope of Detention Basin No. 3, and causes erosion of the slopes of the basin. The City of Phoenix has awarded a contract to Dibble and Associates to analyze Cave Creek Road and develop a solution to intercept the flow in excess of the roadway capacity at curb height.

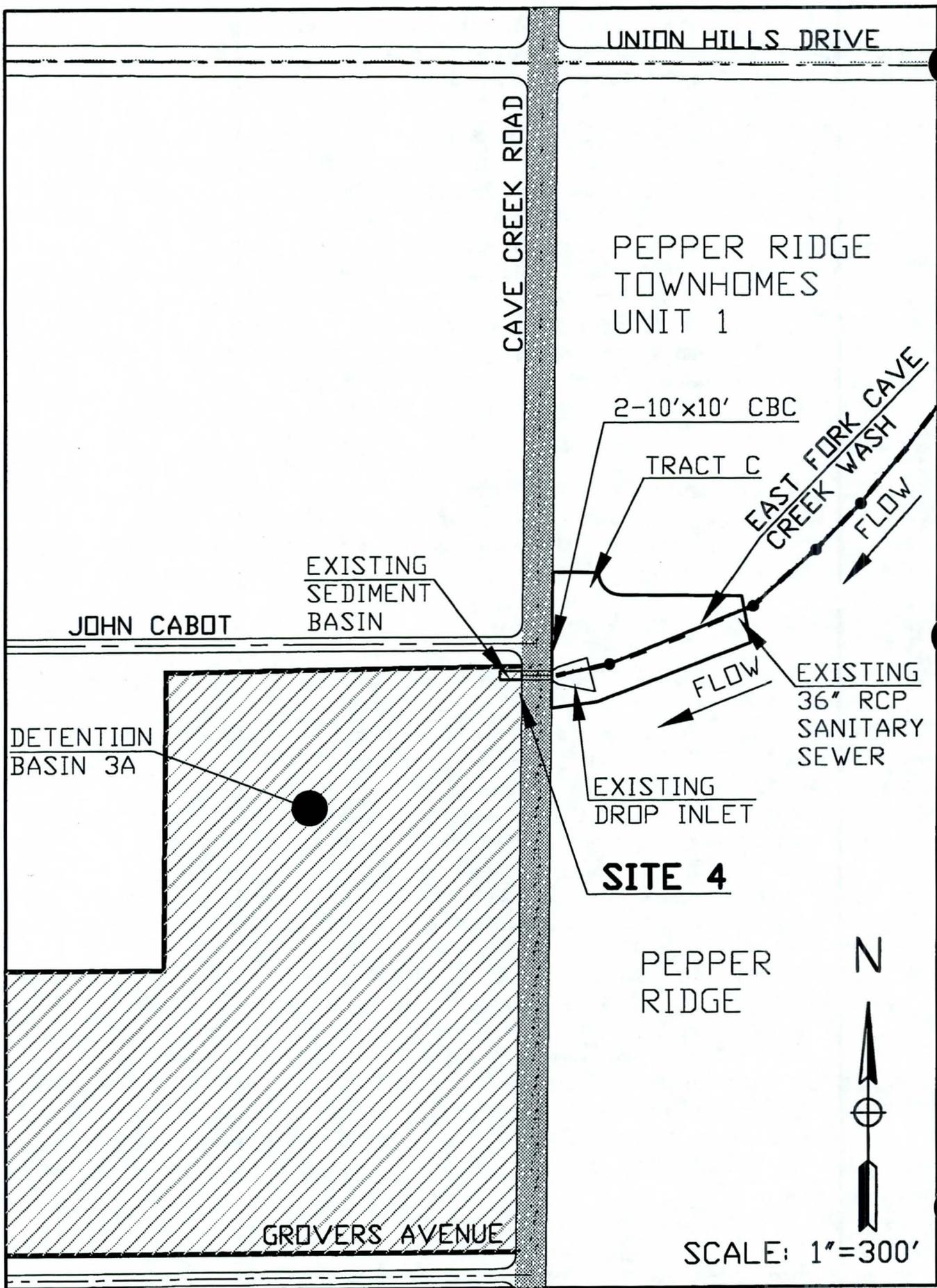
4.3 History

Historically, the flow from the East Fork of Cave Creek Wash has crossed Cave Creek Road and continued southwest. This flow has inundated Bell Road and been the source of flooding of many homes. The City constructed Detention Basin No. 3 in 1992 which alleviated most of the flooding problem.

4.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 38-33, drawn May 3, 1994; 38-34, plotted March 29, 1995; 39-33, plotted November 2, 1995; 38-32, revised September 11, 1991; and 39-34, plotted March 22, 1995.
- City of Phoenix Topographic Quarter Section Map Numbers: 38-33, flown September 2, 1980; 38-34, flown September 2, 1980; 39-33, flown September 2, 1980; 39-34, flown September 2, 1980; and 38-32, flown September 2, 1980.
- City of Phoenix Wastewater Quarter Section Map Numbers: 38-33, revised July 1995; 38-34, revised July 1995; 39-33, revised December 1994; 39-34, revised July 12, 1995; and 38-32, revised November 22, 1994.
- City of Phoenix Water Quarter Section Map Numbers: 38-33, revised July 1995; 38-34, revised September 11, 1973; 39-33, revised March 1996; 39-34, revised March 1996; and 38-32, revised March 1996.
- City of Phoenix Engineering Storm Drain Map M-9 (not dated).
- ADOT Job No. M-501-1(3), Cave Creek Road, Bell Road to Beardsley Road, Maricopa Co., plan and profile sheet and Detail Sheets 3, 4, 5, 9, 10, and 11 of 26, dated March 16, 1992.
- City of Phoenix Index No. S-898007, Cave Creek Road Sanitary Sewer Line, Bell Road to Union Hills Drive/Wash, Sheets 2, 7, 8, 9, 10, 11, and 12, stamped by Design Engineer January 3, 1990.



SITE 4 - PROBLEM IDENTIFICATION

FIGURE 2

- USGS 7.5-minute quadrangle map for Union Hills Arizona, which contains Site 4, its upstream drainage area, and downstream flow path, photo revised 1981.

The COP, FCDMC, and MCDOT were contacted to obtain paving, water, and sanitary sewer plans for this area without much success.

4.5 Hydrology

The East Fork of Cave Creek Wash runs from northeast to southwest. The 100-year flow rate is 1,753 cfs upstream from the Cave Creek culvert. Flood water ponds upstream of Cave Creek Road, discharges through these culverts at a reduced rate of 1,590 cfs, and continues over the weir and down the energy dissipator. The detention basin consists of two large basins in series which reduce the peak discharge. The peak outflow from Basin 3A is 801 cfs, while Basin 3B reduces the outflow to 522 cfs. It has reduced the downstream floodplain which, in turn, has reduced the flooding of downstream homes.

4.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve Cave Creek Road from Grovers Avenue to Union Hills Drive within the next five years. However, within District 2, in construction year 1996-97, a storm drain lateral is planned for Grovers Avenue at Detention Basin 3 from Cave Creek Road to 32nd Street; however, it has no impact to this project site.

4.7 Federal Emergency Management Agency

This site is included on FEMA Flood Insurance Rate Map Panel Number 04013C1220G, revised September 30, 1995. The area is designated shaded Zone A which denotes special flood hazard areas inundated by the 100-year flood with no base flood elevation determined. However, it has been determined that upstream of the East Fork of Cave Creek Wash is completely contained from Beardsley Road through the culverts under Cave Creek Road. According to the Flood Insurance Study (FIS), dated September 30, 1995, the 100-year discharge at the downstream side of Cave Creek Road is 3,900 cfs. However, the Letter of Map Revision (LOMR), dated October 4, 1995, incorporates changes due to the detention basins designed for the East Fork of Cave Creek Wash. One is located just south of Beardsley Road, and the other, Detention Basin No. 3, is just downstream of Cave Creek Road. Detention Basin 3 reduces the 100-year peak discharge to 500 cfs.

This LOMR shows the area south of the detention basin to be rezoned from Zone X shaded to Zone X, indicating a change in the 100-year and 500-year floodplains.

4.8 Alternative Solutions

There are three problems associated with this site: 1) the sediment deposit at the weir structure; 2) the sediment deposit at the large drain culvert under the basin; and 3) the difficulty in cleaning and removing this sediment.

As long as the channel continues to carry sediment to this location, maintenance crews will have to remove the sediment from the upstream sediment basin. However, sedimentation analyses require substantial investigation and assessment. A simplified approach is presented in this study. This approach assumes the sediment carried through the flood is 2 percent by volume of the flow. The 100-year flood has a net volume of 156 acre-feet which will carry 3.12 acre-feet of sediment.

Alternative 1 — Construct A Sedimentation Basin to Reduce the Sediment Carried to the Structure

This alternative is to construct a 4-acre-foot sedimentation basin at the upstream end of the Cave Creek culvert. This can be accomplished by excavating four to five feet from the existing ground for an approximate 1-acre area. A 7-foot drop structure and energy dissipator will be installed at the upstream end of the basin where the existing channel is located. A 4-foot-high weir with a flat concrete apron tied to the existing CBC will be constructed to induce the sediment deposit at the basin. Pipes will be spaced vertically on the weir to bleed the ponded water. Care must be used during design and construction to protect a 36-inch sewer pipe proposed in 1990, if it was installed. An access ramp for cleaning the basin will also be provided.

Alternative 2 — Modify the Existing Structure to Mitigate Sedimentation Problems

This alternative is to remove the existing weir lip located downstream of the Cave Creek culverts. A weir structure will be constructed by extending the existing inlet headwall structure of the basin drain pipe. The height of the weir extension will be designed to accommodate the elimination of the upper weir lip. The increased head will facilitate the cleaning process of the large drain pipe. However, since the drain pipe is constructed on a flatter slope relative to the upstream channels, sediment deposits should be anticipated.

Alternative 3 - Modify the Existing Structure to Provide Better Access for Cleaning

This alternative is to provide a heavy equipment access ramp and modify the inlet drop structure upstream of the Cave Creek culvert. Core drilling to provide spaced drains along the weir structure will minimize the clogging of the existing weir structures. However, this has the potential to increase the sediment deposit in the drain pipes.

4.9 Recommended Alternative

Alternative 3 is the recommended short-term alternative. It will provide heavy equipment access to the two 10'x10' CBC for sediment removal by City maintenance staff and will minimize the clogging of the existing weir structure. The construction of this alternative can be achieved by City forces. The City of Phoenix will need to determine the right to provide an access ramp through the tract of land owned by Pepper Ridge Town Homes Unit 1. (See Site 4 - Preferred Alternative, Figure 3.)

A long-term solution is Alternative 1 or a variation of the sedimentation basin presented in Alternative 1. The City of Phoenix will need to investigate whether excavation is possible in this tract of land which is a part of the Pepper Ridge Town Homes Unit 1.

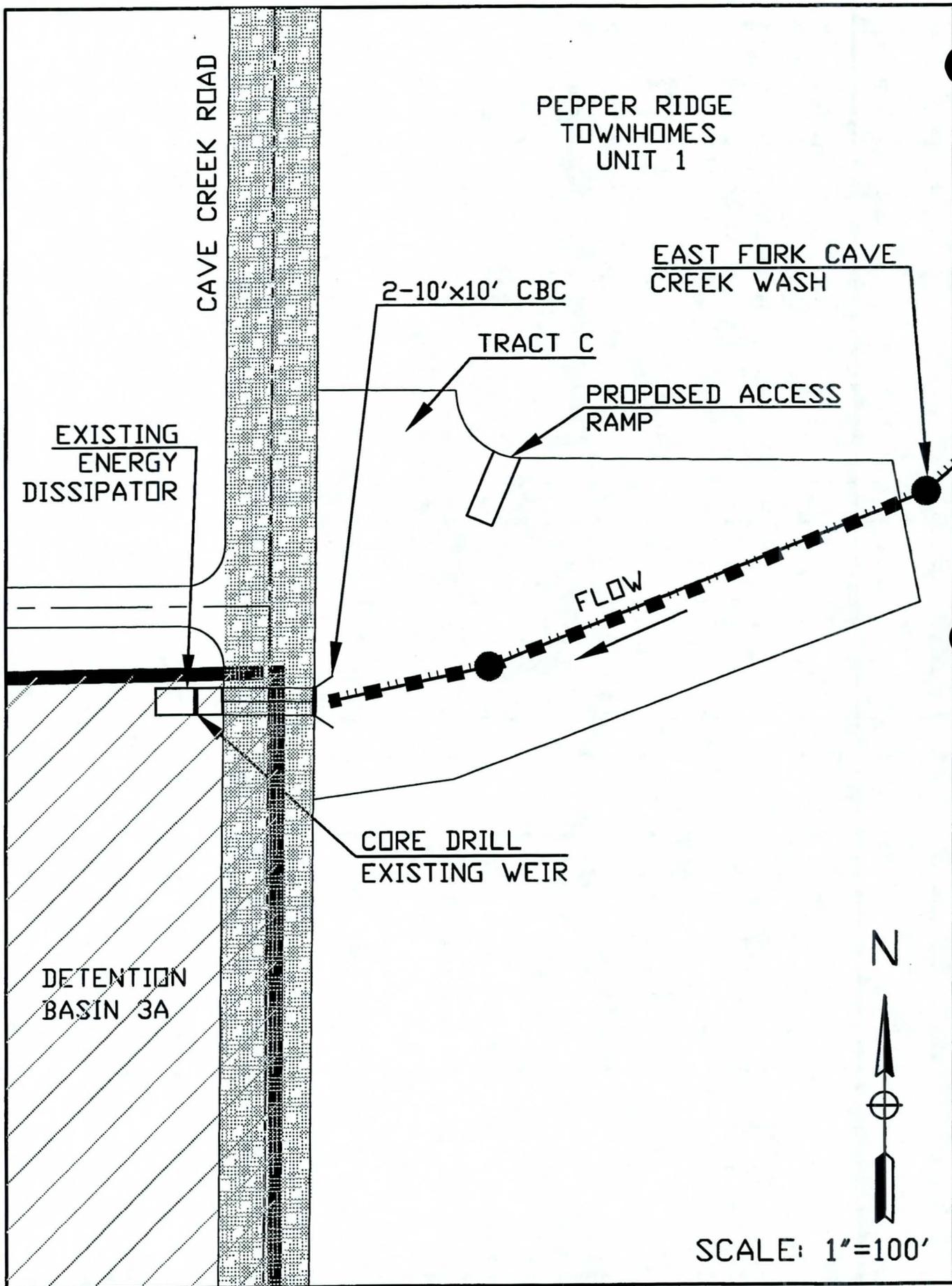
4.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavate New Basin	9,680 YD ³	\$3.00/YD ³	\$29,040
Upstream Drop Structure	Each	\$25,000/Each	25,000
Downstream Weir Structure	Each	\$25,000/Each	25,000
<i>Subtotal</i>			\$79,040
<i>20% Contingency</i>			15,808
<i>Total</i>			\$94,848

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Existing Weir Lip	Each	\$10,000/Each	\$10,000
Construct Downstream Weir	Each	\$50,000/Each	50,000
<i>Subtotal</i>			\$60,000
<i>20% Contingency</i>			12,000
<i>Total</i>			\$72,000



SITE 4 - PREFERRED ALTERNATIVE

FIGURE 3

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Access Ramp	Each	\$4,000/Each	\$ 4,000
Modify Inlet Drop	Each	\$25,000/Each	25,000
Modify Existing Weir	Each	\$2,000/Each	2,000
<i>Subtotal</i>			\$31,000
<i>20% Contingency</i>			6,200
<i>Total</i>			37,200

5. SITE 6 — 16640 North 25th Street

5.1 Location and Site Description

This site is a vacant lot located on 25th Street south of Bell Road and east of Cave Creek Road in a residential neighborhood (see Site 6 - Vicinity Map, Figure 1). An existing 24-inch storm drain at Cave Creek Road carries flow south. An apartment complex is located to the west.

5.2 Problem Identification

Water flows from Bell Road onto 26th Street and crosses the property between 26th Street and 25th Street through a drainage easement as shown on City of Phoenix Right-of-Way Maps. The flow continues through a drainage easement which bounds the site to the south and travels to a wall which separates the site from an apartment complex. Flows pond at the wall and flood the adjoining properties (see Site 6 - Problem Identification, Figure 2). The wall has 2 small holes to allow water to flow through. A drainage easement on the southern edge of the complex carries the flow to a storm drain inlet at Cave Creek Road.

5.3 History

The property has been flooded by flows which pond at the wall which crosses the drainage easement.

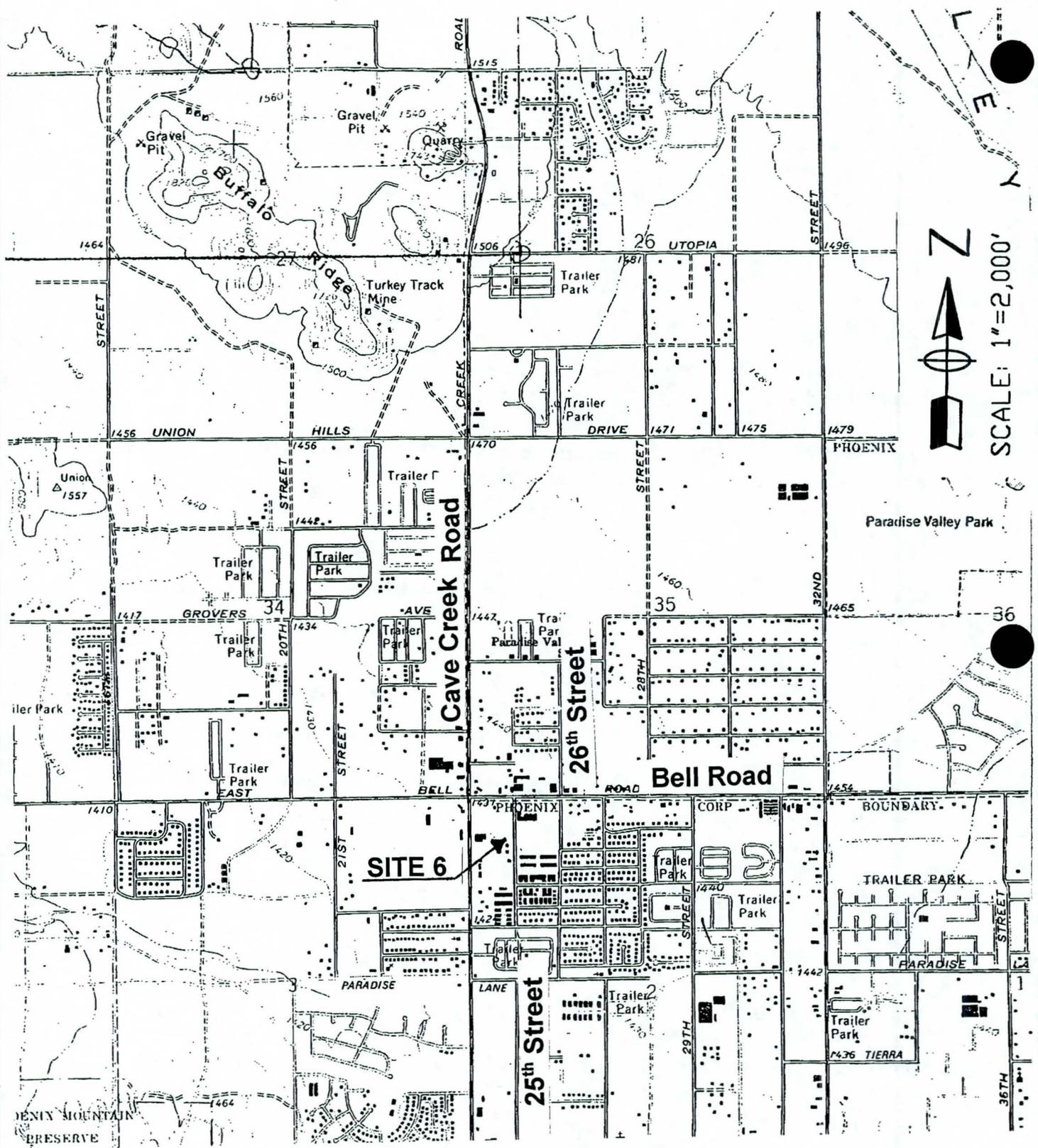
5.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Union Hills which contains Site 6 and its upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Map M-9.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.

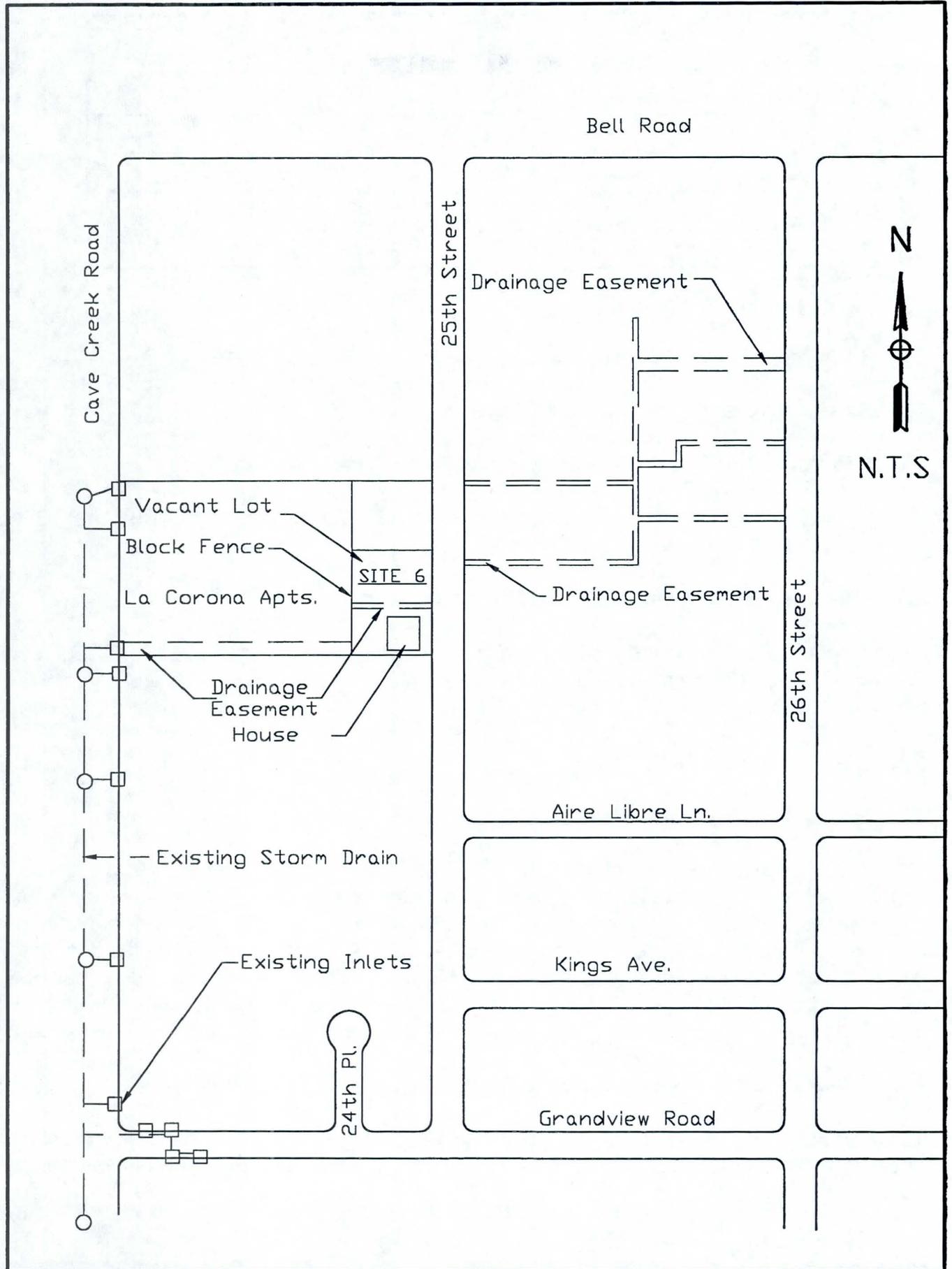
5.5 Hydrology

The values for the runoff amount for the different design periods were calculated using the Rational Method. For the purpose of this study, engineering judgments were used to make assumptions required to facilitate calculations. A detailed hydrologic study of the area was not performed. Due to recent improvements to Bell Road, which includes storm drain construction, it is assumed that flow to the site is from the local drainage area. The boundaries for local drainage were based on City of Phoenix topographic maps and are Bell Road to the north, 25th Street to the west, Phelps Road to the south, and 28th Street to the east.



SITE 6 - VICINITY MAP

FIGURE 1



SITE 6 - PROBLEM IDENTIFICATION

FIGURE 2

<i>Frequency (yr)</i>	<i>Local Discharge (cfs)</i>
100	68
50	59
25	45
10	39
2	28

5.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix has programmed the construction of a storm drain on Bell Road from 20th Street to Cave Creek Road.

5.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1220 G, revised October 4, 1995. The area is designated as Shaded Zone X, which denotes areas within the 500-year floodplain.

5.8 Alternative Solutions

Alternative 1- Improve Drainage Openings in Block Wall

This alternative proposes that the openings through the block wall be enlarged to 9"x18" to allow a greater volume to flow through. Each opening should allow 5 cfs to pass through. Six openings will be required to handle the flow from the 2-year flood event. In addition, a small swale in the easement will be constructed to channel the flow to the openings. The parking lot for the apartment complex will be graded to ensure that flows travel to the existing drainage easement. This may require that an additional easement be acquired either in the complex lot or in the property adjoining the existing easement. This cost is not included in the estimate.

Alternative 2- Construct a Storm Drain from 25th Street to Cave Creek Road

This alternative proposes to construct an 18-inch storm drain to carry flow to the existing storm drain on Cave Creek Road. A Type A inlet will be set in the curb at the edge of the drainage easement.

5.9 Recommended Alternative

The City of Phoenix has recommended that Alternative 1 be implemented (see Site 6 - Preferred Alternative, Figure 3). This alternative requires minimal construction which should not have a significant impact on neighboring properties. Implementation of this alternative will be delayed, at the City's request, until the site has been evaluated to determine the effects of recent improvements on Bell Road.

In addition, City maintenance crews have noted a light pole installed in the drainage easement which should be relocated if improvements are made. The City also recommends that a concrete swale be added to divert flow into the easement at 25th Street.

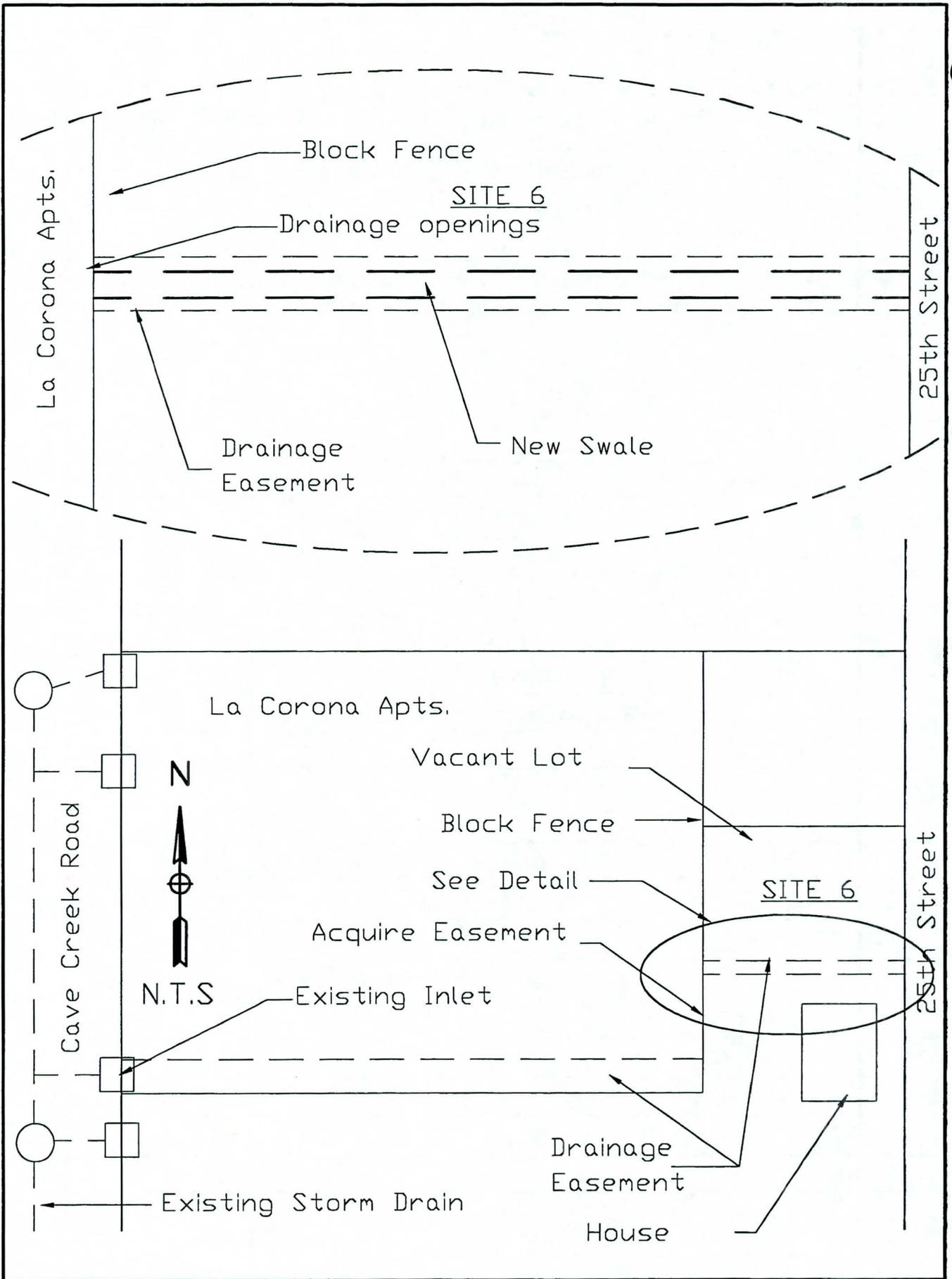
5.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Block Wall Modification	200 FT ²	\$10.00/FT ²	\$2,000
Regrade Parking lot	40 YD ³	\$10.00/YD ³	400
Asphalt Paving	25 Ton	\$32.00/Ton	800
Excavation	100 YD ³	\$3.00/YD ³	300
Subtotal			\$3,500
20% Contingency			700
Total			\$4,200

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	1,100 YD ³	\$9.00/YD ³	\$ 9,900
18" CMP	200 LF	\$35.00/LF	7,000
Backfill	1,100 YD ³	\$15.00/YD ³	16,500
Modify Old Catch Basin	1 Each	\$1,800/Each	1,800
Type A-Catch Basin	1 Each	\$1,200/Each	1,200
Subtotal			\$36,400
20% Contingency			7,300
Total			\$43,700



SITE 6 - PREFERRED ALTERNATIVE

FIGURE 3

6.0 Site 9 — 2800 West Louise

6.1 Location and Site Description

This site is located near Deer Valley Road and 30th Avenue in Township 4 North, Range 2 East, Section 14 of the Gila and Salt River Base and Meridian. The local drainage problem occurs along a segment of Louise Drive between 30th Avenue and 28th Avenue. (See Site 9 - Vicinity Map, Figure 1.)

Scatter Wash runs northeast to southwest through this site and is approximately 150 feet north of the intersection of 30th Avenue and Louise Drive.

Louise Drive and 28th, 29th, and 30th Avenues are dirt roads without curb or gutter. There is no development north of Louise Drive between 29th and 30th Avenues. Single-family homes are developed in the area of Louise Drive from 29th Avenue to 28th Avenue. The White Subdivision located south of Louise Drive is partially developed. Land west of the White Subdivision is zoned commercial and is occupied by an office/warehouse.

Louise Drive is depressed from 29th Avenue to 30th Avenue and is at-grade from 28th Avenue to 29th Avenue along the north right-of-way. A landscaped berm extends along the south right-of-way from a point between 28th Avenue and 29th Avenue to past 30th Avenue.

6.2 Problem Identification

Flows concentrate in Louise Drive and cause erosion of the roadway. Local residents complain of flooding and impassable driving conditions. There is also a concern that Scatter Wash may overtop the bank at this location. (See Site 9 - Problem Identification, Figure 2.)

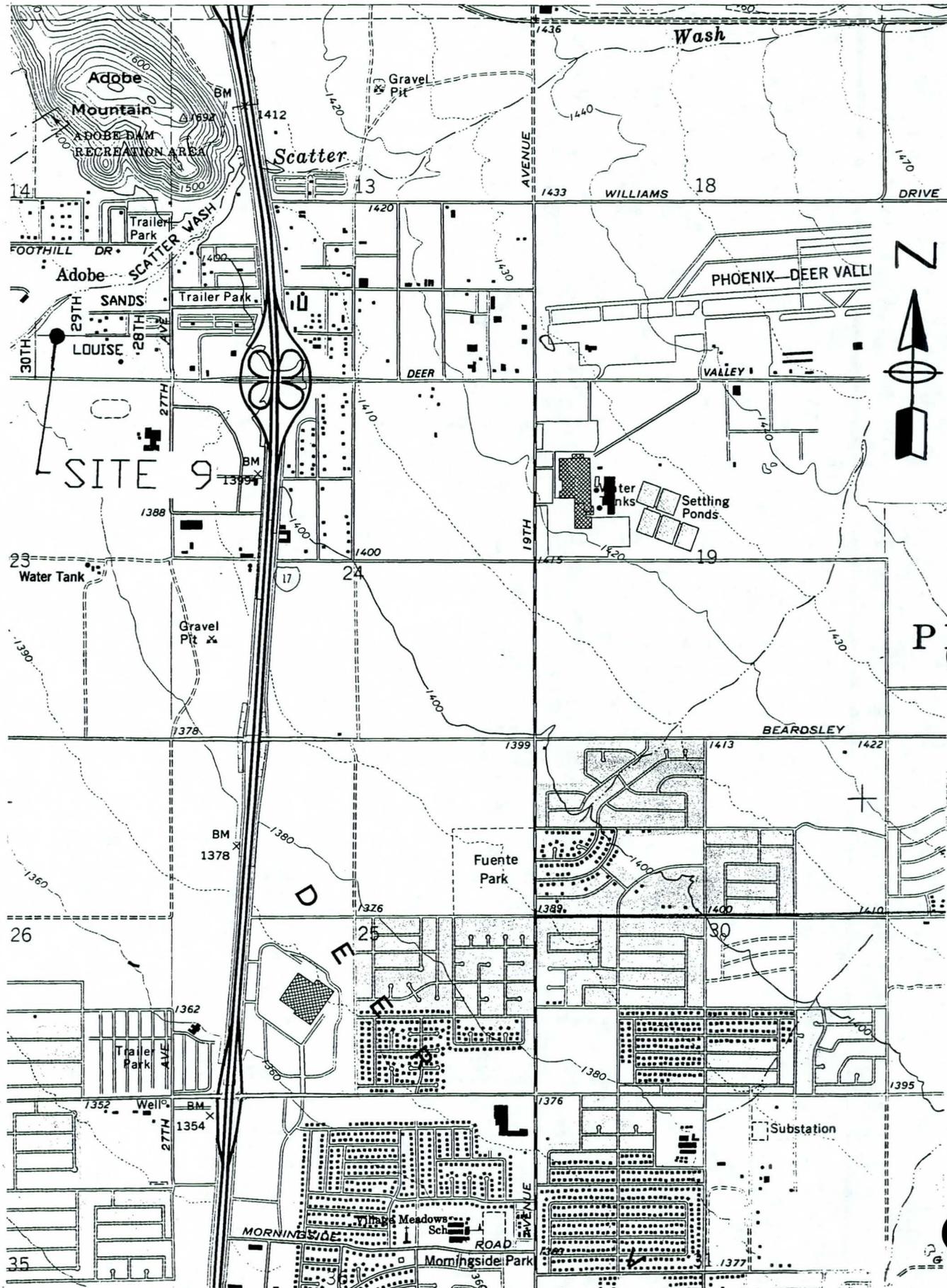
6.3 History

In the past, City of Phoenix maintenance crews have repeatedly placed additional gravel material along Louise Drive to fill in the eroded roadway base caused to rains. Scatter Wash is braided, overgrown with vegetation, and has an undefined south bank along the reach near Louise Drive.

6.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 43-22, drawn October 1991; 43-23, Revised September 1, 1993; 44-22, revised August 3, 1993; and 44-23, revised September 17, 1986.

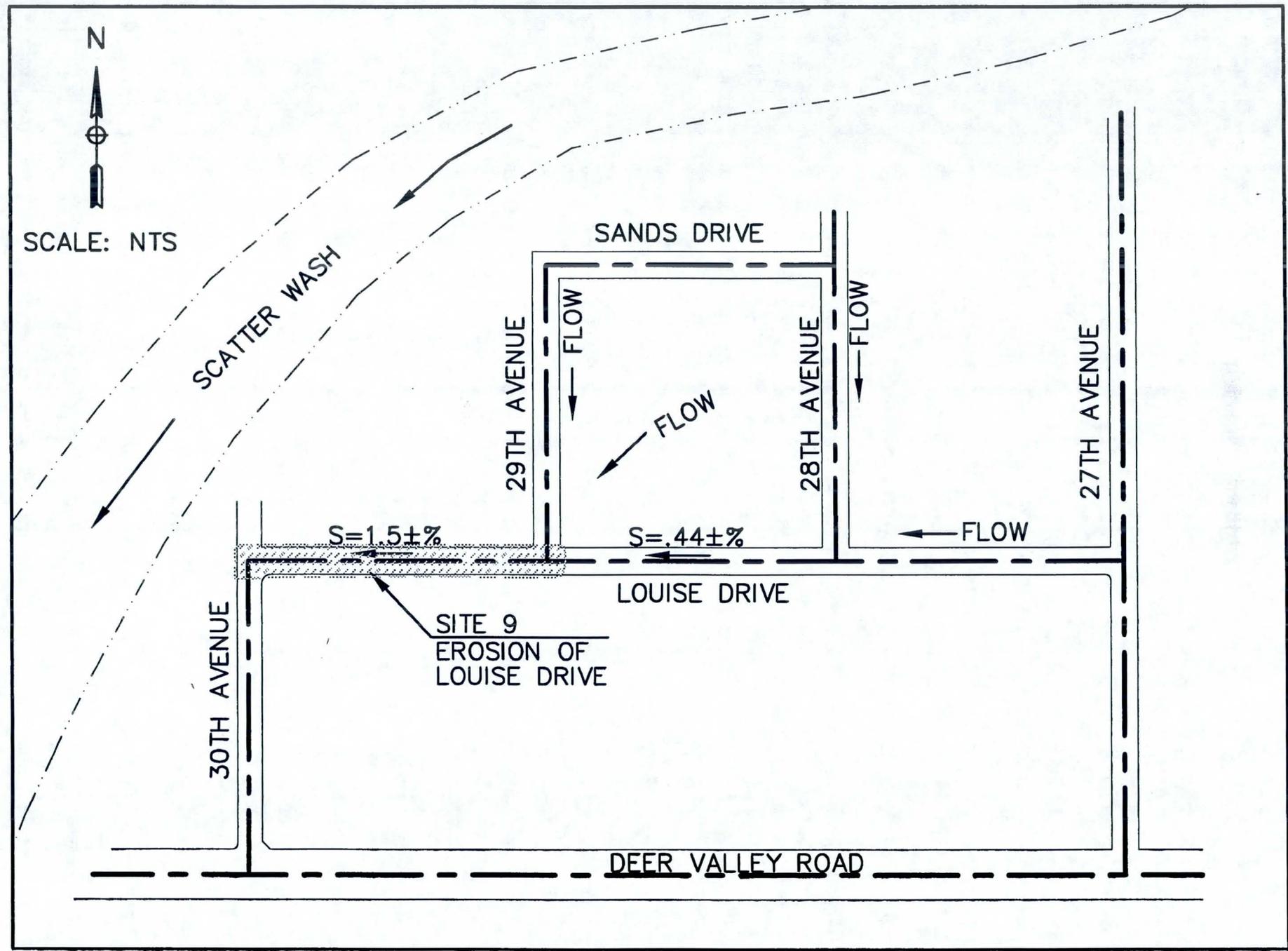


SITE 9 - VICINITY MAP

FIGURE 1



SCALE: NTS



SITE 9 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Topographic Quarter Section Map Numbers: 43-22 flown October 29, 1990; 43-23, flown October 29, 1990; 44-22, flown October 29, 1990; and 44-23, flown October 29, 1990.
- City of Phoenix Wastewater Quarter Section Map Numbers: 43-22, revised December 1995; 43-23, revised December 1995; and 44-22, revised August 31, 1993.
- City of Phoenix Water Quarter Section Map Numbers: 43-22, revised August 1994; 43-23, revised June 8, 1993; 44-22, revised December 13, 1993; and 44-23, revised June 1992.
- City of Phoenix Engineering Storm Drain Map N-7 (not dated).
- USGS 7.5-minute quadrangle map for Union Hills Arizona, which contains Site 9, its upstream drainage area, and downstream flow paths, revised 1981.

No paving, water, or sanitary sewer plans for this area were available from the FCDMC, MCDOT, or City of Phoenix.

6.5 Federal Emergency Management Agency

This site is shown on FEMA Flood Insurance Rate Map Panel Number 04013C1215H, dated September 30, 1995. The area is designated shaded Zone AE which denotes special flood hazard areas inundated by the 100-year flood with base flood elevation determined. The water surface elevation at 28th, 29th, and 30th Avenues are 1,389.9 feet, 1,385.0, feet and 1,380.5 feet, respectively. The floodplain boundaries as shown on the FEMA map are contained and have no impact to the area in concern.

6.6 Hydrology

The 100-year discharge in the north branch of Scatter Wash concentrating at Deer Valley Road is 2,411 cfs.

The local drainage concentrating at Louise Drive and 30th Avenue has a watershed of 59 acres. The flow rates for the 2-, 5-, 10-, 25-, 50-, and 100- year storms are 27 cfs, 37 cfs, 41 cfs, 50 cfs, 58 cfs, and 70 cfs, respectively.

6.7 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

The planned Outer Loop Freeway is one mile to the south, and the ongoing construction of the I-17/ Deer Valley Road interchange is within 0.5-mile from the site in concern. However, there is little impact to this site from these projects.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve Louise Drive from 27th Avenue to 30th Avenue within the next five years.

6.8 Alternative Solutions

Louise Avenue has a grade break at 29th Avenue. The slope east of 29th Avenue is 0.0044 ft/ft, with a flow velocity of 2.9 feet per second and a depth of 0.9 foot at the 100-year flow rate of 70 cfs. The slope west of 29th Avenue is 0.015 ft/ft, with a flow velocity of 4.2 feet per second and a depth of 0.6 foot for the same 100-year storm. It is obvious that the erosion west of 29th Avenue resulted from higher velocity.

Alternative 1 - Paving of Louise Drive from 30th to 29th Avenues

This alternative involves paving Louise Drive from 30th to 29th Avenues. The typical section along Louise Drive to be paved is 28 feet in width with an 8-inch curb on both edges of the pavement. The pavement improvements will be extended 100 feet in each direction to the east and north from the intersection of 29th Avenue and Louise Drive. A concrete ford will be placed at each end of the pavement adjoining the existing dirt road. Additional site grading will be required to ensure the collection and discharge of flows at each end of the improvements. The total length of the road to be paved is 860 feet.

Alternative 2 - Regrading of Louise Drive from 30th to 29th Avenues

This alternative is to flatten existing Louise Avenue west of 29th Avenue. This can be accomplished by adding gravel material along Louise Avenue from 29th Avenue to 30th Avenue to achieve a slope of 0.0044 ft/ft to meet the existing grade to the east. Under this condition, flow approaching 29th Avenue and Louise Drive will drain to the vacant land to the north and the landscaped area to the south. A 24-inch culvert will be installed at 30th Avenue and Louise Drive to drain the ponding water from the landscaped area. This landscaped area may currently be used as a drainage basin for the office/warehouse. In this case, an agreement will be required from the adjacent property owners.

Alternative 3 - Construct a Channel Along Louise Drive

This alternative is to construct a channel along Louise Drive. Louise Drive will be graded to have a mild cross slope to drain to the channel. The right-of-way channel will have low check-dams designed every 30 feet to maintain a low velocity in the channel to reduce the potential for scour. In effect, this will push the flow in 29th Avenue and Louise Drive into a right-of-way channel and maintain a low velocity of flow, thereby reducing the potential for scour.

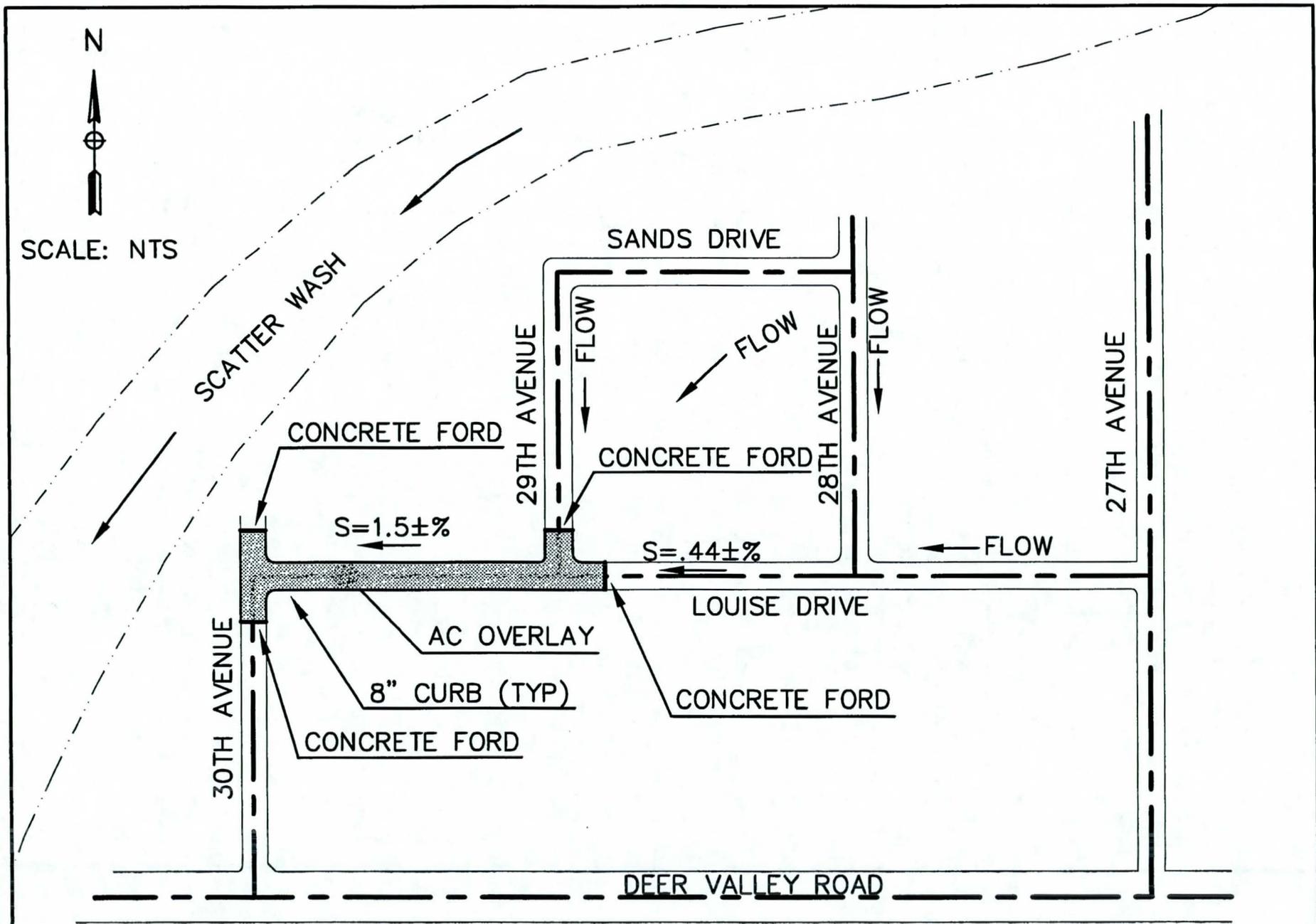
6.9 Recommended Alternative

Alternative 1 is the recommended alternative. (See Site 9 - Preferred Alternative, Figure 3.) This alternative will eliminate the erosion problem between 29th and 30th Avenues and will not require extensive regrading or alteration of existing flow patterns. If implemented, this alternative will require construction by contracted forces.

The City of Phoenix has indicated that Alternative 1 is the preferred alternative, at a minimum.



SCALE: NTS



SITE 9 - PREFERRED ALTERNATIVE

FIGURE 3

Five to six years ago the City had developed plans to pave this area but it was rejected by the neighborhood. The City has again identified this area as a candidate for an improvement district and will propose to pave this segment of Louise Drive, as well as the one block area bounded by Sands Drive, Louise Drive, and 28th and 29th Avenues. The neighborhood will again be polled for their opinion on paving of these areas. If the plan is not accepted, the portion of Louise Drive identified in Alternative 1 will be the minimum solution.

6.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
C-3/4 AC 2" Overlay	293 Tons	\$60/Ton	\$ 17,600
ABC 6" Layer	516 YD ³	\$21/YD ³	10,800
8" Vertical Curb	1,720 LF	\$14/LF	24,100
Concrete Ford	100 LF	\$40/LF	4,000
<i>Subtotal</i>			\$56,500
<i>20% Contingency</i>			11,300
<i>Total</i>			\$67,800

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Fill Material	2,865 YD ³	\$8/YD ³	\$22,900
ABC - 6" Layer	516 YD ³	\$21/YD ³	10,800
Dumped Rip-rap (d ₅₀ =6")	13 YD ³	\$50/YD ³	650
Channel Excavation	13 YD ³	\$3/YD ³	50
1-24" RCRCP	121 LF	\$75.00/LF	9,100
U-Type Headwall	Each	1,000/Each	1,000
Concrete Retaining Wall	50 LF	\$150/LF	7,500
<i>Subtotal</i>			\$52,000
<i>20% Contingency</i>			10,400
<i>Total</i>			\$62,400

Alternative 3*

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Proposed Channel Excavation	623 YD ³	\$3.00/YD ³	\$ 1,900
Grading of Louise Drive	Each	\$3,000/Each	3,000
Check Dams (d ₅₀ =3")	24 Each	\$300/Each	7,200
<i>Subtotal</i>			\$12,100
<i>20% Contingency</i>			2,400
<i>Total</i>			\$14,500

*Does not include right-of-way acquisition costs.

7. SITE 10 — Coral Gables Drive North of Thunderbird Road

7.1 Location and Site Description

This site is in a residential neighborhood at the Moon Valley Wash North Branch which crosses Coral Gables Drive approximately 200 feet north of Thunderbird Road (see Site 10 - Vicinity Map, Figure 1). Coral Gables Drive is west of 7th Avenue. The upstream drainage area for the wash includes a golf course. Thunderbird Road has a bridge crossing over the wash approximately 1,000 feet downstream of the Coral Gables Drive crossing. There is a deteriorated section of asphalt paving in the wash on the south side of Coral Gables Drive.

7.2 Problem Identification

Coral Gables Drive is a paved road which has a low point crossing in the wash. Flow through the wash is sufficiently deep during storm events that vehicles cannot drive through it (see Site 10 - Problem Identification, Figure 2).

7.3 History

The wash has become impassable during storm events due to the high volume of flow which is directed through the wash. The road is barricaded and unusable until flows subside. Local traffic is forced to use a 2-mile detour at these times.

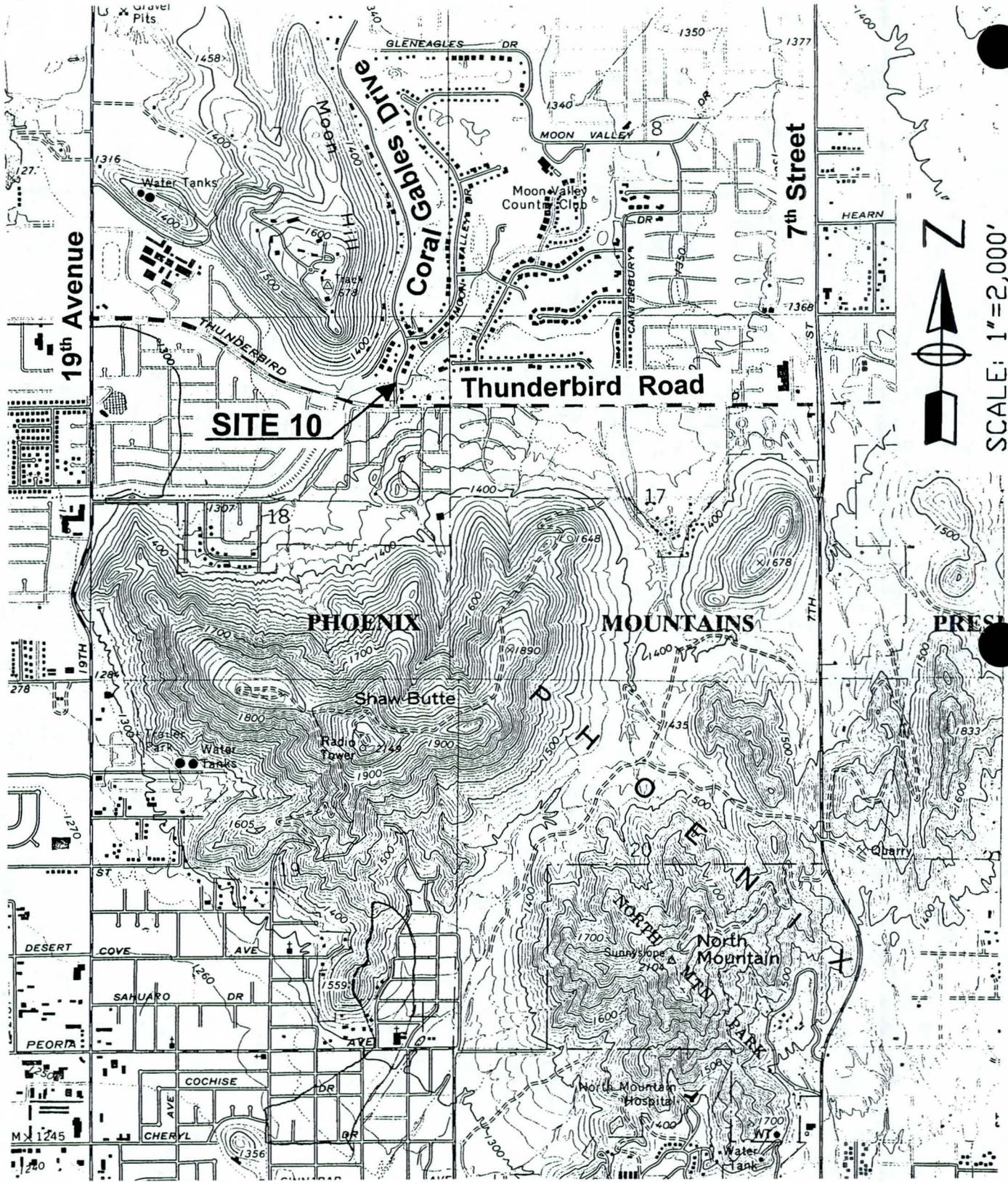
7.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 10 and its upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Map L-8.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.

7.5 Hydrology

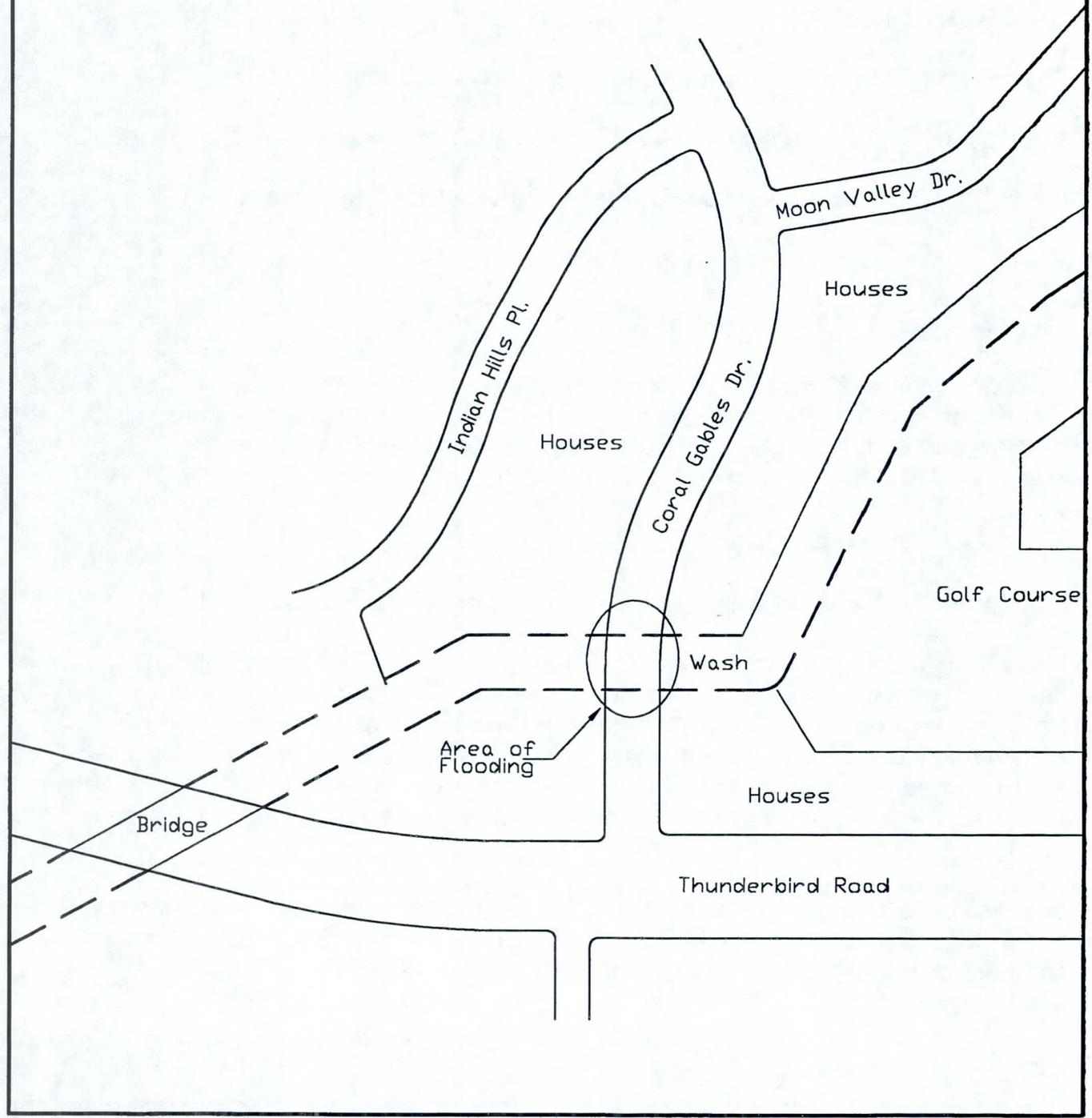
The values for the runoff amount for the different design periods were calculated using the Pima County Method of Approximate Ratios of Lesser Magnitude Floods to the 100-year flood. The value for the 100-year event was obtained from a FEMA study of Maricopa County, 1995.



SCALE: 1" = 2,000'

SITE 10 - VICINITY MAP

FIGURE 1



SITE 10 - PROBLEM IDENTIFICATION

FIGURE 2

<i>Frequency (yr)</i>	<i>Moon Valley Wash Discharge (cfs)</i>
100	2810
50	2389
25	1827
10	1265
2	562

7.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no projects planned which will impact this site.

7.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1655 H, revised September 30, 1995. The area is designated as Zone AE, which denotes areas inundated by the 100-year flood. The FEMA report gives the 100-year flow through the wash at Thunderbird Road as 2,810 cfs.

7.8 Alternative Solutions

Alternative 1 - Construct a Bridge Crossing on Coral Gables Drive

This alternative proposes that a bridge crossing be constructed on Coral Gables Drive across the wash. This will require that the channel be lowered to accommodate the crossing. The FEMA Panel Section Map for Site 10 and its vicinity indicates that there is a sufficient drop in the wash at 17th Avenue to allow the channel to be lowered by approximately 4 feet. This drop will be sufficient to allow an at-grade bridge crossing at Coral Gables with sufficient clearance to accommodate the 100-year flow. The bridge crossing will have approximately 8,000 square feet of deck.

Lowering of the channel may require modifications to the existing bridge at Thunderbird Road. The FEMA report also shows that the current bridge crossing on Thunderbird Road causes a flow back-up due to insufficient clearance to handle the 100-year flow.

Alternative 2- Construct a Low-Flow Crossing at Coral Gables Drive

This alternative proposes that a low-flow crossing be constructed at Coral Gables Drive to carry flow from the 2-year storm even beneath Coral Gables Drive. This alternative will require that twenty-three 30-inch-diameter corrugated metal pipes be installed beneath Coral Gables Drive. The roadway through the wash will be raised to match the existing roadway on both sides of the wash.

This alternative creates a conflict with flows from greater storm events. Higher flows will pond at the crossing and create a tailwater that may flood the adjoining golf courses and properties. This conflict can be addressed by maintaining the roadway at its current grade and excavating the channel to allow the installation of pipes beneath the alignment of the current stream bed. Current topography information suggests that this will require forty 30-inch-diameter pipes to carry the flow from the 2-year event. The width of the wash prevents the installation of that number of pipes; therefore, Alternative 2 is not considered to be a feasible alternative.

Alternative 3 - No Action

This alternative proposes that no action be taken to correct the flooding problem at this time, as the flooding in the wash does not cause damage to private property. However, care should be taken to maintain warning signs for motorists to prevent attempts at crossing the wash when flooded.

7.9 Recommended Alternative

Due to the cost of Alternative 1 and the infeasibility of Alternative 2, it is recommended that Alternative 3, no action, be implemented (see Site 10 - Preferred Alternative, Figure 3). However, if the wash is improved in the future to prevent back-up of flows at the Thunderbird Road bridge, then this site should be reexamined to determine the feasibility of creating a bridge crossing at Coral Gables Drive.

7.10 Cost Estimate

Alternative 1

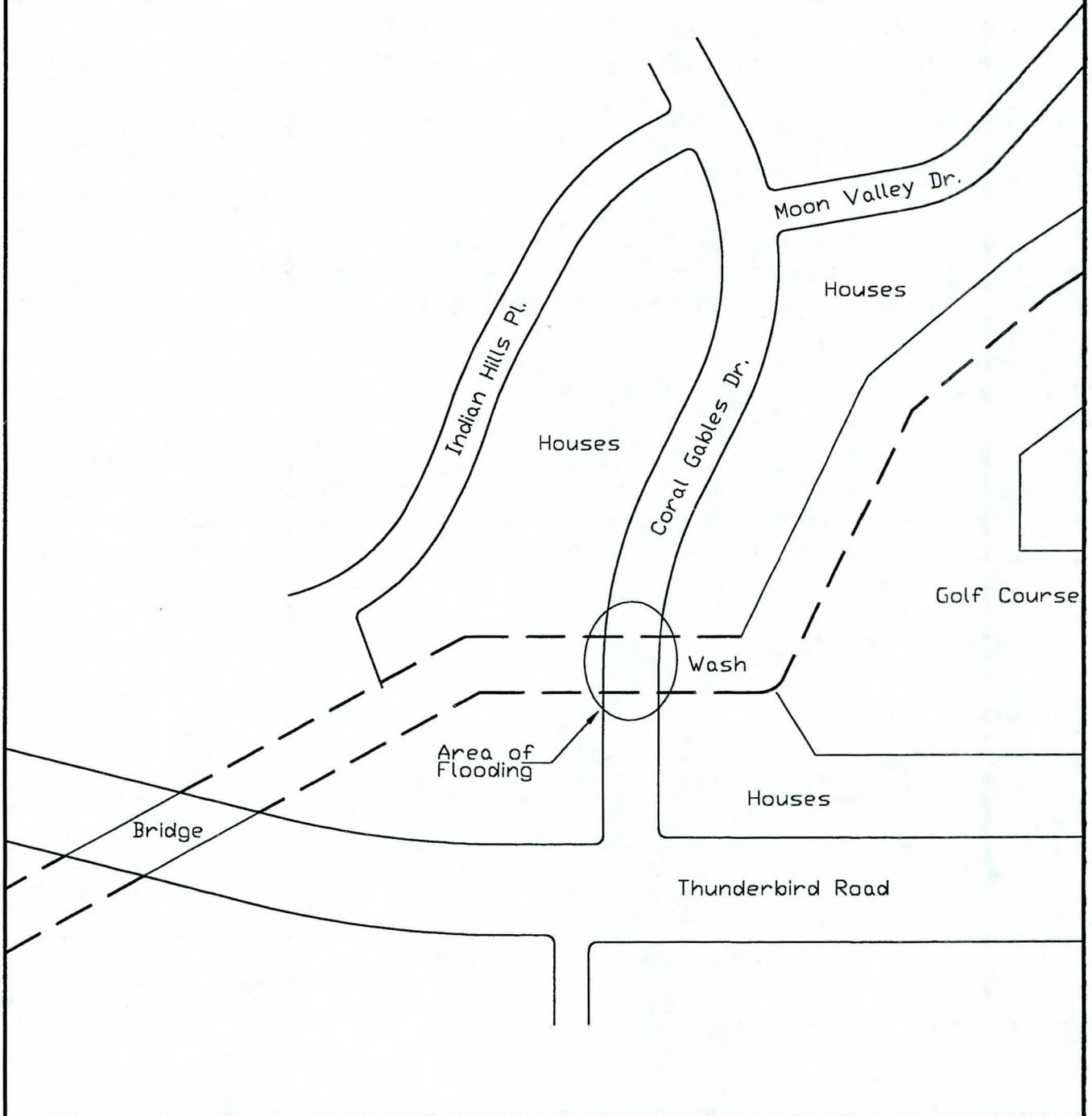
<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Bridge Deck	8,000 FT ²	\$55 - \$65/FT ²	\$440,000 - \$520,000
Excavation	5,000 YD ³	\$15.00/YD ³	\$75,000
<i>Subtotal</i>			\$515,000 - \$595,000
<i>20% Contingency</i>			\$103,000 - \$119,000
<i>Total</i>			\$518,000 - \$714,000

N



N.T.S

NOTE: It is recommended that no action be taken at this site



SITE 10 - PREFERRED ALTERNATIVE

FIGURE 3

8. SITE 11 — 7th Avenue North of Coral Gables Drive

8.1 Location and Site Description

This site is the East Fork of Cave Creek Wash which crosses 7th Avenue approximately 700 feet north of Coral Gables Drive, which is south of Greenway (see Site 11- Vicinity Map, Figure 1). This is a developed residential neighborhood. There is a City of Phoenix park on the banks of the wash east of 7th Avenue. The bed of the wash is lined with rocks with diameters as large as 1 foot.

8.2 Problem Identification

7th Avenue is a paved road which has a local low point in the wash. Flow through the wash is sufficiently deep during storm events that vehicles cannot drive through it (see Site 11 - Problem Identification, Figure 2).

8.3 History

The wash has become impassable during storm events due to the high volume of flow which is directed through the wash. The road is barricaded and unusable until flows subside. Local traffic is forced to use a detour at these times.

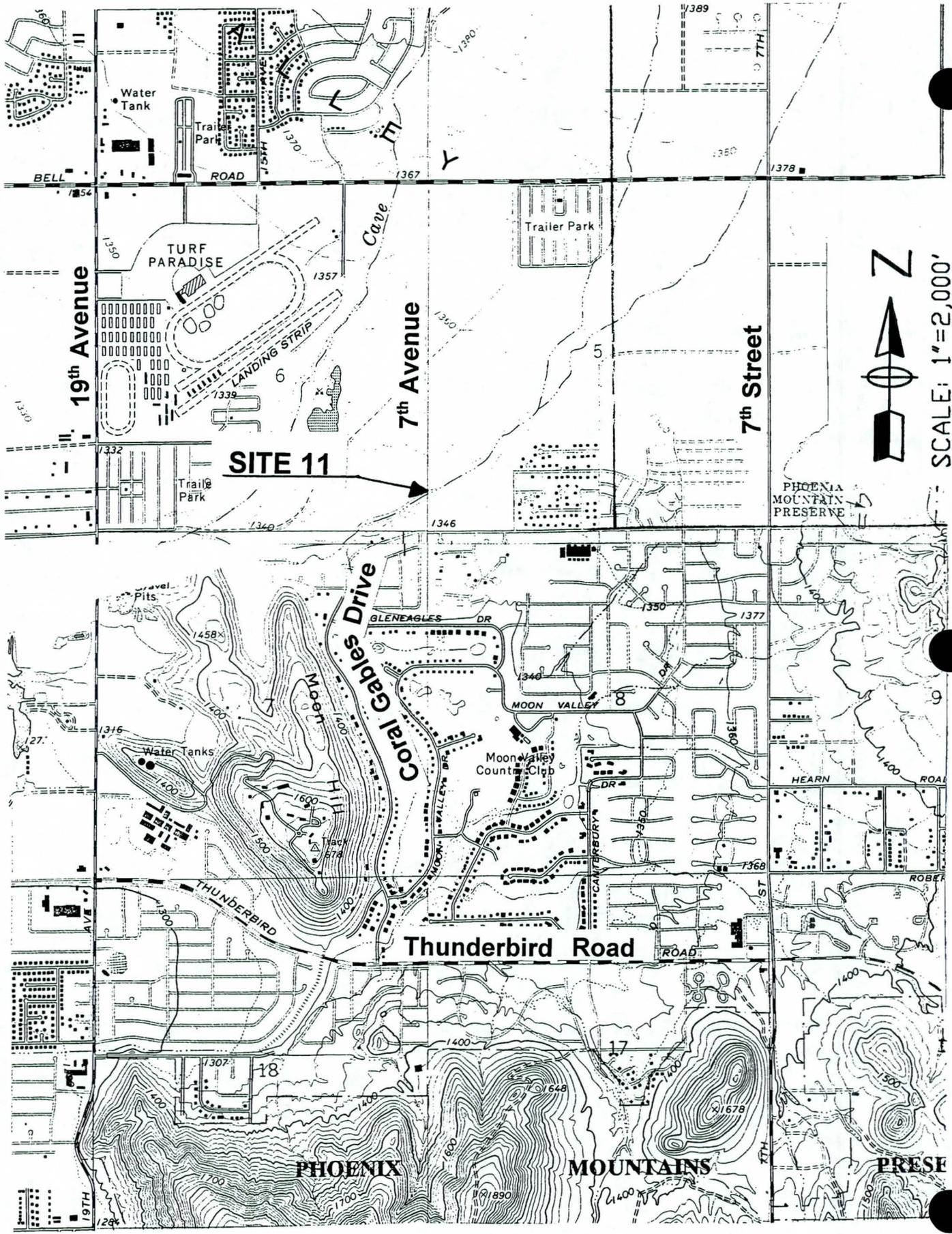
8.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 11 and its upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Map L-8.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.
- City of Phoenix Quarter Section Water Maps.
- City of Phoenix Quarter Section Wastewater Maps.

8.5 Hydrology

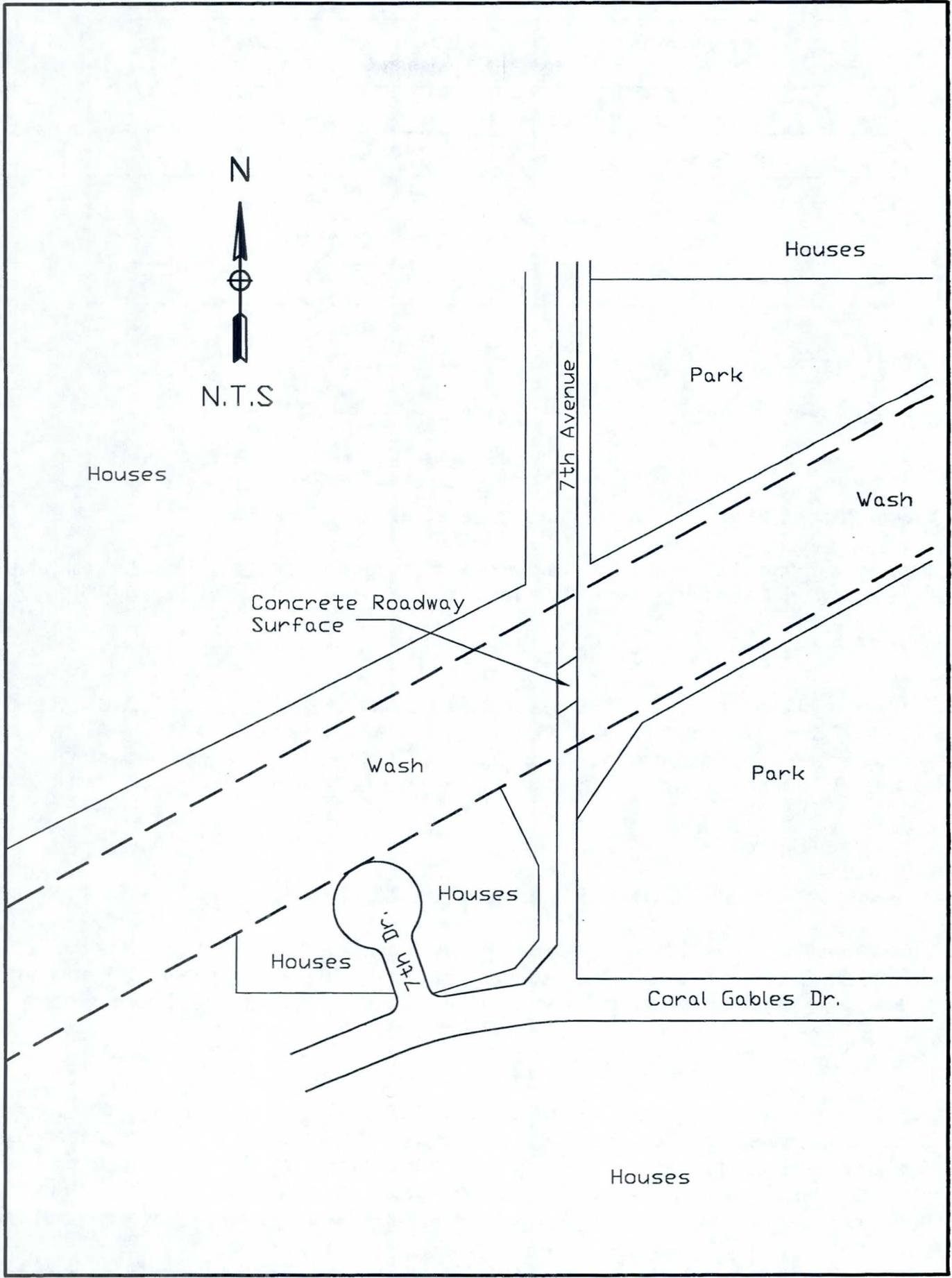
A 1995 FEMA report for Maricopa County determined flows for the 10-, 50-, and 100-year flood events for the East Fork of the Cave Creek Wash near 7th Avenue. The values for the runoff amount for the different design periods not given by the FEMA report were calculated using the Pima County Method of Approximate Ratios of Lesser Magnitude Floods to the 100-year flood.



SCALE: 1"=2,000'

SITE 11 - VICINITY MAP

FIGURE 1



SITE 11 - PROBLEM IDENTIFICATION

FIGURE 2

<i>Frequency (yr)</i>	<i>Moon Valley Wash Discharge (cfs)</i>
100	9400
50	8200
25	6110
10	5500
2	1880

8.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix has plans for the construction of a pedestrian bridge in 1996 that will cross the East Fork of Cave Creek Wash at 7th Avenue. The cost of this project is \$350,000.

8.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Numbers 04013C1655 H and 04013C1215 H, revised September 30, 1995. The area is designated as Zone AE, which denotes areas inundated by the 100-year flood. The FEMA report gives the 10-year, 50-year, and 100-year flow through the wash at 7th Avenue near Coral Gables.

8.8 Alternative Solutions

Alternative 1 - Construct a Bridge Crossing at the Wash

This alternative proposes that a bridge crossing be constructed on 7th Avenue over the East Fork of the Cave Creek Wash. Water elevations for the 100-year flood event provided in the FEMA report show that there is sufficient clearance to construct an at-grade bridge crossing.

Alternative 2 - No Action

This alternative proposes that no improvements be made to 7th Avenue, as no damage occurs to adjacent private property during flood events. In addition, there are detours around the 7th Avenue crossing so that residents have access to their properties. However, care should be taken to maintain warning signs for motorists to prevent attempts at crossing the wash when flooded.

8.9 Cost Estimate

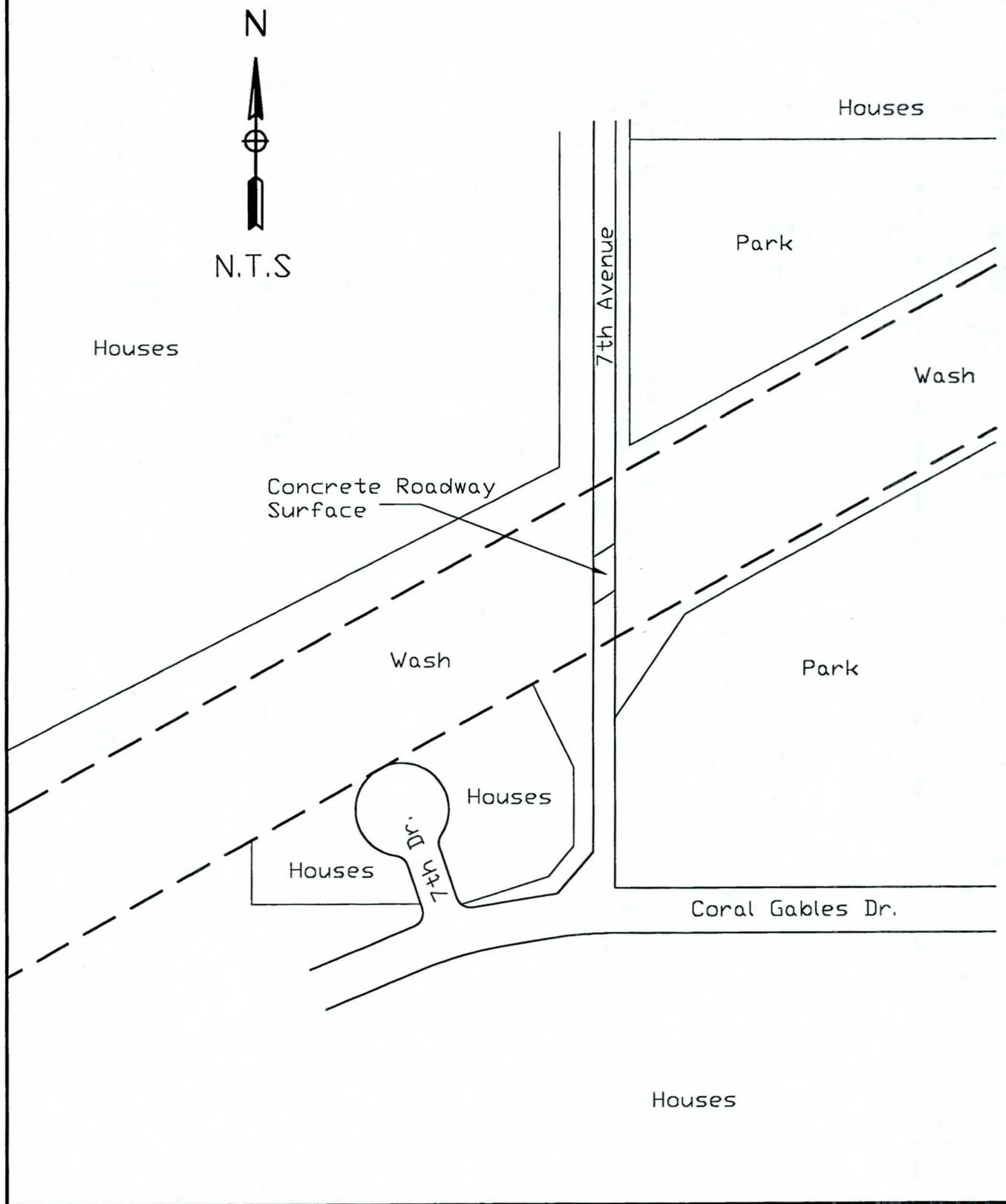
Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Bridge Deck	40,000 FT ²	\$55 - \$65/FT ²	\$2,200,000 - \$2,600,000
<i>Subtotal</i>			\$2,200,000 - \$2,600,000
<i>20% Contingency</i>			\$440,000 - \$520,000
<i>Total</i>			\$2,640,000 - \$3,120,000

8.10 Recommended Alternative

It is recommended that Alternative 2, no action, be taken at this site. There are no costs associated with implementing this alternative (see Site 11 - Preferred Alternative, Figure 3).

NOTE: It is recommended that no action be taken at this site



SITE 11 - PREFERRED ALTERNATIVE

FIGURE 3

9. SITE 12 — 7th Avenue North of Union Hills Drive

9.1 Location and Site Description

This site is the northeast corner of 7th Avenue and Union Hills Drive. This is a partially developed residential neighborhood. The lot on the corner of 7th Avenue and Union Hills Drive is vacant (see Site 12 - Vicinity Map, Figure 1).

9.2 Problem Identification

7th Avenue is a paved road which does not have curb or sidewalk improvements at Union Hills (see Site 12 - Problem Identification, Figure 2).

9.3 History

7th Avenue has experienced street and right-of-way flooding. Sediment also builds up in the street as a result of the flooding.

9.4 Site Specific Data Acquisition

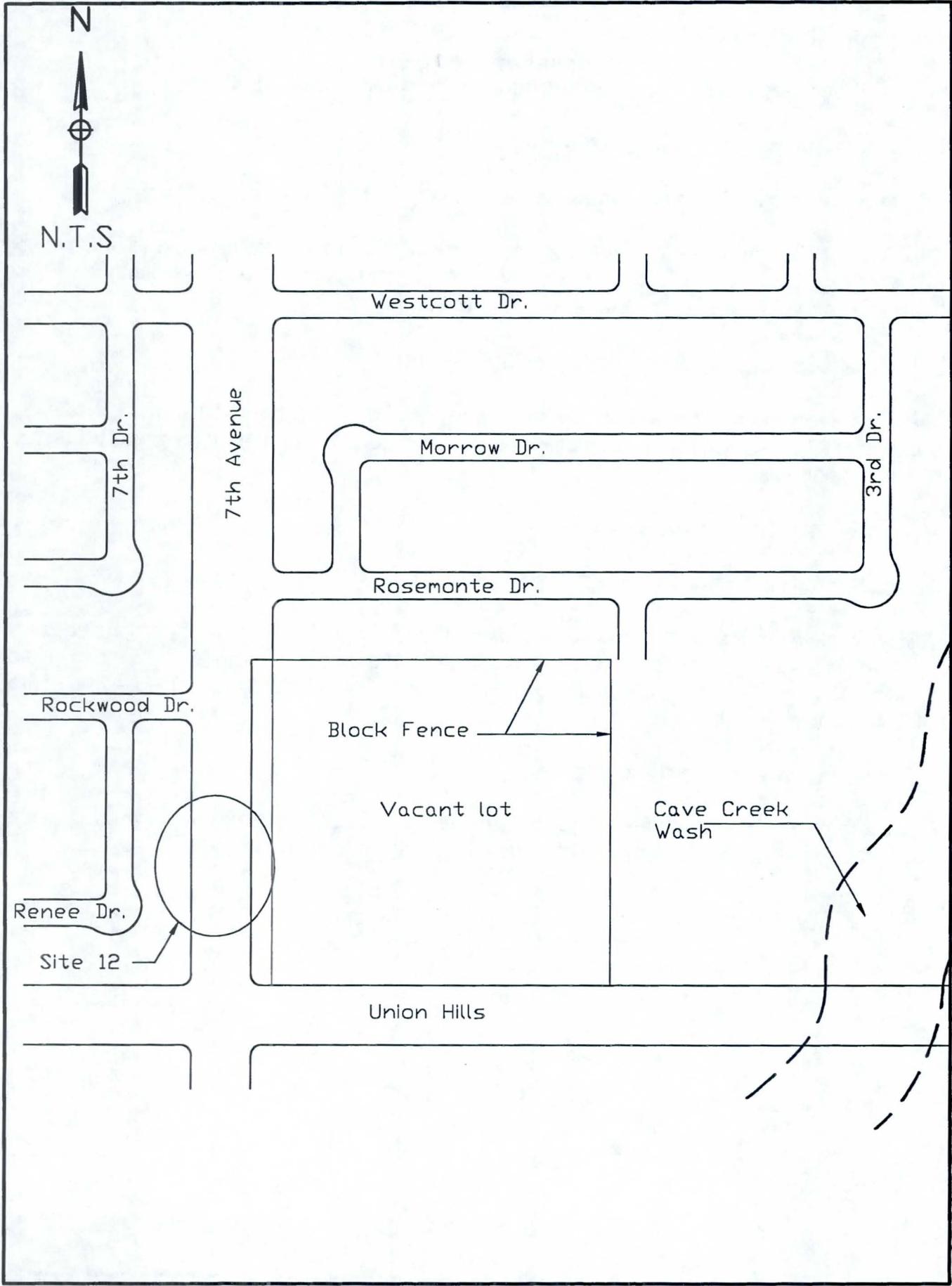
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Union Hills which contains Site 5 and its upstream drainage area, Revised 1981.
- City of Phoenix Storm Drain Map M-8.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.

9.5 Hydrology

The values for the runoff amount for the different design periods were calculated using the Rational Method. Due to sufficient lack of supporting data, engineering judgements were used to make assumptions required to facilitate calculations. The local discharge is the portion of flow on 7th Avenue which originates from the drainage area north of Union Hills to Utopia Drive and east of 7th Avenue to Central Avenue.

<i>Frequency (yr)</i>	<i>Local Discharge (cfs)</i>
100	206
50	184
25	159
10	136
2	84



SITE 12 - PROBLEM IDENTIFICATION

FIGURE 2

9.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix has plans for a storm drain on 7th Avenue from Union Hills Drive to Beardsley Road to be constructed in late 1997. Street improvements are also planned at this time. The cost for these improvements is projected to be \$90,000.

9.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1215 H, revised September 30, 1995. The area is designated as Shaded Zone X, which denotes areas within the 500-year floodplain.

9.8 Alternative Solutions

Alternative 1 - No Action

This alternative proposes that no action be taken at this time to improve flooding conditions on 7th Avenue. This site is scheduled for improvements in 1997 that will address the flooding in this area. It is recommended that the design engineer for those improvements be made aware of the flooding concerns at this site.

9.9 Recommended Alternative

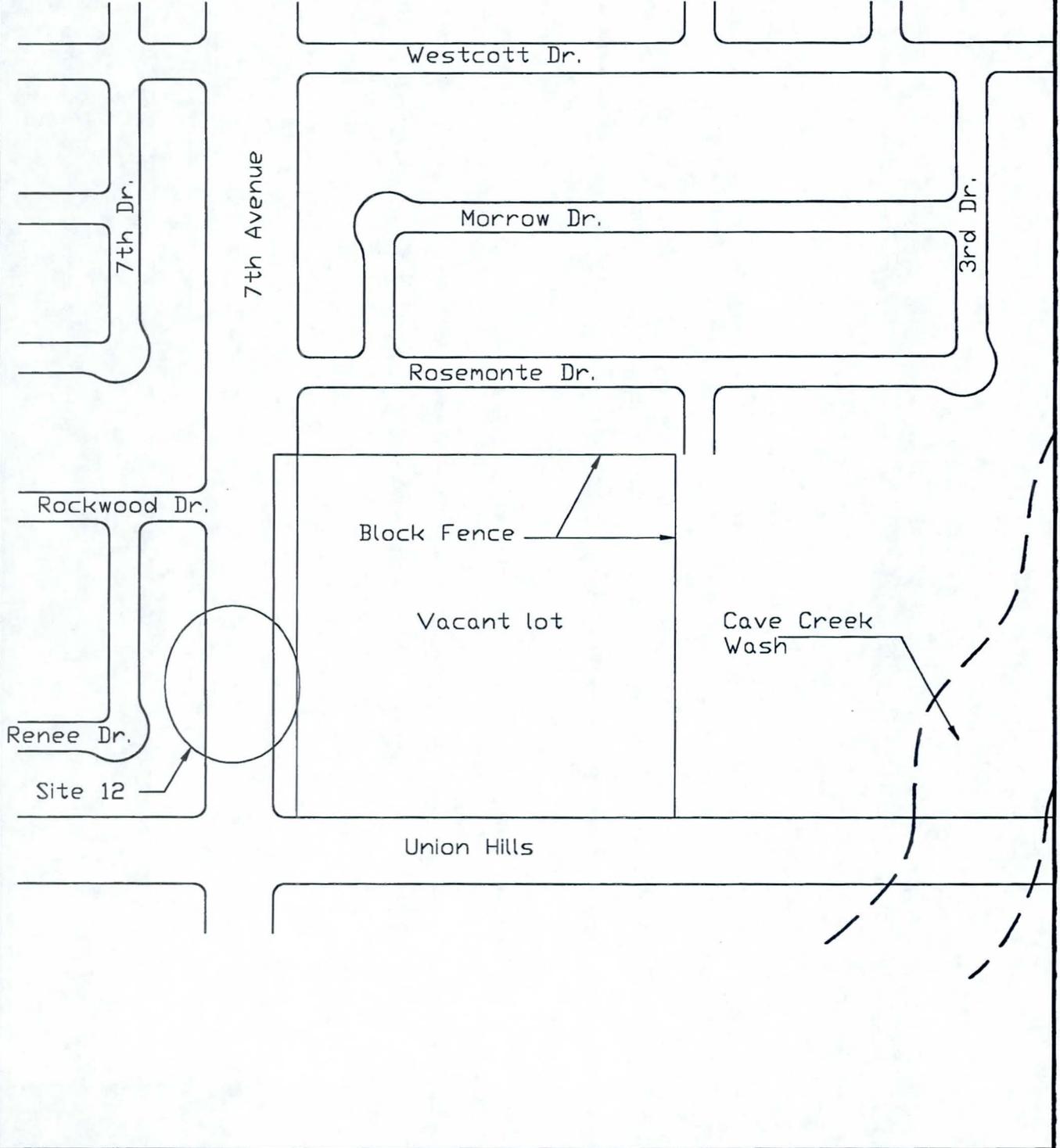
It is recommended that Alternative 1 be implemented (see Site 12 - Preferred Alternative, Figure 3). There are no costs associated with implementing this alternative.

NOTE: It is recommended that no action be taken at this site

N



N.T.S



SITE 12 - PREFERRED ALTERNATIVE

FIGURE 3

10. Site 14 — 7th Street, Beardsley Road to Deer Valley Road

10.1 Location and Site Description

This site is located along 7th Street between Beardsley Road and Deer Valley Road in Township 4 North, Range 3 East, Sections 20 and 21 of the Gila and Salt River Base and Meridian. The local ponding problem occurs at a sag in 7th Street between Deer Valley Road and Beardsley Road. (See Site 14 - Vicinity Map, Figure 1.)

7th Street has a paved width of approximately 28 feet between Beardsley and Deer Valley Roads. The land east of and adjacent to 7th Street is undeveloped desert from Beardsley Road to the Rose Garden Lane alignment. Small commercial businesses are located close to and north of the Rose Garden Lane alignment. United Metro Plant 7, a materials company and division of Tanner, is located north of these small commercial businesses. The Cave Creek Wash Bridge is located north of United Metro approximately 1,100 feet south of Deer Valley Road. The area east of and adjacent to 7th Street, from the Cave Creek Wash Bridge to Deer Valley Road, is undeveloped desert.

A levee is located on the west side of 7th Street and extends from Beardsley Road north to just south of the Cave Creek Wash Bridge. This levee was originally built to protect a sand and gravel mining operation to the west. The mining operation has been replaced by Lone Cactus, a construction materials landfill, a division of Sanifill, Inc. The land remains undeveloped west of 7th Street on the north side of the Cave Creek Wash, extending to Deer Valley Road. There is a short levee which confines the flow to the Cave Creek Wash.

10.2 Problem Identification

The flooding problem at Site 14 consists of water ponding in the roadway and right-of-way between Beardsley Road and Deer Valley Road. The ponding location is located at a dip section approximately 0.25-mile north of the intersection of Beardsley Road and 7th Street. (See Site 14 - Problem Identification, Figure 2.)

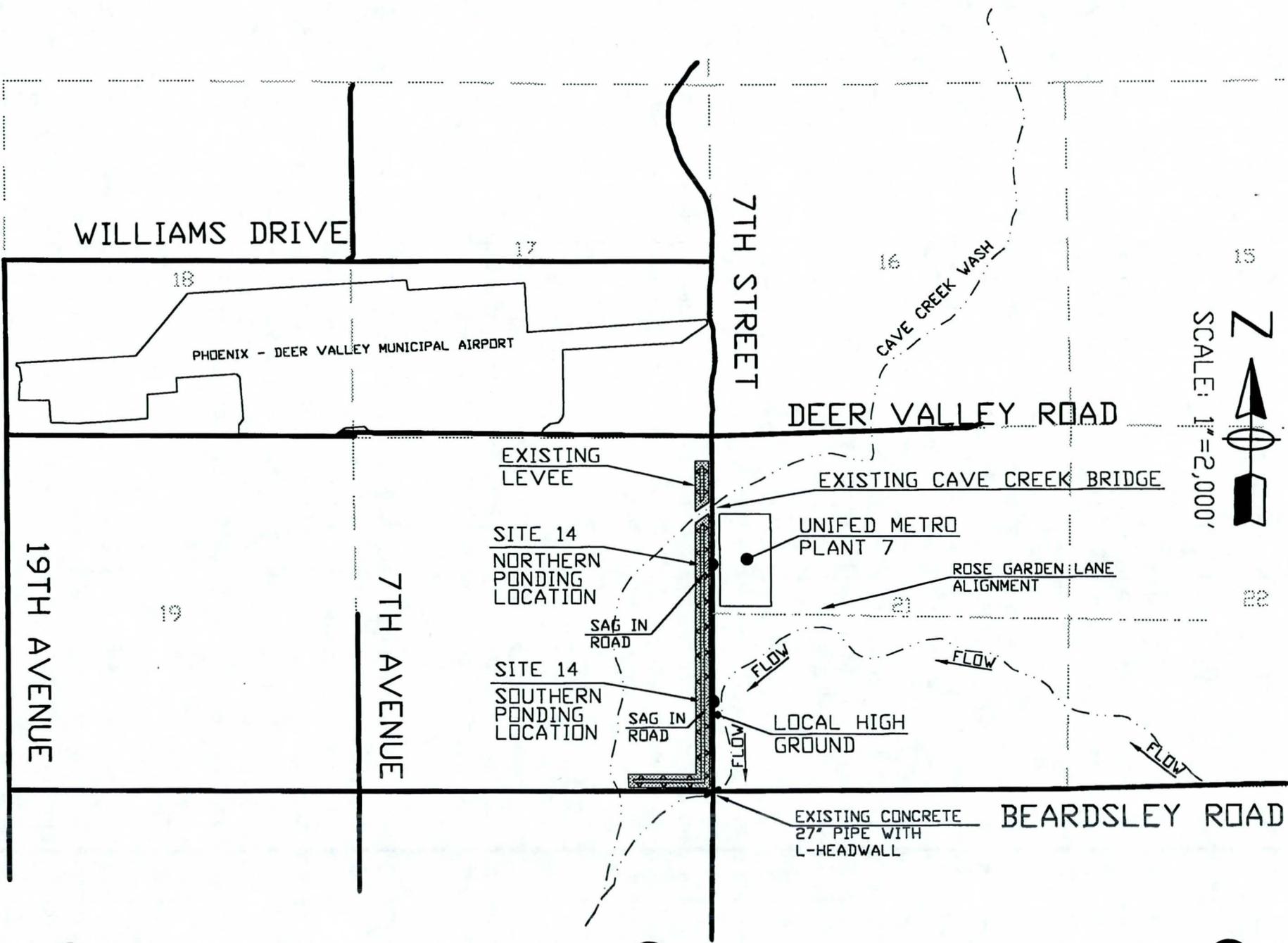
The existing ground on the east side of 7th Street and south of a local wash is at a higher elevation than the ground west of 7th Street adjacent to the dip section (Figure 2). Consequently, flows concentrate at the dip section and weir south on the west side of 7th Street. City maintenance crews have recorded ponding depths of 1.0 to 1.5 feet, requiring periodic barricading of the road. This area creates a safety hazard, as motorists cannot see the water in time to avoid driving into it and potentially stalling their vehicles. Additionally, sediment must be removed after flood waters have subsided or been pumped.

10.3 History

The drainage pattern is from a northeast to southwest direction. 7th Street was originally constructed with numerous at-grade wash crossings. In May of 1978 construction plans were prepared for the Cave Creek Wash Bridge which was subsequently built. A 27-inch concrete

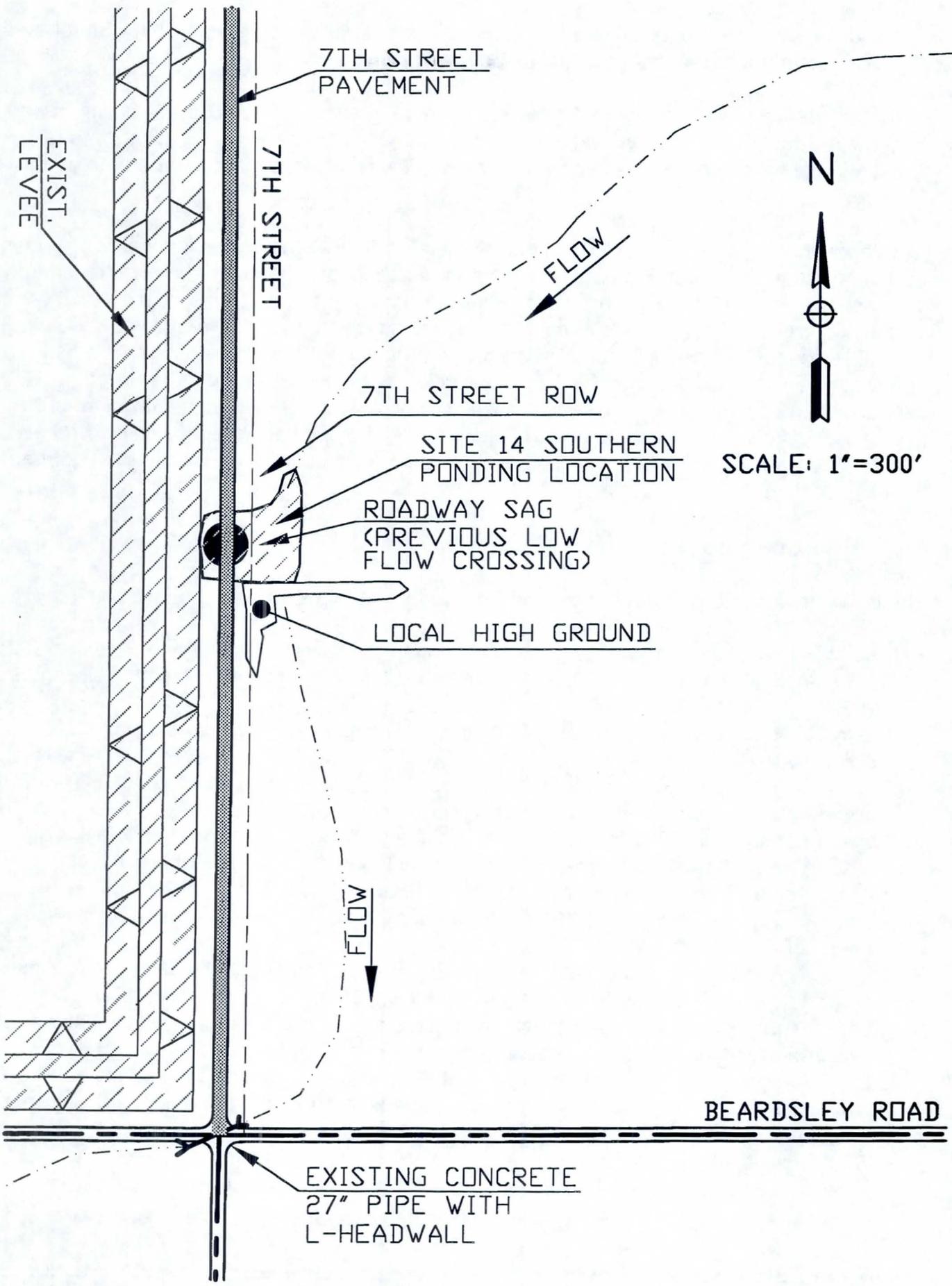
SITE 14 - VICINITY MAP

FIGURE 1



SCALE: 1"=2,000'





SITE 14 - PROBLEM IDENTIFICATION

FIGURE 2

pipe with 'L'-type inlet headwall extends diagonally across the intersection of 7th Street and Beardsley Road from the northeast to the southwest corners.

Historically, flows generated by the drainage area concentrating at the problem location flowed across 7th Street and continued west. A levee was built approximately 20 feet west of the 7th Street edge of pavement which effectively dams this flow path and causes the water to pond in 7th Street.

A northern ponding location also existed approximately 1/8-mile south of the intersection of Deer Valley Road and 7th Street. Flows for the northern ponding location drained along the road on the east side of 7th Street to the south. Ponding occurred due to high ground created by construction vehicles dumping the remainder of their loads along the 7th Street east right-of-way over an extended period of time. The City of Phoenix has regraded the east right-of-way to remove the high ground beginning with the area adjacent to the northern ponding location. This has allowed the ponded water to be conveyed to the south. The flow runs in the east right-of-way to an existing natural wash located south of the United Metro plant on the east side of 7th Street. The flow then continues south to the southern ponding location, thereby eliminating the northern ponding location.

10.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 41-29, drawn January 1992; 42-30, drawn February 1973; 41-29, drawn November 1987; and 41-30, drawn December 1983.
- City of Phoenix Topographic Quarter Section Map Numbers: 41-29, flown June 5, 1971; 42-29, flown June 5, 1971; 41-30, flown February 24, 1973; and 42-30, flown February 24, 1973.
- City of Phoenix Wastewater Quarter Section Map Numbers: 42-30, revised July 1996; 41-30, revised February 1996; and 41-29, revised February 1995.
- City of Phoenix Water Quarter Section Map Numbers: 42-30, revised February 1996; 42-29, revised March 1989; 41-30, revised February 1996; and 41-29, revised March 1989.
- City of Phoenix Engineering Storm Drain Map N-8 (not dated).
- City of Phoenix Job No. P-911727, 7th Street and Beardsley Road plan and profile sheet, Sheet 7 of 11, stamped March 1994.
- City of Phoenix Job No. BR-76198.00, North 7th Street Bridge over the Cave Creek Wash, Sheets 1, 2, 3, 4, 5, 6, 7, 8, 9, and 14, signed by City Engineer September 1977.
- ADOT 60-percent Pima Freeway plans for the area approximately 2,000 feet east and west of the intersection of 7th Street and Beardsley Road, dated as printed March 28, 1996.
- ADOT 60-percent Pima Freeway plans for the proposed detention basin, located at the northeast corner of 7th Street and Beardsley Road, dated as printed March 28, 1996 and December 19, 1995.
- USGS 7.5-minute quadrangle map for Union Hills Arizona, which contains Site 14, its upstream drainage area, and downstream flow path, photo revised 1981.

The COP, FCDMC, and MCDOT were contacted to obtain paving, water, and sanitary sewer plans for 7th Street from Beardsley Road to Deer Valley Road; however, they were not available. Plans for the levee which was constructed on the west side of 7th Street were also not available.

10.5 Federal Emergency Management Agency

This site is on FEMA Flood Insurance Rate Map Panel Number 04013C1215H, revised September 30, 1995. The area is designated shaded Zone X which denotes areas of 500-year floods with average depths of less than one foot or with drainage areas less than one square mile, and areas protected by levees from 100-year floods.

10.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

ADOT has contracted with Parsons Brinckerhoff to prepare construction plans for an interim portion of the Pima Freeway from I-17 to 52nd Street. The alignment of this freeway follows the Beardsley Road alignment. The design and construction of the ultimate drainage facilities are included as a part of the interim design of the freeway.

The discharge which concentrates approximately 0.25-mile north of the 7th Street and Beardsley Road intersection has been calculated to be 900 cfs. A detention basin with outlet pipe is planned at the northeast corner of the intersection of 7th Street and Beardsley Road which will replace the existing culvert, a 27-inch concrete pipe with 'L' - type headwall.

Ponding occurs in 7th Street approximately 1,600 feet north of the intersection of 7th Street and Beardsley Road. The flow weirs over the high point in the road on the west side of 7th Street and continues south to Beardsley Road. A culvert consisting of a 3-8'x5' CBC will be designed by Parsons Brinckerhoff to collect this flow and convey it under and to the east side of 7th Street. It will outlet into the proposed detention basin located at the northeast corner of 7th Street and the proposed Pima Freeway. The outflow pipe from the basin, consisting of 2-8'x6' concrete box culverts, will drain under the intersection of 7th Street and Beardsley Road to the southwest.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. Although improvements to 7th Street from Union Hills Drive to Beardsley Road are programmed from 1998 to 2000, there are no plans to improve the reach of 7th Street from Beardsley Road to Deer Valley Road.

10.7 Hydrology

The drainage area contributing to the ponding extends east from 7th Street through Section 21 into Section 22. It is approximately 0.8 square mile in size as delineated on a 7.5-minute USGS quadrangle map. The existing gradient of the land is from northeast to southwest.

A conservative representation of the drainage area for Site 14 is Drainage Area Sub-basin 253 of *Cave Creek Watershed, Volume 1.7, Arizona Canal Diversion Channel Area Drainage Master Study, Phase 1 Hydrology Report*, prepared and submitted to the FCDMC by Kaminski-Hubbard Engineering, Inc., in May 1993. Drainage Area Sub-basin 253 concentrates about 1,200 feet south and west of the intersection of 7th Street and Beardsley Road. It has a surface area of 0.93 square mile, an existing condition 100-year runoff of 396 cfs and a 100-year developed condition runoff of 596 cfs. However, Parsons Brinckerhoff uses a 100-year developed condition runoff of 900 cfs in their interim Pima Freeway drainage design for essentially the same area.

10.8 Alternative Solutions

Several alternatives were evaluated to develop solutions for mitigation of the ponded water at the southern ponding location. However, realizing that ADOT will be providing the final drainage solution at the intersection of the Pima Freeway and 7th Street, the alternative selected should be coordinated with the freeway construction.

Alternative 1 - Construct a Channel on the West Side of 7th Street

This alternative involves the design of a channel on the west side of 7th Street to be constructed in conjunction with the proposed Pima Freeway. The channel will extend south from the ponding location to the proposed 3-8'x5' CBC being designed by Parsons Brinckerhoff. Here, the flow from the west side to east side of 7th Street will be conveyed through the culverts and outletted into the proposed detention basin located at the northeast corner of the Pima Freeway and 7th Street.

An earthen channel with a bottom width of 20 feet, 3:1 side slopes, 48-foot top width, and a slope of 0.33 percent will convey the 100-year flow rate of 900 cfs at a velocity of 6 fps. The approximate length of this channel is 760 feet, as it need only extend to the proposed CBC location. Rip-rap protection is recommended where the channel curves as it crosses 7th Street from east to west and at the inlet of the 3-8'x5' CBC.

The impact of Alternative 1 is that although it will eliminate ponding in 7th Street, flows will continue to cross 7th Street. Therefore, damage to the asphalt may continue. Additionally, the velocity of flow will slow to turn south once across 7th Street, possibly causing suspended sediment to be deposited in 7th Street.

Alternative 2 - Construct a Channel on the East Side of 7th Street

This alternative involves an earthen channel located in the right-of-way east of 7th Street. This channel will begin at the southern ponding location and will outlet into the proposed detention basin located at the northeast corner of the Pima Freeway and 7th Street. An earthen channel with a bottom width of 12 feet, 3:1 side slopes, 34-foot top width, and a bottom slope of 0.3 percent will convey 390 cfs. (See Site 14 - Proposed Channel.) This is the approximate 10-year developed flow rate and 100-year existing condition runoff. The velocity in this channel is approximately 4.8 fps. Rip-rap protection is recommended where the channel curves south from

the natural wash at the ponding location. The channel is about 1,600 feet long to outlet into the detention basin, and can be located within the current right-of-way which is 42 feet from the edge of pavement. To convey the total 100-year flow concentrating at this location, the configuration proposed by Alternative 1 will be necessary. This will require that an additional 8 to 10 feet of right-of-way be acquired east of 7th Street.

The main concern with this alternative is that the design of the Pima Freeway anticipates that the flow will be conveyed on the west side of 7th Street. If this alternative is selected, Kim Marshall of Parsons Brinckerhoff (phone number 966-8295) must be contacted and arrangements made to modify their current design to anticipate the flow coming from the east side of 7th Street. There is urgency associated with this alternative, as construction of the Pima Freeway is scheduled to begin in August of 1996.

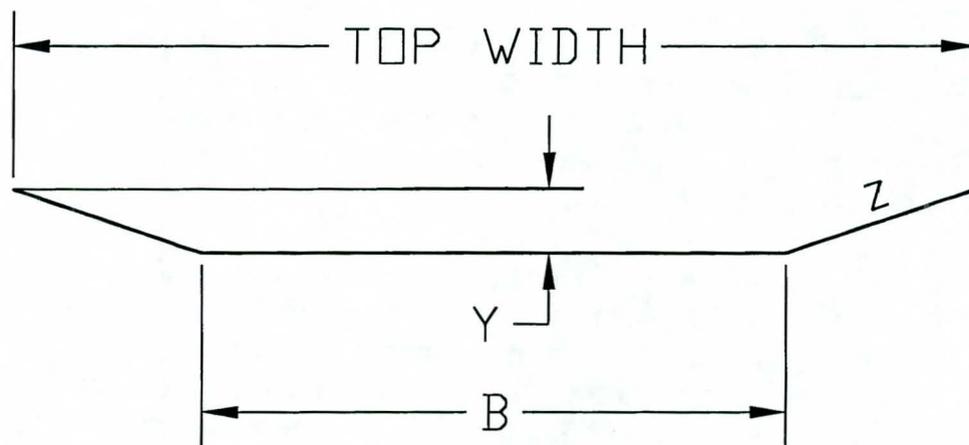
10.9 Recommended Alternative

Alternative 2 is the recommended alternative because it will provide an all-weather access along 7th Avenue and minimize hazardous conditions. (See Site 14 - Preferred Alternative, Figure 3.) The channel configuration contained within the right-of-way is the preferred interim solution and can be constructed using City forces. In the future, additional right-of-way can be obtained and the channel configuration widened to accommodate future developed flow rates. This construction will require contractor forces. The City will need to coordinate with Design Construction Management (DCM) and ADOT for the implementation of Alternative 2.

10.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Channel Excavation	4,239 YD ³	\$3.00/YD ³	\$12,800
Rip-rap (d ₅₀ =6")	201 YD ³	\$50.00/YD ³	10,100
<i>Subtotal</i>			\$22,900
<i>20% Contingency</i>			4,600
<i>Total</i>			\$27,500



$Q=396$ cfs (Q10±)

$B=12'$

$Z=3$

$S=0.3\%$

$n=0.03$ (EARTHEN)

$Y=3.61'$

$A=82.42$ sf

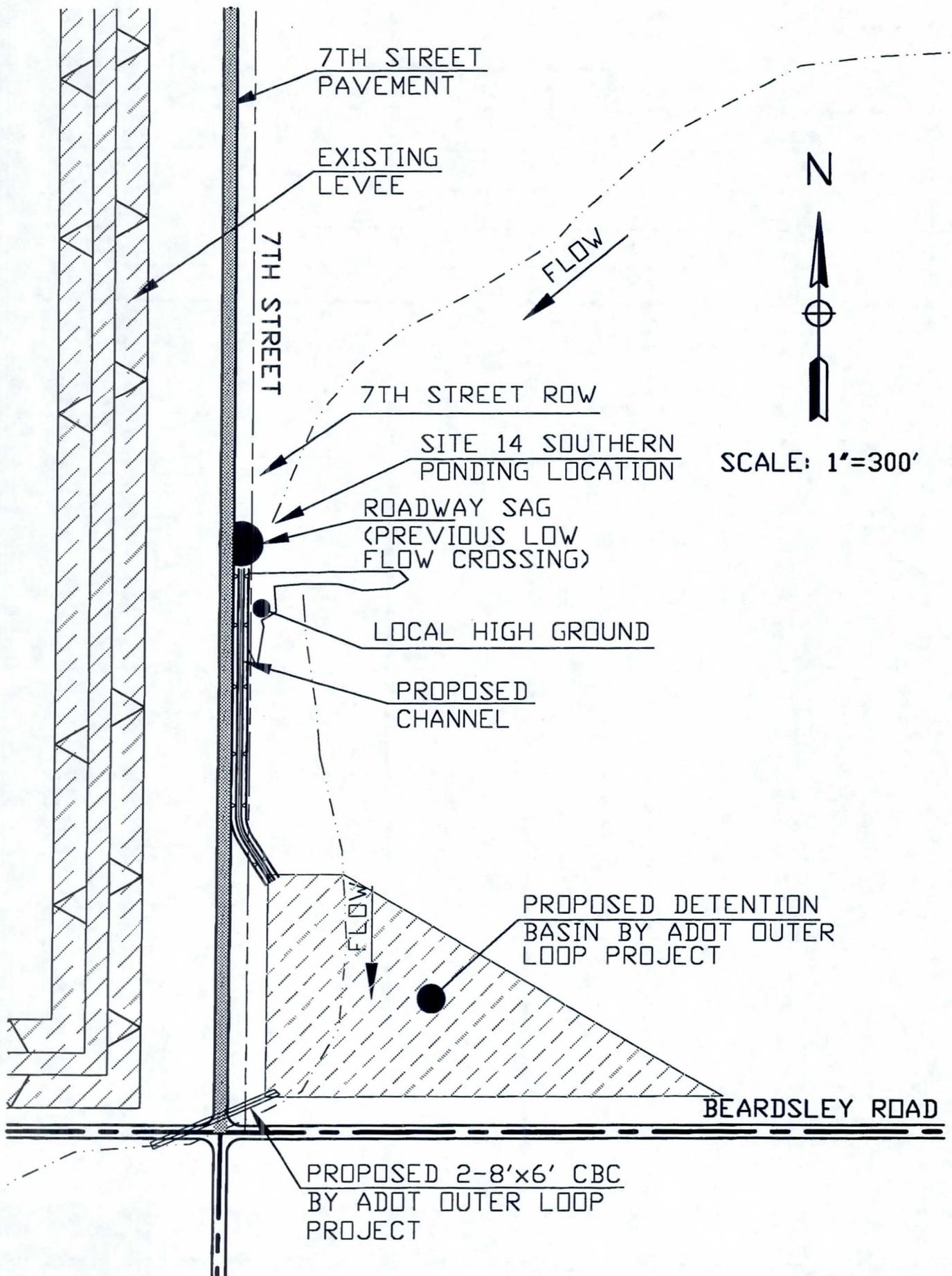
$V=4.82$ fps

$P=34.83$ ft

TOP WIDTH = 33.7

FROUDE = 0.5

SITE 14 - PROPOSED CHANNEL



SITE 14 - PREFERRED ALTERNATIVE

FIGURE 3

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Channel Excavation	5,626 YD ³	\$3.00/YD ³	\$16,900
Rip-rap (d ₅₀ =6")	130 YD ³	\$50.00/YD ³	6,500
<i>Subtotal</i>			\$23,400
<i>20% Contingency</i>			4,700
<i>Total</i>			\$28,100

11. Site 15 — 13201 North 21st Place

11.1 Location and Site Description

This site is located west of Cave Creek Road and north of Cactus Road in Township 3 North, Range 3 East, in Section 10 of the Gila and Salt River Base and Meridian (see Site 15 - Vicinity Map, Figure 1). The site is in a residential development. Commercial land is located to the east along Cave Creek Road.

11.2 Problem Identification

Roadway, right-of-way, and property flooding occurs at Site 15. Before the area was developed, flows would run off the hills to the west and follow a minor wash. During development, the area was regraded and a low point was created on the east side of 21st Place at this site.

A swale was provided and a drainage easement dedicated to allow flows to run eastward along the north property line and then turn south to run down the alley. Presently, the alley elevation is higher than that of 21st Place and flows run from the alley to the west to pond in 21st Place at the site (see Site 15 - Problem Identification, Figure 2).

11.3 History

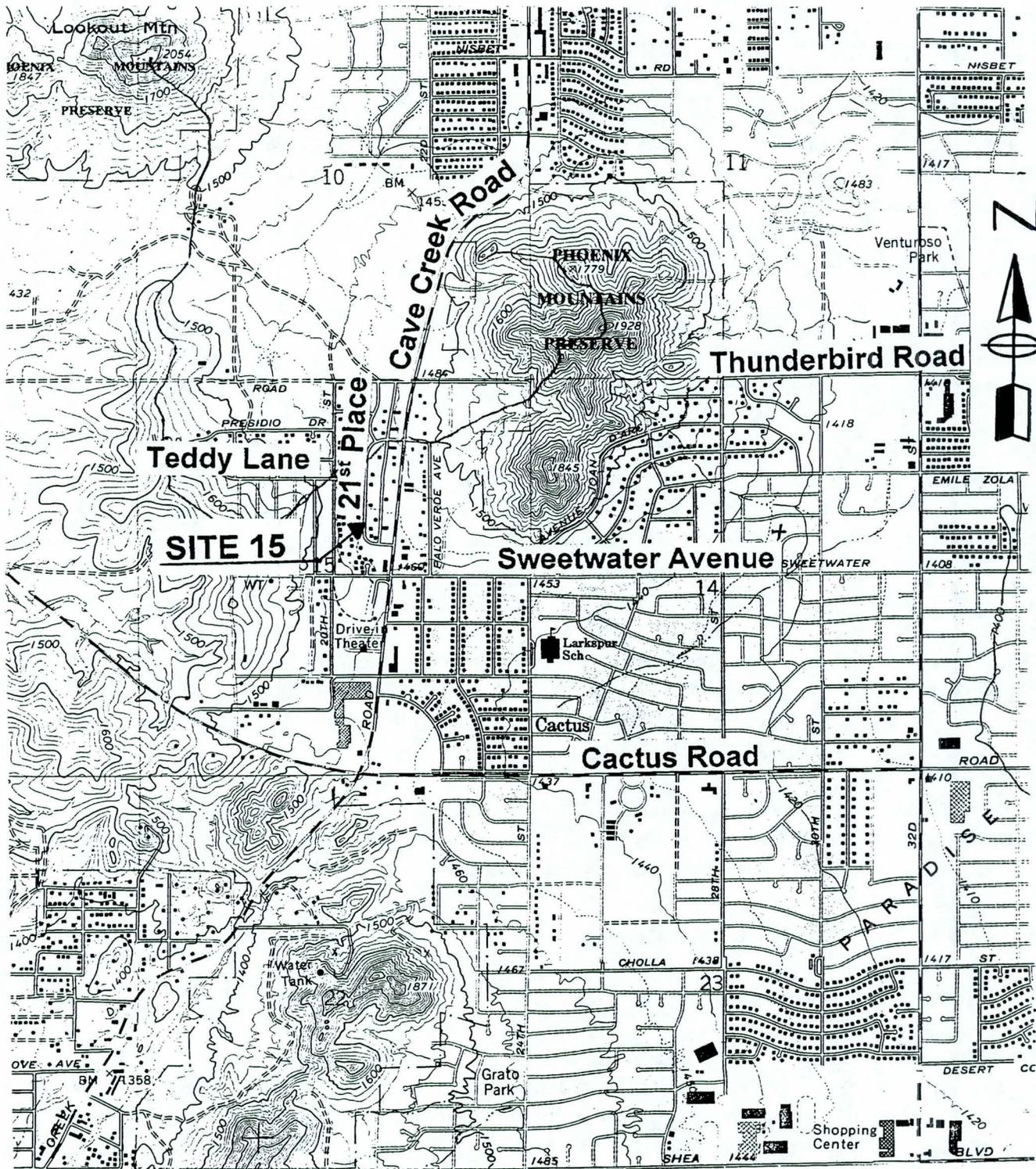
Historically, the flow path at this site has been in a southeasterly direction. After the area was developed, a drainage easement was dedicated along the north property line to the alley. Flows were to run east down the easement into the alley. From the alley, the flow runs south to 21st Place and then into Cave Creek Road.

When Cave Creek Road was improved, a catch basin was located at the south curb return of 21st Place at the intersection of 21st Place and Cave Creek Road. A catch basin was also located at the west curb return of Cave Creek Road just south of the intersection.

11.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

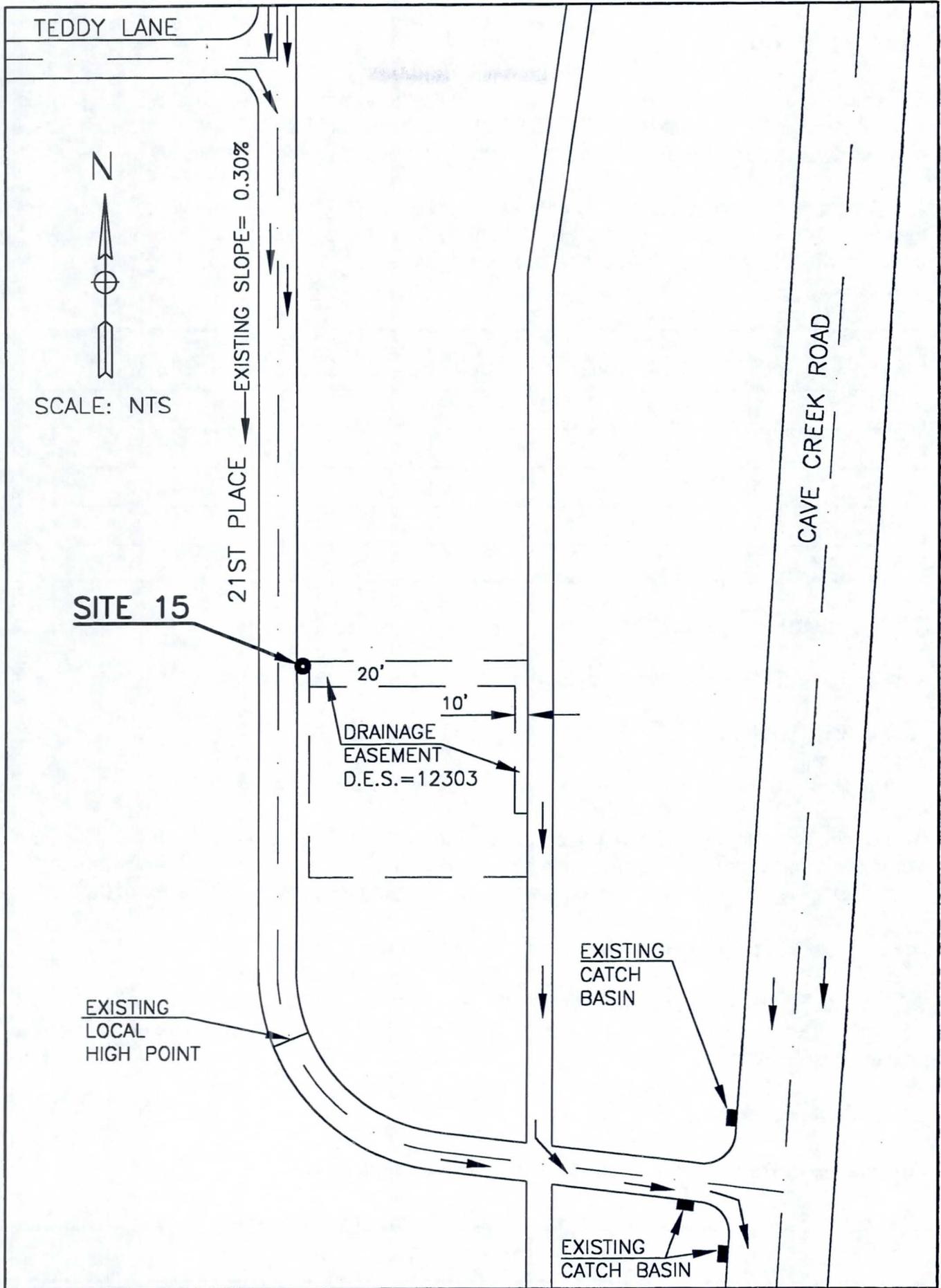
- City of Phoenix Right-of-Way Quarter Section Map Number 32-32, Drawn 12-23-92.
- City of Phoenix Topographic Quarter Section Map Number 32-32, Flown 6-5-71.
- City of Phoenix Aerial Photo Quarter Section Map Number 32-32, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Number 32-32, Revised 4-12-93.
- City of Phoenix Water Quarter Section Map Number 32-32, Revised 4-25-96.
- City of Phoenix Engineering Storm Drain Map L9 (not dated).
- USGS 7.5-minute quadrangle maps for Sunnyslope Arizona which contains Site 15, its upstream drainage area, and downstream flow path, Photo Revised 1982.



SCALE: 1"=2,000'

SITE 15 - VICINITY MAP

FIGURE 1



SITE 15 - PROBLEM IDENTIFICATION

FIGURE 2

11.5 Hydrology

The existing drainage area for Site 15 extends to the north and west. An existing high point is located at Eugie Terrace and Cave Creek Road; 21st Place and Eugie Terrace; and 20th Street and Teddy Lane. The area is a medium density residential development.

A high point is located approximately 315 feet south of Site 15 in 21st Place near the center of the roadway curve. It is approximately 0.4 foot higher than the elevation at Site 15. The following table lists the frequency and discharge concentrating at Site 15 calculated by the Rational Method.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>
100	17	2.8
50	15	2.5
25	13	2.2
10	11	1.8
2	7	1.0

11.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

11.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1660F, dated September 30, 1995. The site is located in Zone X (non-shaded), which denotes areas determined to be outside the 500-year floodplain.

11.8 Alternative Solutions

Alternative 1- Regrade the Drainage Easement and the Alley

This alternative encompasses grading the alley and drainage easement to drain from the alley

south to 21st Place. Beginning at the low point at the gutter, the curb will be removed and the gutter elevation held the same. The drainage easement will be regraded to cause the flow to drain to the east. The alley will be regraded both north and south to allow for vehicle passage and for drainage to flow south in the alley to 21st Place.

The channel will have a 10-foot bottom width, 6:1 side slopes, and be earthen lined. The flow depth for the 2-year flow of 7 cfs is 0.4 foot; for the 100-year flow of 17 cfs, it is 0.7 foot. The 2-year flow velocity is 1.3 fps and the 100-year velocity is 1.8 fps.

The private property adjacent to the drainage easement which runs along the north property line will have to be regraded.

Alternative 2 - Regrade 21st Place to Allow Flow to Drain South in 21st Place to Cave Creek Road

This alternative involves regrading 21st Street beginning at the low point at Site 15, to eliminate the existing high point. This will provide positive drainage by matching the existing elevation at the west side of the catch basin in 21st Place at the intersection of Cave Creek Road and 21st Place. Flows which originally ponded at Site 15 will flow to the south and be intercepted by this existing catch basin.

This alternative will require that a 2.4-foot elevation change be established at the existing high point. The elevation change will have to be made up in the right-of-way. The roadway width is 25 feet and the right-of-way width is 50 feet; therefore, a total of 12.5 feet on either side of the roadway exists to accommodate this change. The driveways will have to be modified from their existing configuration to continue to connect to the roadway.

The subdivision was originally designed such that the flows which currently concentrate at Site 15 would flow to Cave Creek Road. Consequently, the proposed regrading of 21st Place to allow these flows to drain to Cave Creek Road does not change the original drainage flow pattern to its original outfall.

Alternative 3 - 2-Year Storm Drain Connecting to Trunk Line in Cave Creek Road

It was assumed that the catch basin located in 21st Place at the intersection of Cave Creek Road and 21st Place was designed to intercept the 2-year flow from Site 15. 21st Place is superelevated to the east near Site 15.

This alternative involves the installation of one City of Phoenix Standard Detail P1569 curb opening catch basin, M2, L=10, at the low point in 21st Place at Site 15. In addition, 690 lineal feet of 24-inch RGRCP and four City of Phoenix P1520 storm drain manholes will be installed. This design will intercept the flow at Site 15 and direct it south and east to tie into the trunk line in Cave Creek Road.

11.9 Recommended Alternative

Alternative 1 is recommended by the City of Phoenix. This alternative is the least costly and will require the least maintenance (see Site 15 - Preferred Alternative, Figure 3).

With the implementation of this alternative, flows will continue to run close to the back doors of the existing residences. It is also noted that obstructions placed in the drainage easement, such as a shed, soda machine and fences, will reduce the effectiveness of this alternative. The cooperation of the property owner and tenants in keeping the area clean will be required for the alternative to be successful.

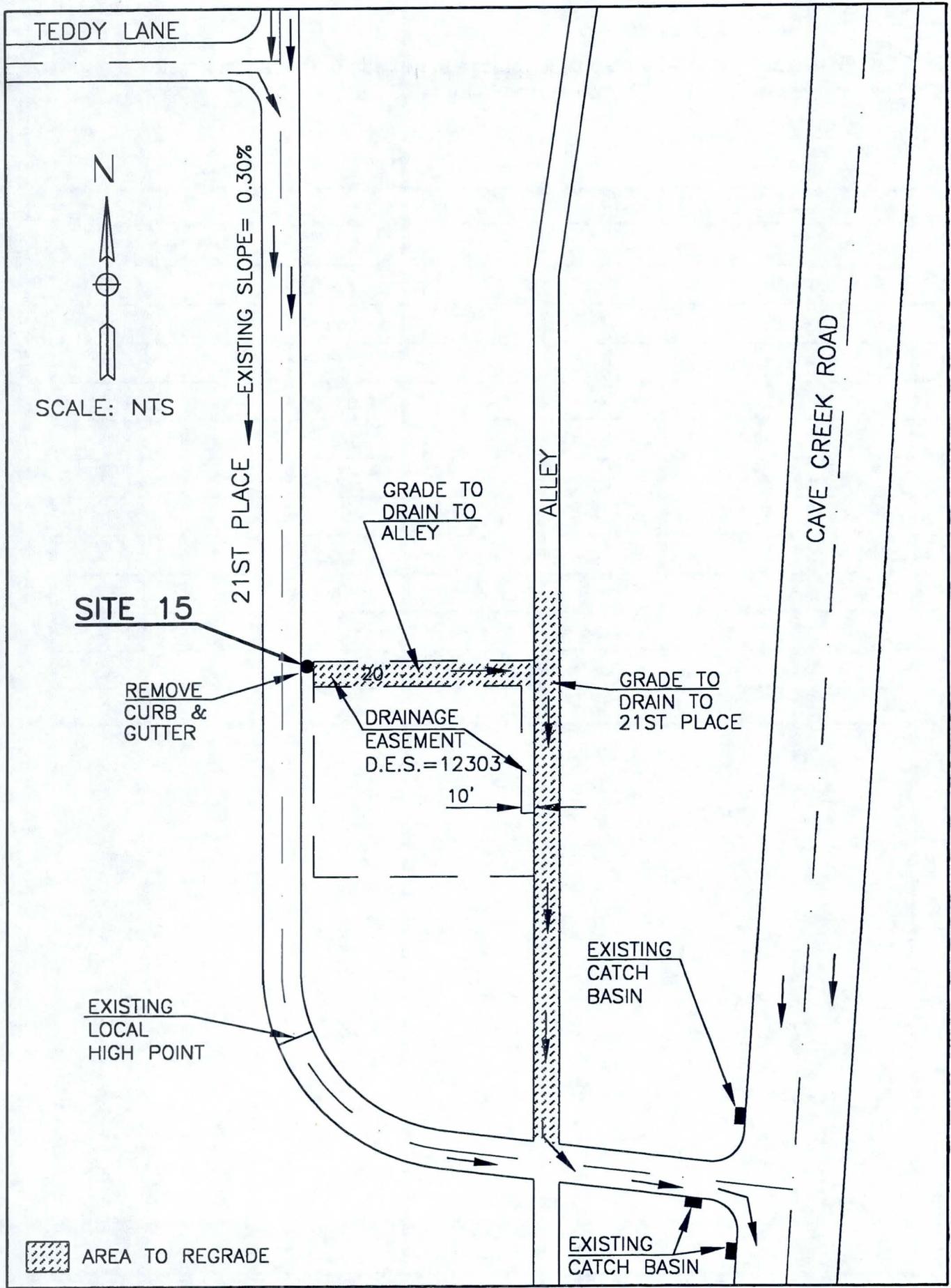
11.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Curb & Gutter Removal	20 LF	\$2.00/LF	\$ 100
Sod	2,800 FT ²	\$0.30/FT ²	800
Excavation	401 YD ³	\$3.00/YD ³	1,200
ABC, 6" Lift	193 YD ³	\$21.00/YD ³	4,100
Place Gutter	20 LF	\$6.00/LF	100
Subtotal			\$6,300
20% Contingency			1,300
Total			\$7,600

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Asphalt Removal	1,916 YD ²	\$1.80/YD ²	\$ 3,400
Curb & Gutter Removal	1,326 LF	\$2.00/LF	2,700
Excavation	780 YD ³	\$3.00/YD ³	2,300
Asphalt, 2" Lift	186 Tons	\$60.00/Ton	11,200
ABC, 6" Lift	320 YD ³	\$21.00/YD ³	6,700
Place Curb and Gutter	1,326 LF	\$6.00/LF	8,000
Subtotal			\$34,300*
20% Contingency			6,900*
Total			\$41,200*



SITE 15 - PREFERRED ALTERNATIVE

FIGURE 3

* These costs do not include the cost to remove the existing driveway concrete, regrade the driveways, or replace the driveway concrete for the 7 lots.

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Asphalt Removal	384 YD ²	\$1.80/YD ²	\$ 700
Curb & Gutter Removal	26 LF	\$2.00/LF	100
Excavation	639 YD ³	\$3.00/YD ³	1,900
Fill	558 YD ³	\$8.00/YD ³	4,500
24" RGRCP	690 LF	\$100.00/LF	69,000
COP P1569 M2, L=10 Catch Basin	1 Each	\$2,700/Each	2,700
COP P1520 Manhole	5 Each	\$2,300/Each	11,500
Asphalt, 2" Lift	42 Tons	\$60.00/Ton	2,600
ABC, 6" Lift	64 YD ³	\$21.00/YD ³	1,300
Place Curb & Gutter	26 LF	\$6.00/LF	200
Subtotal			\$ 94,500
20% Contingency			18,900
Total			\$113,400

12. Site 16 — 35th Avenue South of Mohawk

12.1 Location and Site Description

This site is located south of Mohawk Lane at the Scatter Wash crossing of 35th Avenue in Township 4 North, Range 2 East, along the north-south section line between Sections 22 and 23 of the Gila and Salt River Base and Meridian (see Site 16 - Vicinity Map, Figure 1).

The wash crossing consists of both a low-flow crossing consisting of 3-18" corrugated metal pipe (CMP) with concrete headwalls, and an at-grade crossing where the flow runs across the road. The downstream channel is small, undefined, and meanders in a southwesterly direction for approximately 370 feet to the downstream ADOT channel.

12.2 Problem Identification

In the past, roadway and right-of-way flooding occurred at Site 16, including sheet flooding having a spread width of approximately 40 to 50 feet and a flow depth of 1.5 feet, as observed by street maintenance staff. The maintenance department has observed shoulder erosion at the west edge of pavement ranging from 8 to 10 inches below existing ground. The headwall inlet and outlet are depressed and water ponds at these two locations after a flooding event. In addition to the at-grade crossing, flood water inundation of the street is aggravated by the outlet channel being undefined and beginning at an elevation higher than the existing pipe outlet invert elevation (see Site 16 - Problem Identification, Figure 2).

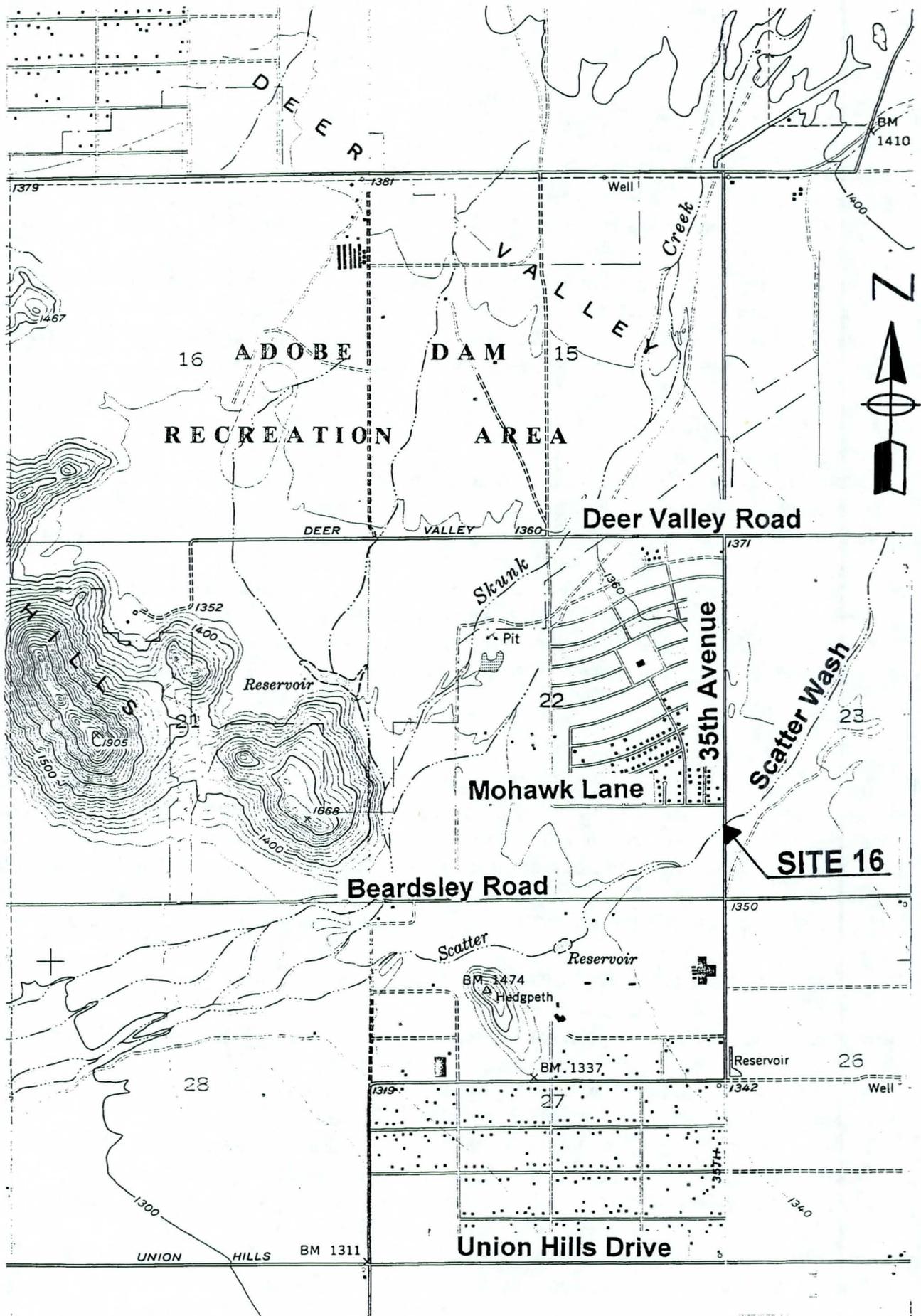
12.3 History

Downstream of the wash crossing at this site, ADOT has constructed a channel with concrete side slopes and a flattened sand bottom. At Beardsley Road, a large box culvert has been constructed which will extend under the future Agua Fria Freeway, currently under construction. At the end of the culvert, ADOT extended a channel to daylight. Beginning at the end of the ADOT channel, the City of Phoenix has constructed a channel consisting of levee sides and natural bottom with riprap lined side slopes. The reach of the City channel ends at 43rd Avenue.

12.4 Site Specific Data Acquisition

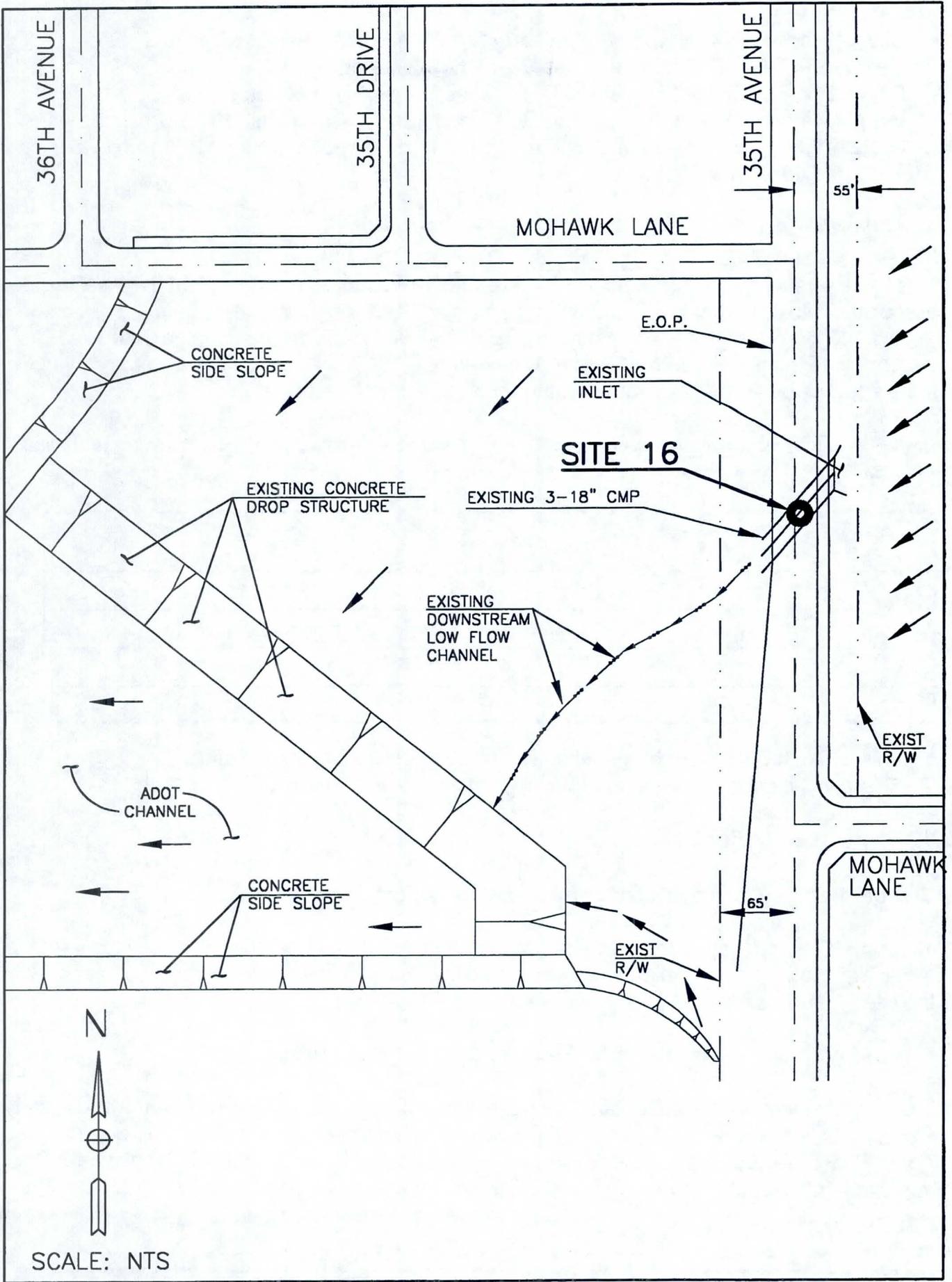
The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 41-20, Drawn 9-83; 41-21, Revised 9-19-90; 42-20, Drawn 1-80; and 42-21, Plotted 3-31-95.
- City of Phoenix Topographic Quarter Section Map Numbers: 41-20, Flown 10-19-92; 41-21, Flown 10-29-90; 42-20, Flown 10-19-90; and 42-21, Flown 10-29-90.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 41-20, Flown 3-16-95; 41-21, Flown 3-16-95; 42-20, Flown 3-16-95; and 42-21, Flown 3-16-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 41-20, Revised 5-26-95; 41-21, Revised 9-28-93; 42-20, Revised 10-26-95; and 42-21, Plotted 4-16-96.



SITE 16 - VICINITY MAP

FIGURE 1



SITE 16 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Water Quarter Section Map Numbers: 41-20, Revised 9-22-94; 41-21, Revised 6-25-96; 42-20, Revised 7-9-96; and 42-21, Plotted 10-2-95.
- City of Phoenix Engineering Storm Drain Maps N6 and N7 (not dated).
- USGS 7.5-minute quadrangle maps for Hedgepeth Hills and Union Hills Arizona, which contain Site 16, its upstream drainage area, and downstream flow path, Photos Revised 1981 and 1982, respectively.

12.5 Hydrology

This is the Scatter Wash Crossing at 35th Avenue. There have been two 100-year discharges associated with this area. First, a FEMA study from an FCDMC ADMS determined the discharge to be 6,100 cfs. Second, the latest study for FEMA calculates the discharge to be 2,300 cfs. The current Flood Insurance Study 100-year discharge of 6,100 cfs lists the water surface elevation to be approximately 1,352 at 35th Avenue (approximately 2-feet deep).

Using the discharge from the LOMR, a probability proportion was done. The following table lists the results.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>
100	2,300*
50	1,950**
10	1,050**
2	450**

* This is the 100-year discharge taken from the LOMR submitted to FEMA.

** These values derived using a probability proportioning analysis.

12.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

The Agua Fria Freeway is under construction at this time and is located at the Beardsley Road alignment. However, this project is located about 0.25 mile south of the site and does not affect the site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. Improvements to 35th Avenue from the Agua Fria Freeway to Deer Valley Road are proposed for the 1998-99 fiscal year. The improvements include street widening and major storm drain system.

12.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1195D, dated April 15, 1995. The site is located in Zone A4, which denotes areas of 100-year flood; base flood elevations and flood hazard factors determined. Although a LOMR has been submitted to FEMA, it has not been approved.

12.8 Alternative Solutions

Alternative 1 - Maintain the Existing Crossing

This alternative involves maintaining the existing Scatter Wash crossing. City maintenance crews will have to maintain the current procedure of placing flood warning signs during flooding events.

Alternative 2 - Design a Low-Flow Crossing to Convey the 2-Year Storm Under 35th Avenue

The 2-year discharge from the CLOMR (2,300 cfs) is 450 cfs. This alternative consists of providing 2-8'x4'x100' CBC under 35th Avenue to convey the 2-year storm under 35th Avenue. The outlet velocity is approximately 9 fps. The upstream and downstream channel will have to be regraded to install this box culvert.

A concrete-lined drop inlet will be constructed beginning approximately 10 feet upstream of the culvert inlet headwall to help direct the flow into the box culvert. A riprap-lined transition structure approximately 92 feet long will be constructed to connect the proposed culvert outlet and the proposed downstream trapezoidal channel (4:1 expansion). The riprap lining will protect the culvert outlet from the high outlet velocity. This downstream outlet channel will have a bottom width of 20 feet, side slopes of 3:1, and a longitudinal slope of 0.3 percent to convey the 2-year flow from the CBC to the beginning of the existing ADOT channel. The flow depth is 3.2 feet, and the velocity is 4.8 fps. The channel will be earthen to match the existing desert scheme of the area and reduce construction costs.

Another transition will occur from the 20-foot bottom width to the 40-foot top width where the downstream channel matches the top of the existing ADOT concrete drop structure.

Running parallel to and on the east side of 35th Avenue, 365 feet of drainage v-ditch will be constructed with 8:1 roadway side slopes (160 feet north and 165 feet south of the drop inlet) and graded to drain to the inlet. These swales will have minimal slopes and will be located on the back side of the sidewalk. Their purpose is to help direct overbank flow that is beyond the width of the drop inlet back into the drop inlet.

All construction will be completely contained within the Scatter Wash drainage easement or the 35th Avenue right-of-way. These proposed improvements will reduce the flow which weirs across the roadway and mitigate the flooding conditions at this location by reducing the width of flood water inundation of 35th Avenue and the depth of flow in 35th Avenue.

The depth of flow is approximately 1.36 feet deep, the velocity is 4.28 fps, and the spread on the roadway is 444 feet with the 2-year storm conveyed under the roadway during the 100-year storm. These flow conditions will require continued closure of the roadway during the 100-year storm.

Alternative 3 - 100-Year Culvert Crossing with Downstream 100-Year Channel

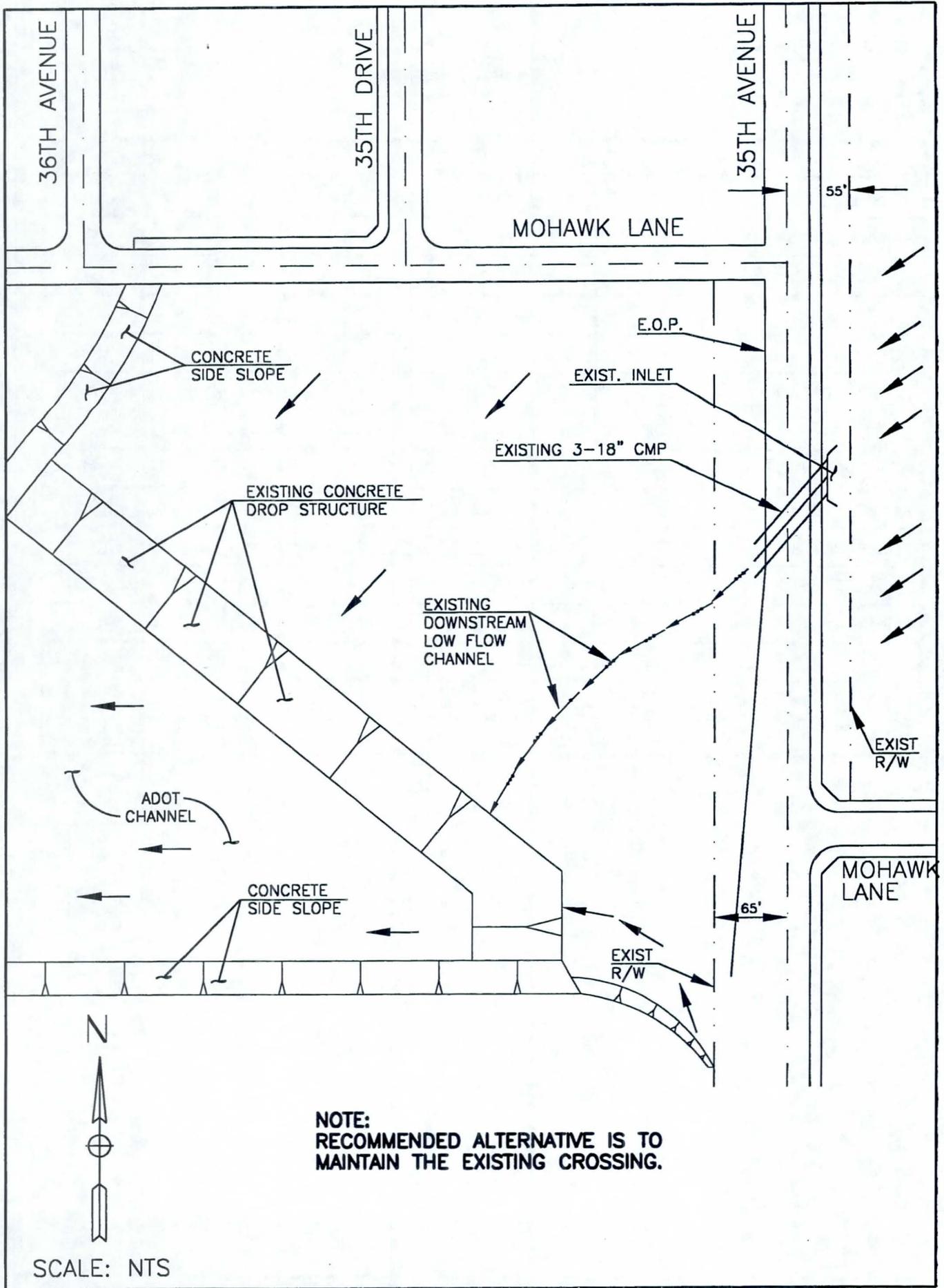
This alternative includes the installation of 6-10'x5'x100' CBC at a slope of 0.3 percent to convey the 100-year discharge of 2,300 cfs (per the FEMA CLOMR) under 35th Avenue. The upstream headwater elevation will contain the 100-year flow. The outlet velocity is approximately 11 fps. The downstream channel will have a 100-foot bottom width, 3.5 feet of depth, 3:1 side slopes, and will be earthen lined. It will take approximately 230 feet of riprap-lined transition structure to connect the culvert to the downstream channel. The riprap will protect the culvert outlet from erosion. However, the downstream earthen channel may experience some erosion.

Upstream of the culvert, a concrete drop inlet will be constructed which extends to the east approximately 40 feet. Channels which run parallel to 35th Avenue to the north and south will be constructed for the full width of the Scatter Wash drainage easement to ensure that all flow is directed into the culvert. The fill slope of 35th Avenue should be riprap protected from flows impacting the roadway embankment.

All construction will be located within the Scatter Wash drainage easement or the 35th Avenue right-of-way. These improvements will remove 35th Avenue from the floodplain.

12.9 Recommended Alternative

Alternative 1 is the recommended alternative. The City of Phoenix has indicated that 35th Avenue from the Agua Fria Loop to Deer Valley Road is scheduled for storm drain improvements in 1998-99. Solutions for eliminating flooding problems at this location should be addressed in the design planning phase of the planned improvements (see Site 16 - Preferred Alternative, Figure 3).



SITE 16 - PREFERRED ALTERNATIVE

FIGURE 3

12.10 Cost Estimate

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	322 YD ²	\$1.80/YD ²	\$ 600
Remove Curb & Gutter	21 LF	\$2.00/LF	100
Remove 5-Foot Sidewalk	21 LF	\$1.00/ SF ²	100
Excavation	1,943 YD ³	\$3.00/YD ³	5,800
Fill	295 YD ³	\$8.00/YD ³	2,400
2-8'x4'x100' CBC	1	Lump Sum	38,400
Riprap	308 YD ³	\$40.00/YD ³	12,300
Drainage Swale	325 LF	\$2.00/Each	700
Asphalt, 2-Inch Lift	36 Tons	\$60.00/Ton	2,200
ABC, 6-Inch Lift	54 YD ³	\$21.00/YD ³	1,100
Install 5-foot Sidewalk	105 SF ²	\$2.00/SF ²	200
Place Curb and Gutter	21 LF	\$6.00/LF	100
Subtotal			\$63,300
20% Contingency			12,700
Total			\$76,000

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Asphalt Removal	856 YD ²	\$1.80/YD ²	\$ 1,500
Remove Curb & Gutter	77 LF	\$2.00/LF	200
Remove 5-foot Sidewalk	77 LF	\$1.00/ SF ²	100
Excavation	7,559 YD ³	\$3.00/YD ³	22,700
Fill	450 YD ³	\$8.00/YD ³	3,600
6-10'x5'x100' CBC	1	Lump Sum	180,000
Riprap (Transition Str. & Fill Slope)	790 YD ³	\$40.00/YD ³	31,600
Parallel Collector Channels Ex.	4,452 YD ³	\$3.00/YD ³	13,400
Asphalt, 2-Inch Lift	94 Tons	\$60.00/Ton	5,600
ABC, 6-Inch Lift	143 YD ³	\$21.00/YD ³	3,000
Install 5-foot Sidewalk	385 FT ²	\$2.00/SF ²	800
Place Curb & Gutter	77 LF	\$6.00/LF	500
<i>Subtotal</i>			\$263,000
<i>20% Contingency</i>			52,600
<i>Total</i>			\$315,600

13. Site 20 — 2504 W. San Miguel

13.1 Location and Site Description

This site is located west of I-17 adjacent to the frontage road, south of Bethany Home Road and north of Missouri Avenue. It is in Township 2 North, Range 2 East, in Section 13 of the Gila and Salt River Base and Meridian (see Site 20 - Vicinity Map, Figure 1).

The area is a medium density residential development. A series of ditches connected by culverts is located on the west side and runs parallel to the I-17 frontage road. The culverts are located under all of the roadways which connect to the frontage road. Grated catch basins are located at the curb returns of each roadway and connect to the culverts to intercept the flow in the roadway.

13.2 Problem Identification

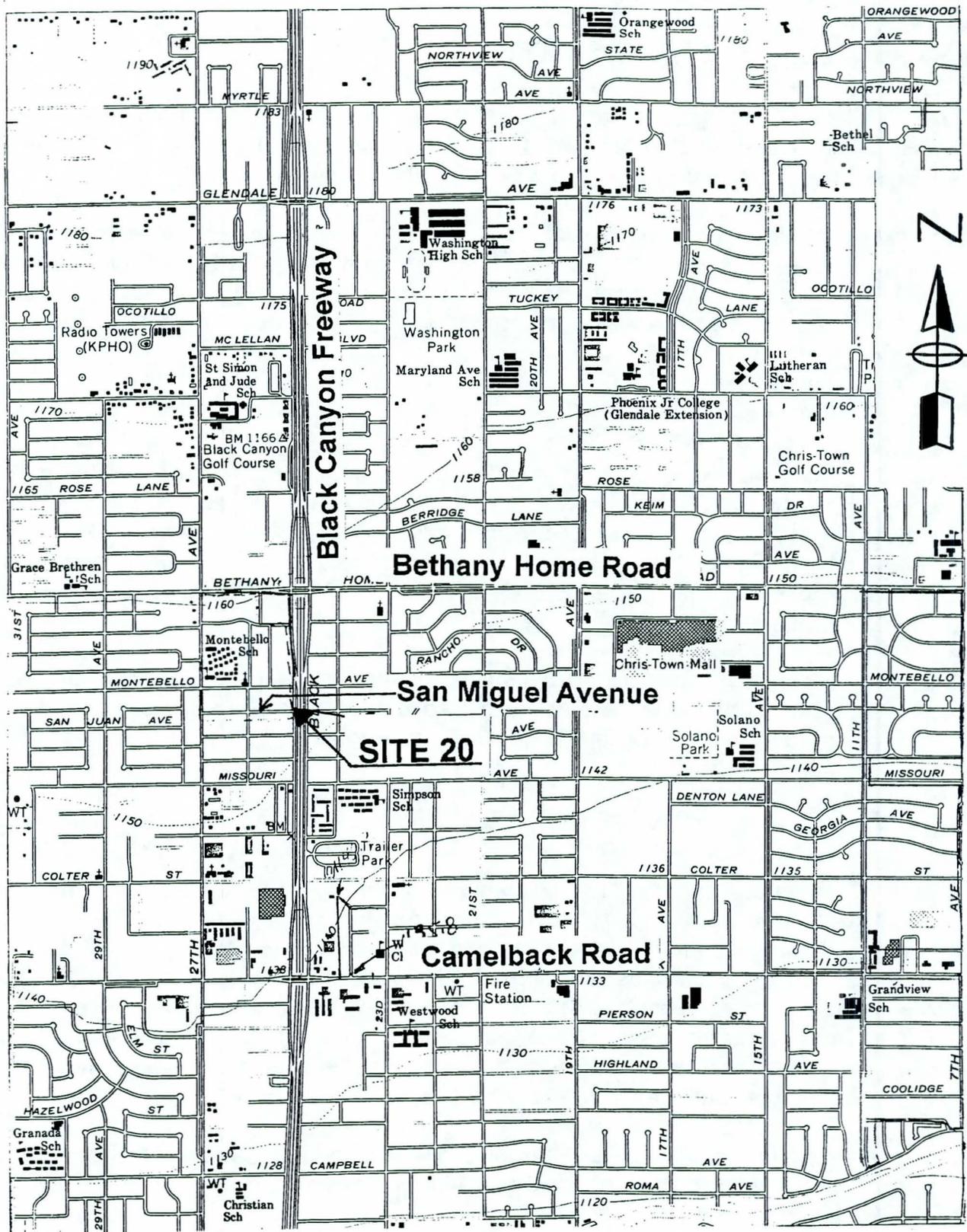
Roadway, right-of-way, house, and property flooding occur at Site 20. This property is the only one adjacent to the ADOT drainage system which floods. Flows conveyed in the ditch running parallel to the I-17 frontage road exceed the capacity of the ADOT ditch and the 18-inch culvert under San Miguel Avenue. The flow backs up into San Miguel and overtops the curb to run onto the private property. This property is depressed below the curb and the water surface elevation in the ADOT channel.

A 4-inch pipe is located approximately 15 feet north of the curb return which penetrates the west bank of the ADOT ditch. It was most likely designed to drain the property into the ditch (see Site 20 - Problem Identification, Figure 2). Flows from the channel run onto the property and contribute to the flooding.

13.3 History

Because I-17 is depressed, a ditch is located adjacent to and on the west side of the I-17 frontage road. This ditch is designed to collect runoff from the west and prevent it from overtopping the frontage road and running onto the freeway. The ditch has a 2.5-foot bottom width, is 2.5 feet deep, and has side slopes of 1:1. It extends north and south of this site. A culvert with 'U'-shaped headwalls at its inlet and outlet has been installed under all of the roadways which connect to the frontage road. Located at each curb return of these side roads are two grated catch basins, one at the north and one at the south curb return, which connect to the culvert running under the residential roadways.

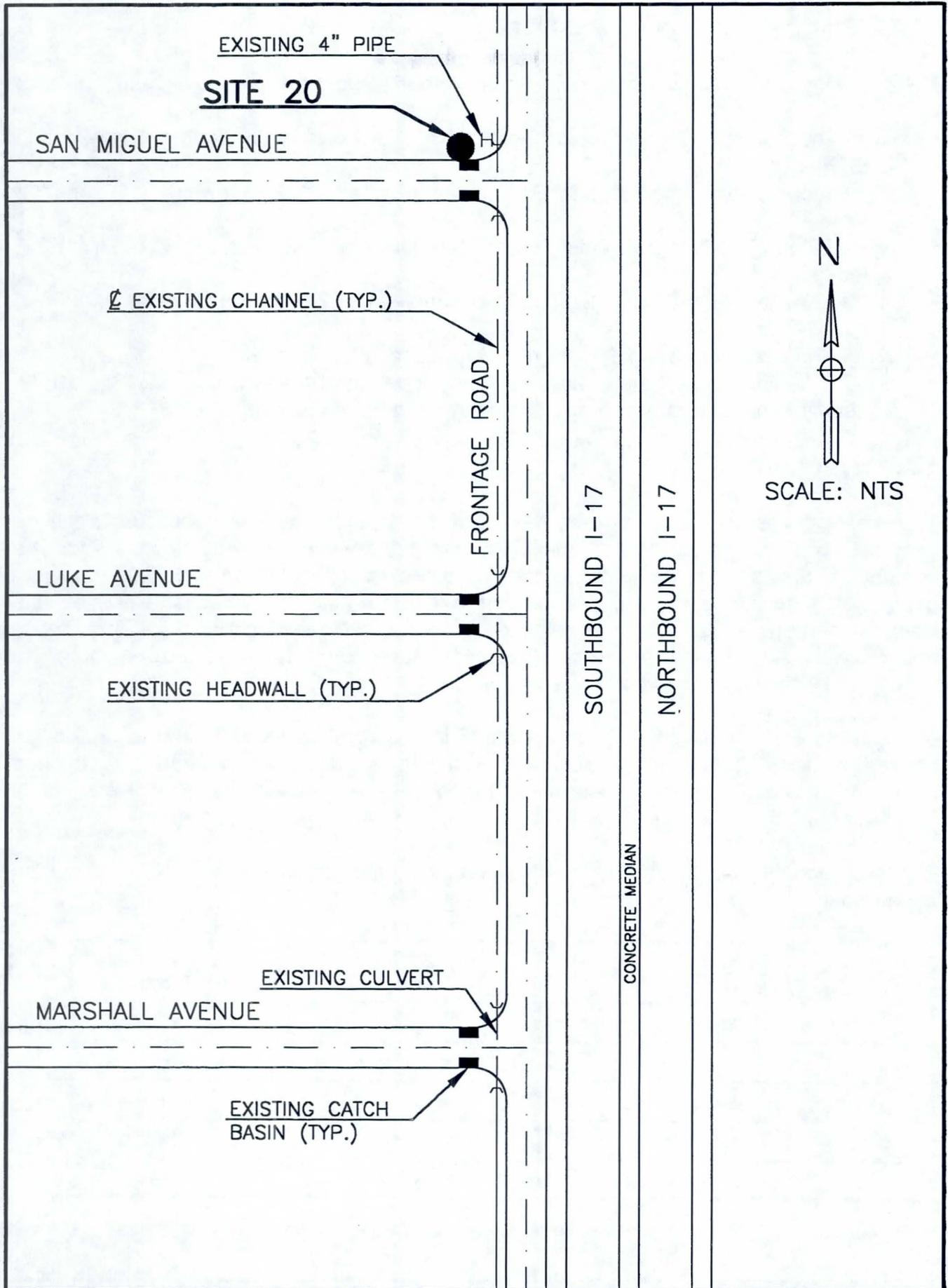
Due to repeated flooding, the resident has called the City and complained of flows overtopping the curb and flows running through the existing 4-inch pipe located in the west bank of the ADOT channel onto his property.



SCALE: 1"=2,000'

SITE 20 - VICINITY MAP

FIGURE 1



SITE 20 - PROBLEM IDENTIFICATION

FIGURE 2

13.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 19-23, Plotted 10-11-94; and 20-23, Revised 10-22-92.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 19-23, Flown 6-12-95; and 20-23, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 19-23, Revised 11-6-95; and 20-23, Plotted 11-6-95.
- City of Phoenix Water Quarter Section Map Numbers: 19-23, Plotted 11-6-95; and 20-23, Plotted 11-6-95.
- City of Phoenix Engineering Storm Drain Maps H7 and I7 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 20, its upstream drainage area, and downstream flow path, Photo Revised 1982.

13.5 Hydrology

The existing drainage area for Site 20 extends to the north and west. A high point runs along the centerline of 27th Avenue and another along the centerline of Bethany Home Road. The contributing drainage area is approximately 54 acres as delineated on a USGS 7.5-minute quadrangle map. The existing ditch was rated to determine the stage-discharge relationship. However, since no existing City of Phoenix topographic quarter section maps exist for this part of the City, the slope for the channel of 0.39 percent was determined from the USGS map. The ditch flow capacity is approximately 46 cfs.

The existing culvert under San Miguel is an 18-inch concrete pipe. It has an upstream 'U'-shaped headwall. The headwater depth at the inlet can pond to 2.5 feet before it will overtop either the channel side or the headwall. The conveyance capacity for the culvert, with a headwater of 2.5 feet, is 11 cfs.

The following table lists the frequency, discharge, and runoff volume for Site 20, as computed by the Rational Method:

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>
100	79	18.2
50	70	16.1
25	61	14.0
10	52	11.4
2	32	6.5

13.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

13.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1665G, dated September 30, 1995. The site is located in Zone X (shaded), which denotes areas of 500-year flood; areas of the 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 100-year flood.

A LOMR was approved October 23, 1995. However, the map revisions described in the LOMR are in an area of the City covered by this panel number but not affected by the LOMR.

13.8 Alternative Solutions

Alternative 1 - Construct a Berm Around Site

This alternative consists of building a wall along the west bank of the ADOT channel beginning at the north edge of the property and extending to the headwall of the culvert. A berm will be constructed that will tie into the wall around the front of the property. The wall and the berm will have to be built to a height that is equal to the 100-year water surface elevation. This elevation is set at 1.0 foot above the headwall of the existing culvert.

Included with this alternative is the requirement that the 4-inch irrigation return pipe be removed to prevent flows from running through the pipe onto the property.

An alternative to the floodwall and berming of the property is to raise the building pad to an elevation that is greater than the 100-year water surface elevation. In addition, the yard needs to be depressed to accommodate .08 acre-foot of water volume generated from the 100-year storm.

Alternative 2 - Intercept the 100-Year Storm and Convey it South to Take the Residence out of the 100-year Floodplain

This alternative involves the construction of 50 feet of rectangular concrete channel beginning 50 feet north of the existing headwall for the existing 18-inch concrete pipe and extending to the

north. The channel will have a 3.3-foot bottom width, a depth of 2.5 feet, and will convey 58 cfs. A catch basin will be constructed beginning at the southern end of the channel. This basin will consist of four City of Phoenix P1570 Type N catch basins with four City of Phoenix P1565 Type 1 grates, and extend north to intercept 58 cfs. The remainder of the 100-year flow of 21 cfs will be conveyed south through 1-30"x50' RGRCP which will replace the existing 18-inch concrete pipe located under San Miguel Avenue.

Five feet of transition structure will be extended north to connect to the existing channel beginning at the upstream inlet to the proposed 1-30" RGRCP. The existing channel will be connected to the proposed concrete channel.

Alternative 3 - 100-Year Storm Drain

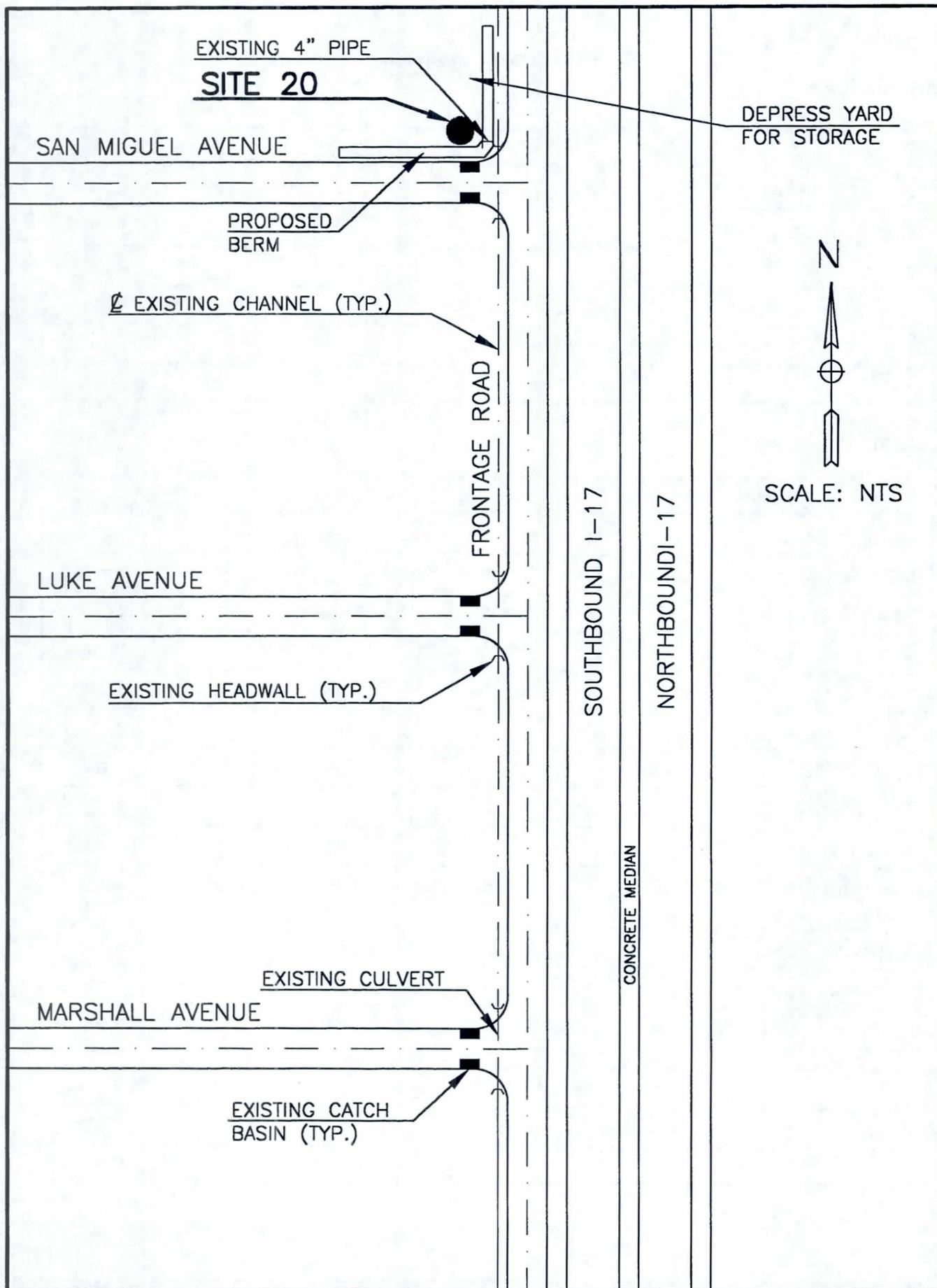
Two catch basins and 100-feet of rectangular channel will be required to intercept the 100-year flow of 79 cfs. The northern catch basin, consisting of four City of Phoenix P1570 Type N catch basins with four City of Phoenix P1565 Type 1 grates will be located 50 feet north of the current 18-inch upstream headwall and will intercept 58 cfs. The southern catch basin, consisting of two City of Phoenix P1570 Type N catch basins and two City of Phoenix P1565 Type 1 grates, will begin at the location of the existing headwall for the existing 18-inch concrete pipe and extend along the proposed 100-foot concrete rectangular channel to the north. Beginning at the downstream concentration point located about 100-feet north of the Missouri Avenue and ADOT frontage road intersection, one 60-inch RGRCP will be extended approximately 925 feet north to a manhole located opposite the southern catch basin. Approximately 10 feet of 30-inch RGRCP will be extended west to connect to the southern catch basin. Beginning at the manhole opposite the southern catch basin, one 54-inch RGRCP will be extended 50 feet north to a manhole located opposite the northern catch basin. The northern catch basin will be connected with the northern manhole with 10 feet of 54-inch RGRCP. The 60-inch RGRCP will require one City of Phoenix P1560 manhole located between the outlet and the manhole opposite the southern manhole. A total of three manholes are required for the system.

Alternative 4 - Purchase Property

As an alternative to some of the more expensive alternatives, the City could purchase the site.

13.9 Recommended Alternative

The City of Phoenix has recommended that Alternative 1 be implemented (see Site 20 - Preferred Alternative, Figure 3). This is the least costly alternative and will require the least maintenance. However, there has been some discussion about adding a flap gate to the 4-inch pipe instead of removing the pipe. This will allow water from the property to drain into the ditch on the east side of the property without allowing water from the ditch to enter the property.



SITE 20 - PREFERRED ALTERNATIVE

FIGURE 3

13.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Fill (70 LF of 1-foot hump)	21 YD ³	\$8.00/YD ³	\$ 200
140 LF of Retaining Wall	-	Lump Sum	3,900
Yard Earthwork & Reseeding	-	Lump Sum	5,000
Subtotal			\$ 9,100
20% Contingency			1,800
Total			\$10,900

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Asphalt Removal	756 YD ²	\$1.80/YD ²	\$1,400
Curb & Gutter Removal	10 LF	\$2.00/LF	100
Excavation	1,543 YD ³	\$3.00/YD ³	4,600
Fill	982 YD ³	\$8.00/YD ³	7,900
Asphalt, 2" Lift	84 Tons	\$60.00/Ton	5,000
ABC, 6" Lift	126 YD ³	\$21.00/YD ³	2,600
Place Curb & Gutter	10 LF	\$6.00/LF	100
30" RGRCP	50 LF	\$65.00/LF	3,300
54" RGRCP	935 LF	\$200.00/LF	187,000
COP P1570 Type N 4-Cell Catch Basin	1 Each	\$4,800/Each	4,800
COP P1560 54" Manhole	2 Each	\$4,500/Each	9,000
MAG Headwall U-type	2 Each	\$400/Each	800
50-LF of Concrete Rectangular Channel	-	Lump Sum	3,600
Subtotal			\$230,200
20% Contingency			46,000
Total			\$276,200

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Asphalt Removal	778 YD ²	\$1.80/YD ²	\$ 1,400
Excavation	1,815 YD ³	\$3.00/YD ³	5,400
Fill	499 YD ³	\$8.00/YD ³	4,000
Asphalt, 2" Lift	85 Tons	\$60.00/Ton	5,100
ABC, 6" Lift	130 YD ³	\$21.00/YD ³	2,700
60" RGRCP	925 LF	\$275.00/LF	254,400
54" RGRCP	50 LF	\$250.00/LF	12,500
30" RGRCP	10 LF	\$70.00/LF	700
COP P1570 Type N 4-Cell Catch Basin	1 Each	\$4,800/Each	4,800
COP P1570 Type N Double Catch Basin	1 Each	\$2,400/Each	2,400
COP P1560 51" Manhole and Larger	3 Each	\$4,500/Each	13,500
100 LF of Concrete Rectangular Channel	-	Lump Sum	7,200
<i>Subtotal</i>			\$314,100
<i>20% Contingency</i>			62,800
<i>Total</i>			\$376,900

14. Site 41 — 2105 E. Everett Drive

14.1 Location and Site Description

This site is located south of Greenway Road and west of Cave Creek Road in Township 3 North, Range 3, Section 10 of the Gila and Salt River Base and Meridian. Lookout Mountain Preserve is located to the west (see Site 41 - Vicinity Map, Figure 1).

The subdivision is developed as medium density residential. Everett Drive has no curb and gutter on the south side; 4-inch rolled curb and gutter exist on the north. The roadway slopes to the east.

14.2 Problem Identification

Everett Drive has no curb and gutter on the south side. Therefore, flows running along Everett Drive continue south and onto the private property (see Site 41 - Problem Identification, Figure 2).

14.3 History

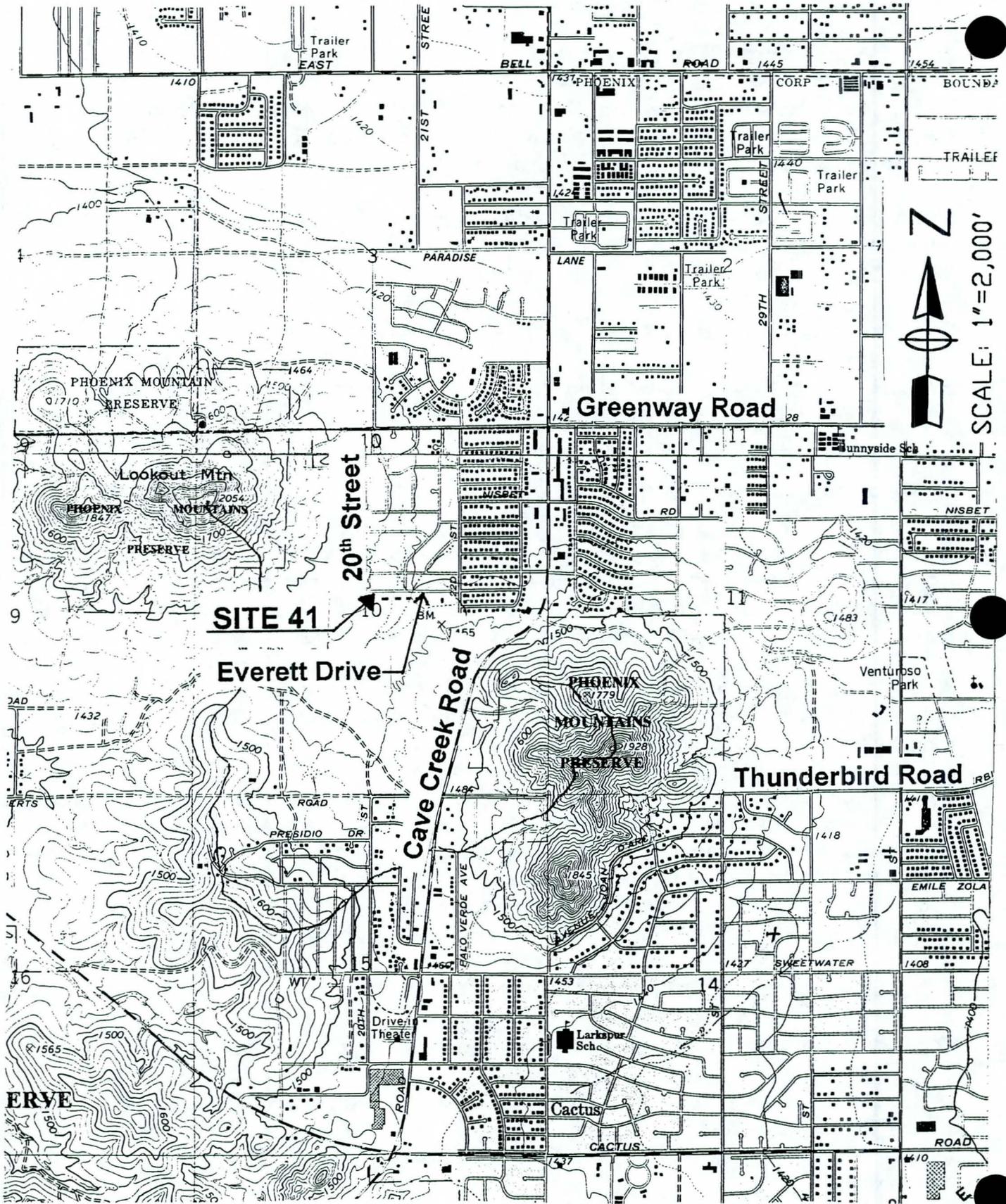
According to the owner, before Medallion Developers started the construction of the Lookout Mountainside subdivision (recorded 3-7-96) to the west, the land was natural desert. Flows ran off the mountain to the east, would break at the west side of 20th Street, and run to the north. Before Site 41 was developed, the flow from Lookout Mountain would run across 20th Street and contribute to a natural channel located approximately 1,900 feet to the west of Cave Creek road. A 40-foot drainage easement has been dedicated at the old location of the channel that is approximately 300 feet east of Site 41. This channel discharges into 21st Place and the flow runs north toward Greenway Road.

When the owner complained of flooding to the developer, he regraded the right-of-way adjacent to the site on the south side of Everett Drive and created an asphalt-lined valley gutter/berm to convey flows away from the affected property and back into Everett Drive. The owner has purchased fill material and created a small berm on the back side of the asphalt valley gutter/berm to help push flows back into Everett Drive. The owner stated that the regrading of the right-of-way has helped. However, flooding is still a possibility.

14.4 Site Specific Data Acquisition

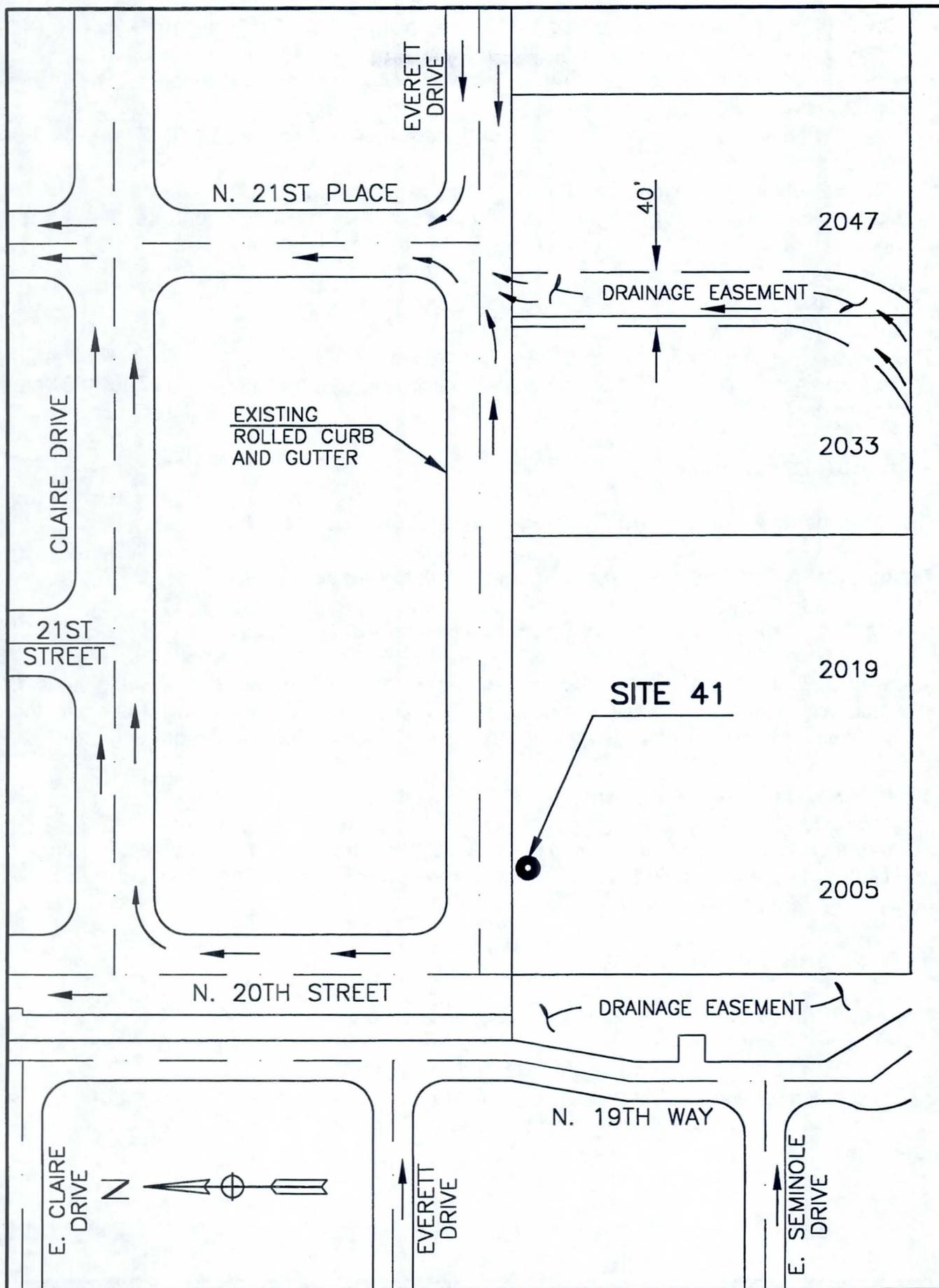
The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 34-31, Plotted 11-20-95; and 34-32, Revised 3-20-92.
- City of Phoenix Topographic Quarter Section Map Numbers: 34-31, Flown 6-5-71; and 34-32, Flown 6-5-71.



SITE 41 - VICINITY MAP

FIGURE 1



SITE 41 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Aerial Photo Quarter Section Map Numbers: 34-31, Flown 3-16-95; and 34-32, Flown 3-16-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 34-31, Revised 11-17-95; and 34-32, Revised 3-30-95.
- City of Phoenix Water Quarter Section Map Numbers: 34-31, Revised 11-16-95; and 34-32, Revised 11-15-95.
- City of Phoenix Engineering Storm Drain Map L9 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 41, its upstream drainage area, and downstream flow path, Photo Revised 1982.

14.5 Hydrology

The 10-year pre-developed discharge, as determined by the developer's design engineer, Clouse Engineers, is 7.7 cfs and the post-developed discharge is 7.3 cfs. The 100-year discharge is 11 cfs.

14.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

14.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1660F, dated September 30, 1995. The site is located in Zone X (not shaded), which denotes areas determined to be outside the 500-year floodplain.

14.8 Alternative Solutions

Flows from the Medallion Development subdivision, platted as Lookout Mountainside, discharge under the property boundary wall that runs parallel to 20th Street and continue east down Everett Drive. They join flows from the south discharging from an existing 40-foot drainage easement located along the north/south property line at 2033 and 2047 East Everett Drive. This confluence occurs at the tee intersection of Everett Drive and 21st Place at the mouth of the drainage easement previously mentioned.

Alternative 1 - Maintain Asphalt Valley Gutter

From the residents' comments during a site visit, the asphalt valley gutter appears to be directing the flow back toward Everett Drive. The resident was contacted after recent rains to discuss the flooding status at the site. The resident stated that the asphalt valley gutter/berm appears to be working. Since the flow is minor, the existing asphalt valley gutter/berm appears to be working, and the contractor created the non-uniform geometry of the asphalt valley gutter/berm in the field, the actual conveyance capacity was not computed.

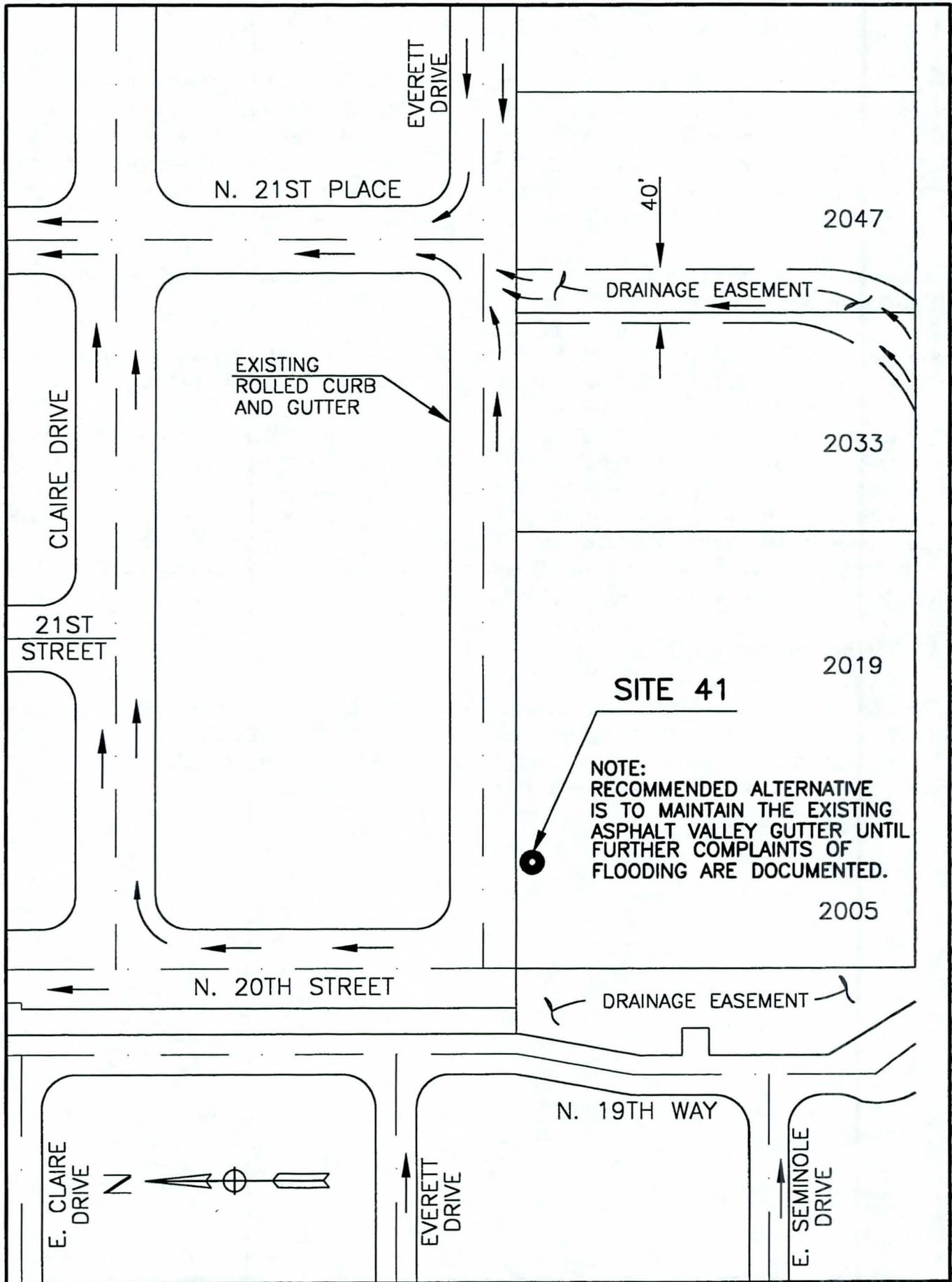
This alternative involves maintaining this existing asphalt valley gutter/berm. No further action is recommended unless more complaints of flooding are received.

Alternative 2 - Regrade Everett Drive to Create an Inverted Crown Roadway Section and Construct 4-inch Rolled Curb and Gutter on the South Side of the Street

This alternative consists of regrading Everett Drive to create an inverted crown roadway section, City of Phoenix Standard Detail P1021, beginning at the curb return at 20th Street, and extend this roadway section approximately 470 feet to the east to daylight at the tee intersection of Everett Drive with 21st Place. Four-inch rolled curb and gutter will be constructed along the south edge of pavement extending from 20th Street to the drainage easement previously mentioned to contain the flow from the Medallion Development in Everett Drive. This alternative will convey the 100-year discharge of 11 cfs.

14.9 Recommended Alternative

The City of Phoenix has recommended Alternative 1 (see Site 41 - Preferred Alternative, Figure 3). The City has indicated that changes made by the development located northwest of the site in conjunction with the asphalt valley gutter have improved the flooding problem at this location. The existing asphalt valley gutter may periodically require repairs.



SITE 41 - PREFERRED ALTERNATIVE

FIGURE 3

14.10 Cost Estimate

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	731 YD ²	\$1.80/YD ²	\$ 1,300
Excavation	238 YD ³	\$3.00/YD ³	700
Valley Gutter	2,350 FT ²	\$3.00/FT ²	7,100
Asphalt, 2" Lift	138 Tons	\$60.00/Ton	8,300
ABC, 6" Lift	209 YD ³	\$21.00/YD ³	4,400
4" Curb and Gutter	470 LF	\$6.00/LF	2,800
<i>Subtotal</i>			\$24,600
<i>20% Contingency</i>			4,900
<i>Total</i>			\$29,500

15. Site 42 — 4506 North 11th Avenue

15.1 Location and Site Description

This site is a single-family private residence located at 4506 North 11th Avenue. It is located at the northwest corner of Campbell Avenue and 11th Avenue in Township 2 North, Range 3 East, Section 19 of the Gila and Salt River Base and Meridian (see Site 42 - Vicinity Map, Figure 1).

The majority of the area is medium density, single-family residential development. Existing roadway geometry consists of a normal crown with rolled curb and gutter. Located at the northeast and northwest corners of 11th Avenue are grated curb opening catch basins.

15.2 Problem Identification

Two different types of flooding occur at this site (see Site 42 - Problem Identification, Figure 2). First, the existing levee located to the south and running parallel to the Grand Canal causes flood waters to back up, thereby completely inundating the site and adjacent properties. Second, the flow in 11th Avenue exceeds the roadway's conveyance capacity and the property becomes flooded.

The property is lower than the existing curb. Flood waters which overtop the 4-inch curb onto the property cannot flow back into the roadway. The street does not have the capacity to convey the 2-year storm.

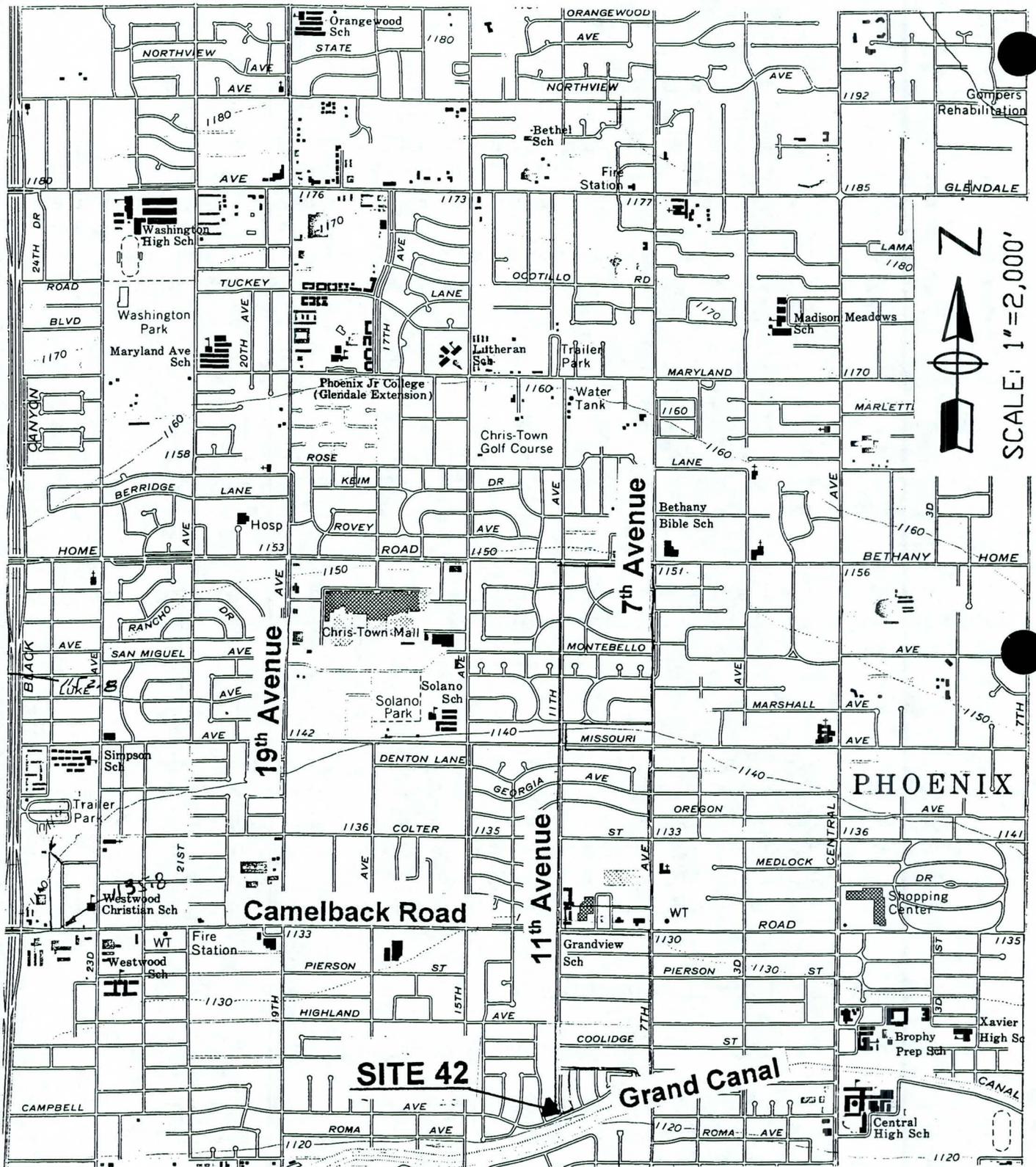
15.3 History

The house and property at 4506 N. 11th Avenue regularly flood during storm events. The owner has observed flood waters overtopping the curb and flowing onto his property. He commented that the north half of the intersection ponds and the catch basins are undersized for the amount of flow which concentrates in this area. He also said that once the catch basins finally drain from the roadway, which usually requires an extended period of time, the water ponding on his property does not return to the street to drain. Rather, the ponded water continues to stand in his front yard.

15.4 Site Specific Data Acquisition

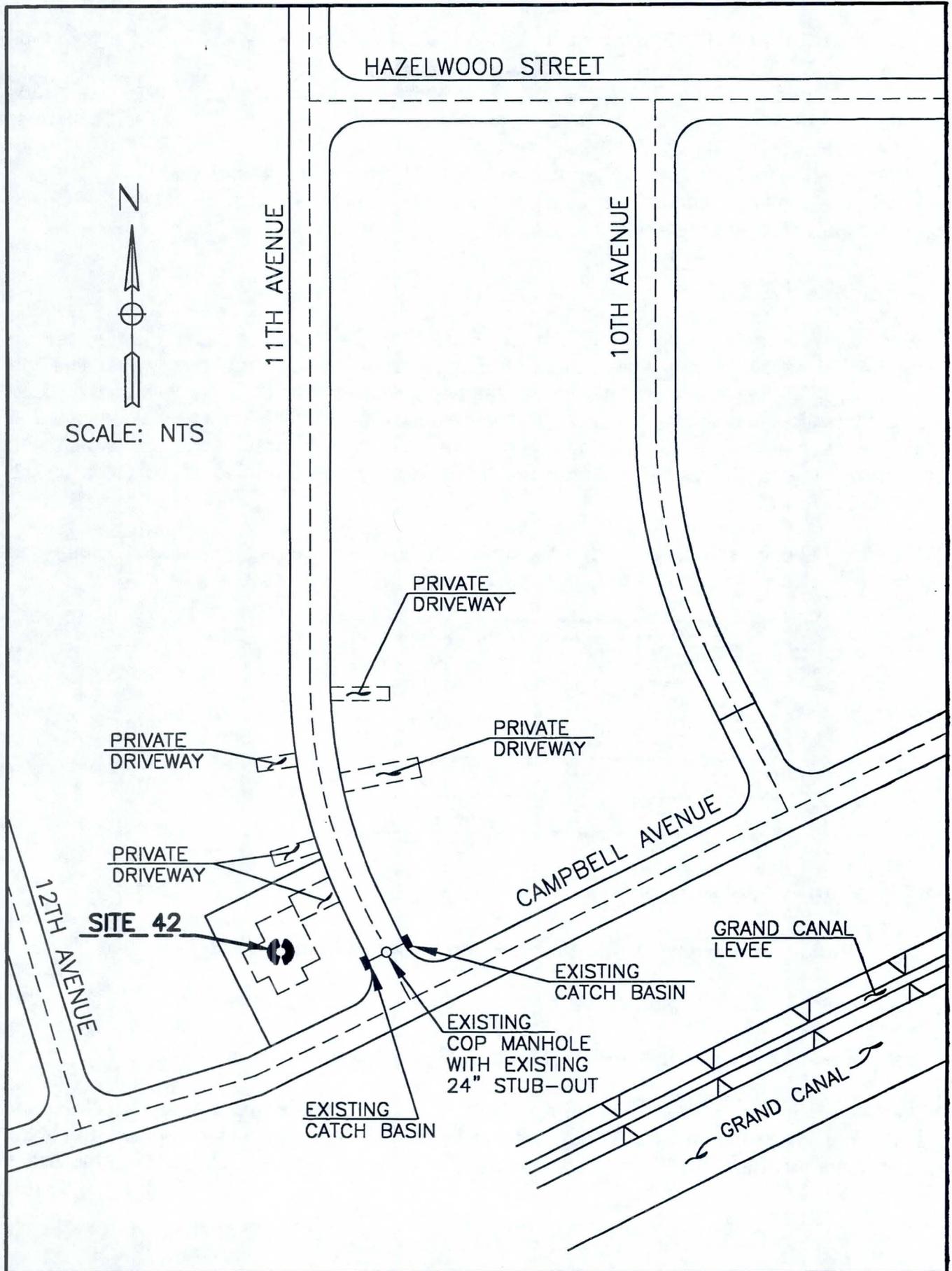
The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 17-25, Plotted 8-17-95; 17-26, Revised 1-21-92; 18-25, Revised 8-23-93; 18-26 Revised 6-93; 19-25, Revised 4-22-94; 19-26, Revised 6-93; and 20-26, Revised 3-1-95.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 17-25, Flown 6-12-95; 17-26, Flown 6-12-95; 18-25, Flown 6-12-95; 18-26, Flown 6-12-95; 19-25, Flown 6-12-95; 19-26, Flown 6-12-95; and 20-26, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 17-25, Revised 1-4-95; 17-26,



SITE 42 - VICINITY MAP

FIGURE 1



SITE 42 - PROBLEM IDENTIFICATION

FIGURE 2

Revised 10-11-94; 18-25, Revised 10-28-94; 18-26, Revised 10-28-94; 19-25, Revised 4-6-94; 19-26, Revised 11-21-94; and 20-26, Revised 11-10-94.

- City of Phoenix Water Quarter Section Map Numbers: 17-25, Revised 12-18-92; 17-26, Revised 1-4-95; 18-25, Revised 5-22-95; 18-26, Revised 10-24-94; 19-25, Revised 10-31-94; 19-26, Revised 6-6-95; and 20-26, Revised 6-21-94.
- City of Phoenix Engineering Storm Drain Maps H7, H8, I7, and I8 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 42, its upstream drainage area, and downstream flow path, Photo Revised 1982.

15.5 Hydrology

Flood waters concentrating at this site originate from the northeast. City quarter section topographic maps were not available for this area; therefore, the drainage area was delineated on a USGS 7.5-Minute Quadrangle Map, Sunnyslope, Arizona. The Rational Method was used to compute discharges at the major and minor arterials. A 50-percent flow split was assumed at Missouri Avenue and Camelback Road. The discharges that were assumed to flow to the south were directly added together to determine the discharge concentrating at the catch basins adjacent to the site.

The next set of catch basins in 11th Avenue to the north are located at Bethany Home Road (refer to the following table for frequency and discharge).

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>
100	162
50	144
10	107
2	66

15.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

15.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1665F, dated September 30, 1995. The site is located in Zone AH. A LOMR dated April 19, 1995 has been submitted and approved by FEMA. The new Panel Number is 04013C1665G. A portion of the upstream area has changed from Zone AH to shaded Zone X. However, an area of the site still remains in Zone AH, which denotes areas subject to base flooding with average depths from 1 to 3 feet (usually areas of ponding). The base flood elevation at the intersection of 11th Avenue and Campbell Avenue was determined to be 1124.8. This condition is a result of flood waters ponding on the upstream side of the Grand Canal levee.

15.8 Alternative Solutions

Flooding which occurs at this site is a combination of flows initially running south along 11th Avenue and the backwater effect from the Grand Canal levee. This investigation focused on local flooding only. The flooding resulting from the Grand Canal should be investigated and resolved by City Floodplain Management.

The catch basins which are located at the curb return of 11th Avenue connect to the Campbell Avenue lateral line. The Campbell Avenue lateral is a part of the 15th Avenue storm drain trunk line.

Alternative 1 - Extend a Storm Drain Lateral Beginning at the Stub-out from the Manhole in 11th Avenue to the North

An existing storm drain lateral runs in Campbell Avenue and is a branch off the trunk line in 15th Avenue. Two existing catch basins connect to the lateral line in Campbell Avenue, one at each curb return in 11th Avenue. They connect by means of a manhole located in the center of 11th Avenue. An existing 24-inch stub-out extends north from the manhole.

Because the street does not have the capacity to convey the 2-year storm, this alternative includes the extension of 74 feet of 24-inch RGRCP beginning at the 24-inch pipe stub-out on the north side of the existing manhole to a COP P1520 manhole located in the center of 11th Avenue. At the manhole, 16 feet of 24-inch RGRCP will be extended both east and west to the new COP P1569 Type M catch basins M2, L=10 at the curb returns. These catch basins will each intercept approximately 6.2 cfs.

Approximately 4,100 feet of 24-inch RGRCP will be extended north, beginning at the new manhole located in the center of 11th Avenue at Bethany Home Road. The Bethany Home intersection is the origin of the flow from the 2-year storm event. By intercepting this flow at Bethany Home Road, the residences along 11th Avenue will benefit from the construction.

One 24-inch RGRCP will be installed to the west to connect to one COP P1569 Type M catch basin M2, L=17. Approximately 40 feet of 24-inch RGRCP will be extended to the northeast from

the proposed manhole located about 4,145 feet north of the existing manhole in 11th Avenue. This will connect to a COP P1569 Type M catch basin M2, L=17. Each catch basin intercepts 26 cfs.

The new catch basins will intercept all but 1.6 cfs which will be intercepted by the existing catch basins located at the curb return of 11th Avenue at the intersection of 11th Avenue and Campbell. This design will intercept the 2-year storm of 66 cfs which runs down 11th Avenue from the north.

The street is not able to convey the difference in flow between the 2-year and 100-year flows of approximately 94 cfs without flooding the resident's property. Therefore, a berm will need to be constructed immediately at the back of the curb. This berm must be 0.93 foot higher than the gutter elevation to protect the residence from this flow. In addition, the driveway will have to be regraded to create a high point at an elevation equal to the top of the berm. The front yard, which is lower than the house and existing back of curb elevation, will be used to store the runoff volume from the roof.

Alternative 2 - Construct Hump in Front Yard

This alternative consists of working with the resident of the property at 4505 North 11th Avenue to construct a hump in the front yard of the property. A high point will be created at the back of curb. The hump will have to be built to an elevation that will protect the property from the 100-year storm of 160 cfs. By creating a high point around the property by building a hump set at an elevation 1.21 feet higher than the gutter elevation, the property will be isolated from the 100-year storm. However, it is important to construct a high point in the driveway which will be set at the same elevation as the hump and connected to the hump. The front yard will be used to store the runoff volume from the roof. The berm side slope will be 6:1 and its top width will be 2 feet. The berm will remain within the right-of-way.

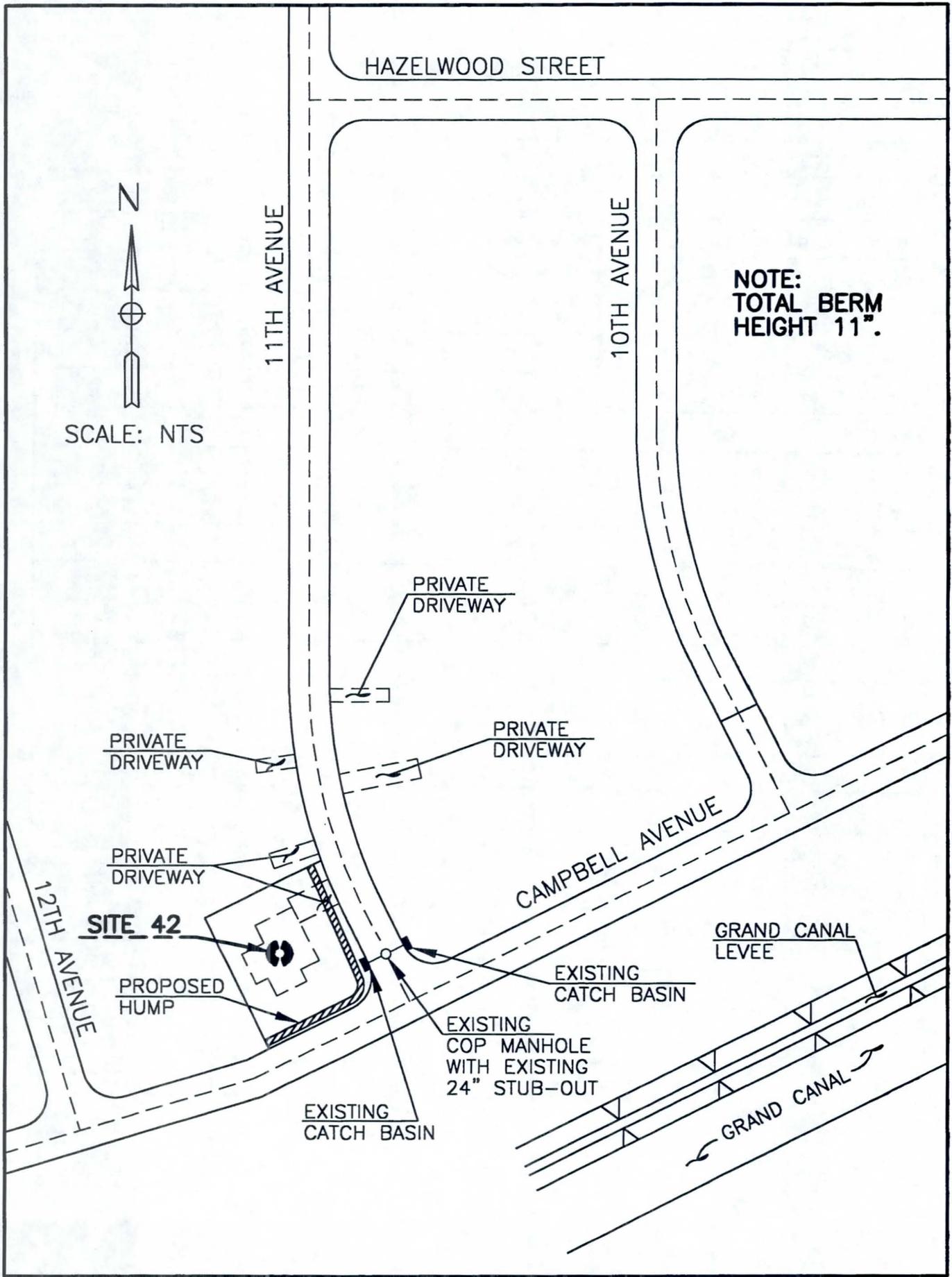
This alternative will help to drain the property after a flooding event.

Alternative 3 - Upsize Existing Lateral in 11th Avenue and Increase the Existing Catch Basin Size to Collect Greater than the 2-year Storm

This alternative requires a hydrologic and hydraulic study to determine the hydraulic grade line in the existing trunk lines in Campbell Avenue and 15th Avenue before constructing these improvements. If the existing storm drain cannot take any more flow without causing a bubbling out of flow at another location, then this alternative cannot be implemented.

15.9 Recommended Alternative

The City has recommended Alternative 2 which will protect the residence from flooding at the least expense to the City (see Site 42 - Preferred Alternative, Figure 3).



NOTE:
TOTAL BERM
HEIGHT 11".

N
SCALE: NTS

SITE 42 - PREFERRED ALTERNATIVE

FIGURE 3

15.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	2,303 YD ²	\$1.80/YD ²	\$ 4,100
Remove Rolled Curb & Gutter	134 LF	\$2.00/LF	300
Excavation	4,351 YD ³	\$3.00/YD ³	13,100
Fill	3,868 YD ³	\$8.00/YD ³	30,900
24" RGRCP	4,233 L.	\$100.00/LF	423,300
COP P1569 M2, L=17 Catch Basin	2 Each	\$3,800/Each	7,600
COP P1569 M2, L=10 Catch Basin	2 Each	\$2,700/Each	5,400
COP P1520 Manhole	2 Each	\$2,300/Each	4,600
Asphalt, 2" Lift	252 Tons	\$60.00/Ton	15,100
ABC, 6" Lift	384 YD ³	\$21.00/YD ³	8,100
Subtotal			\$512,500
20% Contingency			102,500
Total			\$615,000

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Volume of Fill for 0.88' Hump	31 YD ³	\$8.00/YD ³	\$ 200
Sawcut Concrete Drive	38 LF	\$2.00/LF	100
Concrete Removal	-	Lump Sum	1,000
Concrete Replacement (Drive)	10 YD ³	\$150/YD ³	1,500
Sod	1,633 FT ²	\$.30/FT ²	500
Subtotal			\$3,300
20% Contingency			700
Total			\$4,000

16. Site 43 — 24th Avenue and Camelback Road

16.1 Location and Site Description

This site is located on the north side of Camelback Road at 24th Avenue in Township 2 North, Range 2 East, Section 13 of the Gila and Salt River Base and Meridian (see Site 43 - Vicinity Map, Figure 1).

The area is developed as medium density, single-family residents. Existing roadway geometry consists of a normal crown with rolled curb and gutter. Curb opening catch basins are located at the curb returns at the northeast and northwest corners of 24th Avenue.

16.2 Problem Identification

The houses and properties beginning at Camelback Road and extending north on both sides of 24th Avenue regularly flood during storm events. Some of the property owners have constructed humps in their front yards in an attempt to prevent flood waters which overtop the curb from flooding their homes.

Flooding may be caused by three situations at this location. First, the flows generated within the drainage area exceed the interception capacity of the existing catch basins. Second, the hydraulic grade line of the main line storm drain in Camelback Road is higher than the ground at the existing catch basins and flows bubble out.

Camelback Road may be in a sag condition, causing flows to drain back into 24th Avenue where they pond. Humps have been built around several of the front yards of the properties to protect them from flooding (see Site 43 - Problem Identification, Figure 2).

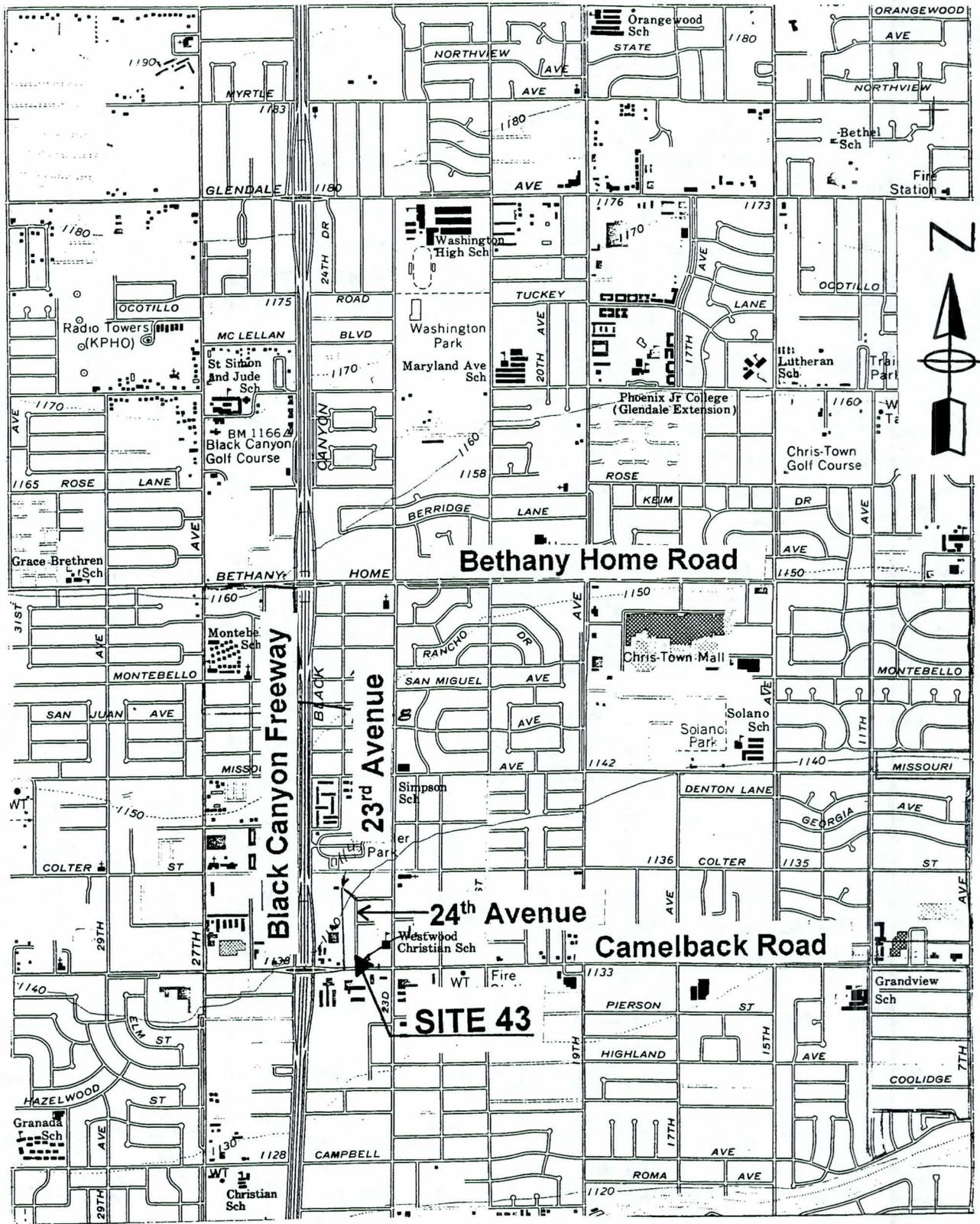
16.3 History

The catch basins (each a single COP P1572 Type Q catch basin) which are located at the curb return of 24th Avenue connect to the Camelback Road trunk line. These storm drain plans are not available from Central Records.

16.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

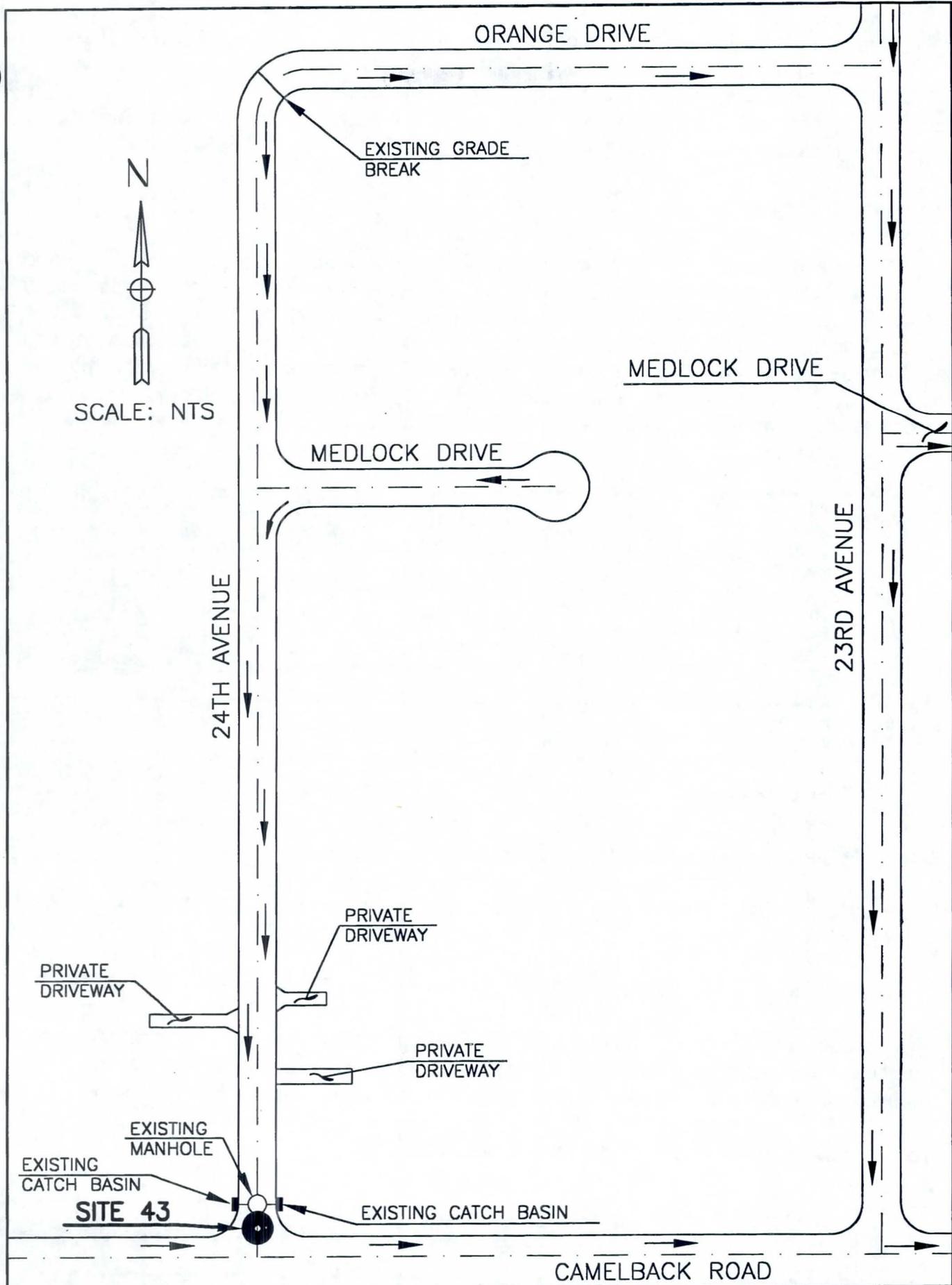
- City of Phoenix Right-of-Way Quarter Section Map Numbers: 19-23, Plotted 10-11-94; 19-24, Revised 9-12-91; 20-23, Revised 10-22-92; and 20-24 Revised 9-12-91.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 19-23, Flown 6-12-95; 19-24, Flown 6-12-95; 20-23, Flown 6-12-95; and 20-24, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 19-23, Revised 11-6-95; 19-24, Revised 4-6-94; 20-23, Plotted 11-6-95; and 20-24, Revised 9-22-94.



SCALE: 1"=2,000'

SITE 43 - VICINITY MAP

FIGURE 1



SITE 43 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Water Quarter Section Map Numbers: 19-23, Plotted 11-6-95; 19-24, Revised 10-31-94; 20-23, Plotted 11-6-95; and 20-24, Revised 5-16-95.
- City of Phoenix Engineering Storm Drain Map H7 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 43, its upstream drainage area, and downstream flow path, Photo Revised 1982.

16.5 Hydrology

Flood waters intercepted by the catch basins located at the curb return of 24th Avenue and Camelback Road originate from the northwest. City quarter section topographic maps are not available for this area; therefore, the drainage area was delineated on a USGS 7.5-Minute Quadrangle Map. The Rational Method was used to calculate the discharges at this location and are listed in the following table. The roadway geometry has a normal crown section, with rolled curb and gutter. The cross slope was assumed to be 2.0 percent. The subdivision does not have sidewalks. Refer to the following table for frequency, discharge, flow depths, and flow velocity at the catch basins.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>	<i>Flow Depth (ft)</i>	<i>Flow Velocity (fps)</i>
100	22	3	*	*
50	20	3	*	*
10	15	2	.4	1.7
2	7	1	.3	4.0

*Flow exceeds the roadway right-of-way.

16.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

Improvements to the Camelback Road traffic interchange with I-17 are currently in the planning stage.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a 5-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

16.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1665F, dated September 30, 1995. The site is located in Zone X (shaded), which denotes areas of 500-year flood; areas

of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 100-year flood. A LOMR dated April 19, 1995 has been submitted and approved by FEMA, and the new Panel Number is 04013C1665G. The LOMR does not modify the flooding zone for this site.

16.8 Alternative Solutions

The roadway has the capacity to convey the 2-year storm. The existing catch basins (COP P1569 Type M catch basin M1, L=0) located at the curb returns of 24th Avenue at the intersection of 24th Avenue with Camelback Road are in a sag condition. They can intercept 2.2 cfs of the total 7.0 cfs generated in the 2-year storm.

Alternative 1 - 2-year Storm Drain Lateral Beginning at the Manhole in 24th Avenue and Extending North

An existing storm drain lateral extends north into 24th Avenue from the trunk line in Camelback Road. It consists of a manhole in the center of 24th Avenue with catch basins located at the curb returns of 24th Avenue directly opposite the manhole. The roadway section has a normal crown. A 24-inch pipe will be extended north in 24th Avenue from the existing manhole for about 110 feet to a new City of Phoenix P1520 manhole. From the manhole, a 24-inch pipe will branch due west to join to a new City of Phoenix P1569 M2, L=10 catch basin installed in the curb on the west side of 24th Avenue. A 24-inch pipe will be extended to the northeast beginning at the proposed manhole previously mentioned and join a new City of Phoenix P1569 M2, L=10 catch basin. These catch basins will intercept 6.6 cfs of the 7.0 cfs generated in the 2-year storm. The existing catch basins will intercept the remaining flow.

Alternative 2 - Increase the Capacity of the Mainline in Camelback Road

Residents have complained that drain times for the existing catch basins are excessive. The existing ponding may be a result of the conveyance capacity of the mainline being exceeded. As the storm drain is filled during a flooding event, the hydraulic grade line may exceed the top of ground at the existing catch basins and water may discharge from the mainline through these catch basins, causing the local flooding at this site. A detailed storm drain analysis of the Camelback Road Storm Drain will have to be performed to evaluate this possibility.

Alternative 3 - Build a Hump Around the Properties

This alternative involves building berms around the houses if the flooding is the result of two conditions: 1) Camelback Road is in a sag condition at 24th Avenue, and 2) the houses are lower than the intersection.

16.9 Recommended Alternative

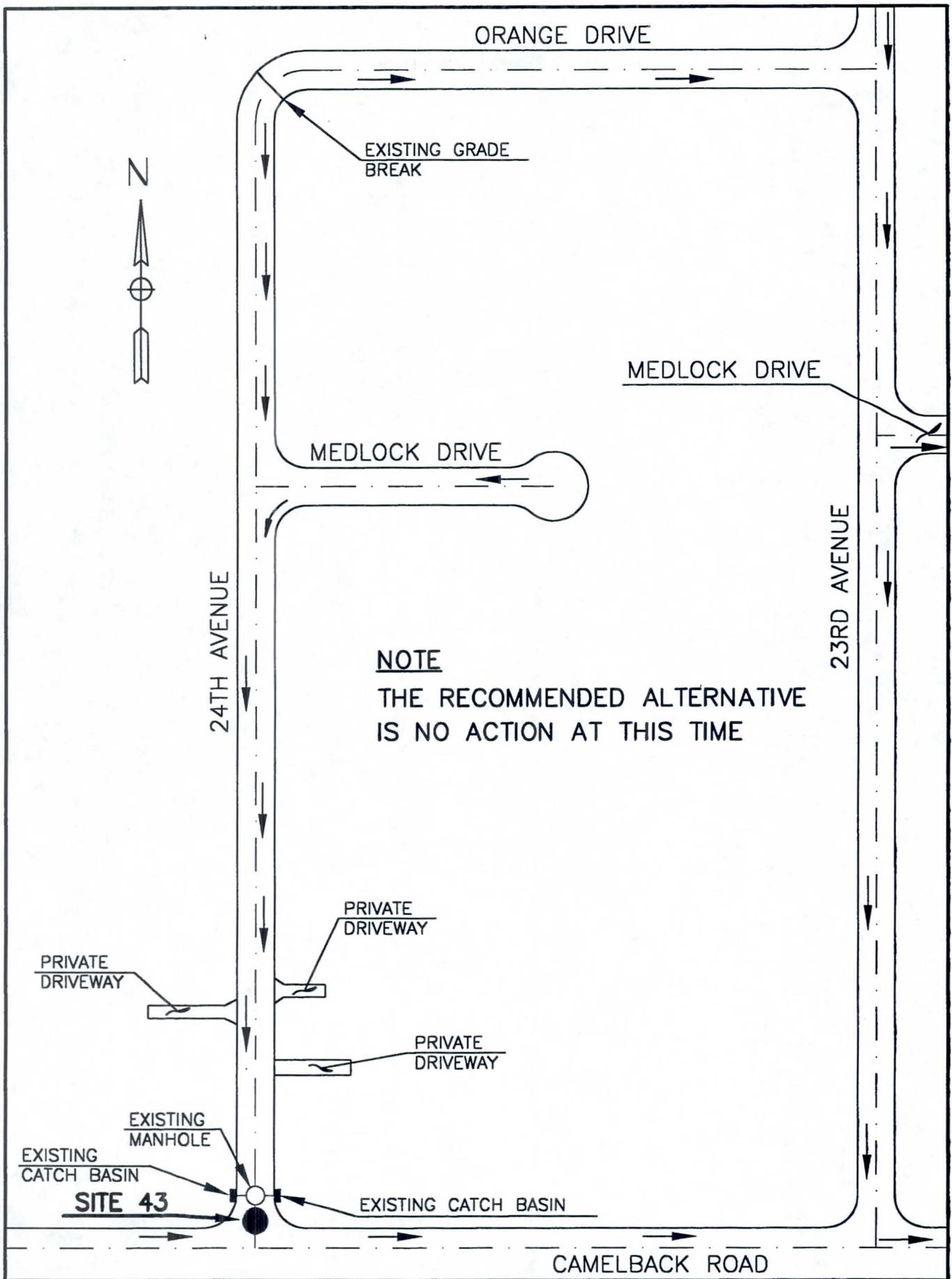
The City of Phoenix has decided to take no action at this time at this site, as improvements to the Camelback Road traffic interchange may address the problem. It is recommended that the

City discuss this possibility with ADOT and their design engineers, Wood/Patel. Jeff Holzmeister of Wood/Patel, 234-1344, has expressed a willingness to discuss this issue with the City (see Site 43 - Preferred Alternative, Figure 3).

16.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Rolled Curb & Gutter	61 LF	\$2.00/LF	\$ 100
Remove Asphalt	74 YD ²	\$1.80/YD ²	100
Excavation	139 YD ³	\$3.00/YD ³	400
Fill	123 YD ³	\$8.00/YD ³	1,000
Asphalt, 2" Lift	9 Tons	\$60.00/Ton	500
ABC, 6" Lift	13 YD ³	\$21.00/YD ³	300
24" RGRCP	132 LF	\$100.00/LF	13,200
COP P1569 M2, L=10 Catch Basin	2 Each	\$2,700/Each	5,400
COP P1520 Manhole	1 Each	\$2,300/Each	2,300
<i>Subtotal</i>			\$23,300
<i>20% Contingency</i>			4,700
<i>Total</i>			\$28,000



SITE 43 - PREFERRED ALTERNATIVE

FIGURE 3

17. Site 45 — 19th Avenue from Mohawk Lane to Deer Valley Road

17.1 Location and Site Description

This site is located along the east right-of-way of 19th Avenue from Mohawk Lane north to Deer Valley Road. It is situated along the north/south boundary line for Township 4 North, Range 3 East, and along the east section lines of Sections 18 and 19 of the Gila and Salt River Base and Meridian (see Site 45 - Vicinity Map, Figure 1).

The site extends for approximately 4,000 feet along 19th Avenue. The existing land use for the adjacent property east of 19th Avenue includes native desert, airport, commercial property, and single family, medium density residential.

17.2 Problem Identification

Street and right-of-way flooding occur along 19th Avenue originating from the northeast. This reach of 19th Avenue does not have curb and gutter along the east side of the roadway extending north from Rose Garden Lane. There is a reach of approximately 590 feet of curb and gutter which extends south from the southeast curb return of 19th Avenue (see Site 45 - Problem Identification, Figure 2).

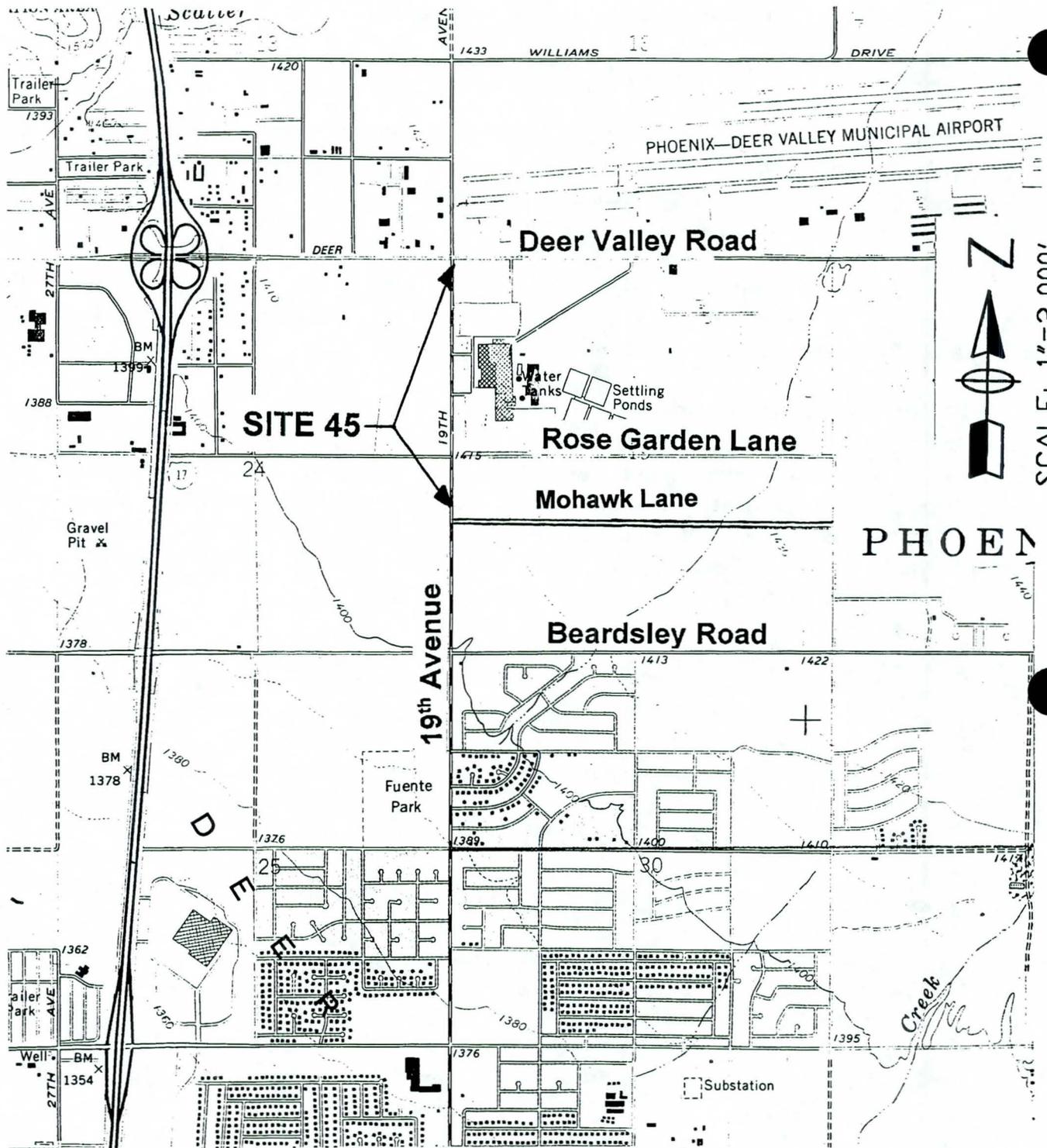
17.3 History

Beginning at Mohawk Lane and extending north to Deer Valley Road, 19th Avenue is a four-lane roadway, two lanes in each direction. Beginning at Deer Valley Road and extending north to Williams Road, 19th Avenue is a two-lane road, one lane in each direction.

17.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

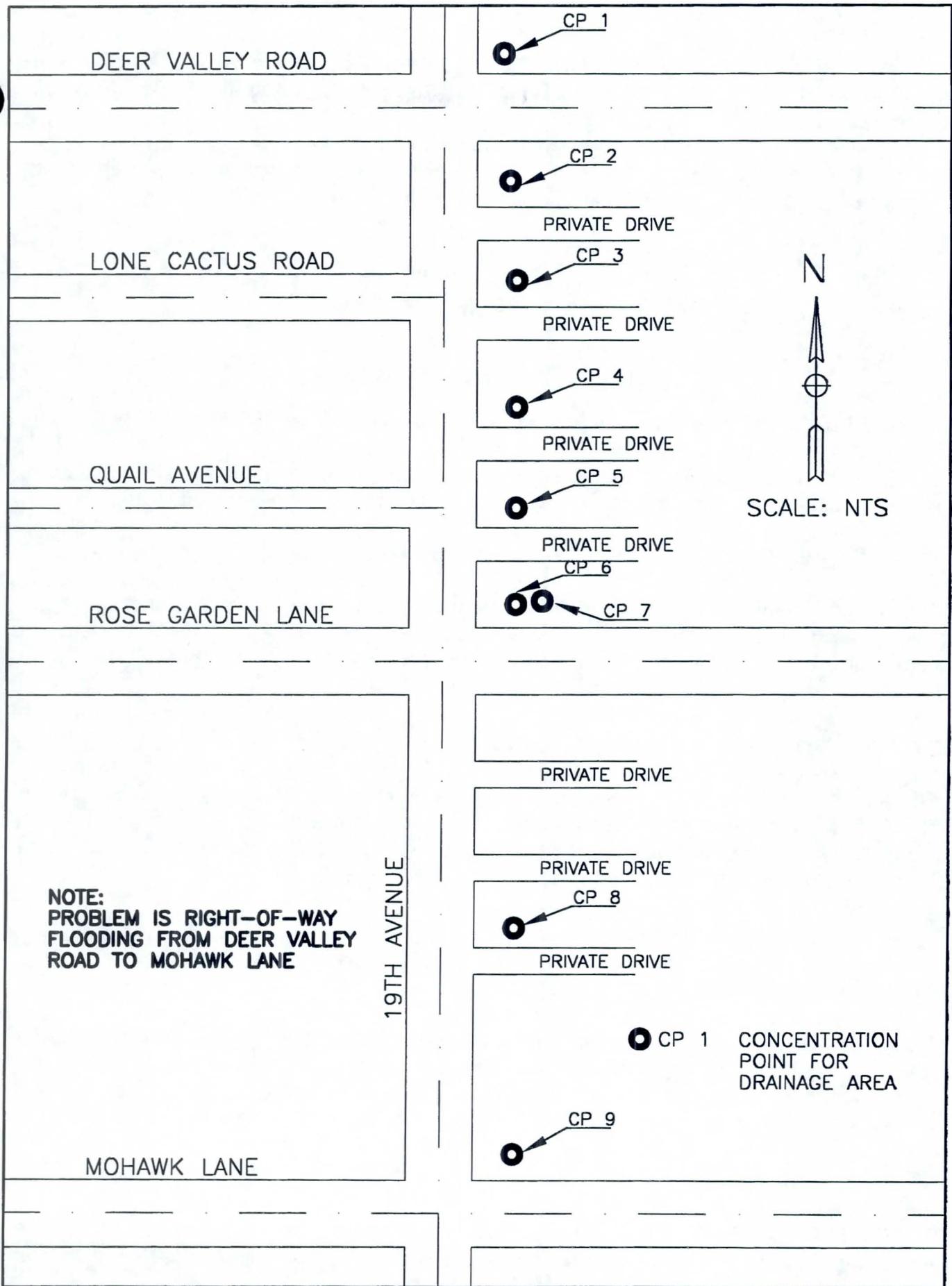
- City of Phoenix Right-of-Way Quarter Section Map Numbers: 42-24, Revised 1-15-92; 42-25, Revised 8-15-90; 43-24, Drawn 6-88; 43-25, Revised 1-8-88; 44-24, Plotted 11-9-95; and 44-25, Revised 10-30-91.
- City of Phoenix Topographic Quarter Section Map Numbers: 42-24, Flown 10-29-90; 42-25, Flown 2-24-73; 43-24, Flown 10-29-90; 43-25, Flown 5-9-76; 44-24, Flown 10-24-90; and 44-25, Flown 4-17-73.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 42-24, Flown 3-16-95; 42-25, Flown 3-16-95; 43-24, Flown 3-16-95; 43-25, Flown 3-16-95; 44-24, Flown 3-16-95; and 44-25, Flown 3-16-95.
- City of Phoenix Wastewater Quarter Section Map Numbers : 42-24, Revised 6-27-95; 42-25, Revised 12-3-90; 43-24, Revised 10-1-93; 43-25, Revised 6-5-92; 44-24, Drawn 3-94; and 44-25, Revised 3-2-94.



N
 SCALE: 1"=2,000'

SITE 45 - VICINITY MAP

FIGURE 1



SITE 45 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Water Quarter Section Map Numbers : 42-24, As-built 5-96; 42-25, Drawn 1980; 43-24, Revised 7-10-90; 43-25, Revised 10-18-93; 44-24, Revised 7-10-96; and 44-25, Revised 11-28-94.
- City of Phoenix Engineering Storm Drain Maps N7 and O7 (not dated).
- USGS 7.5-minute quadrangle map for Union Hills, Arizona which contains Site 45, its upstream drainage area, and downstream flow path, Photo Revised 1982.

17.5 Hydrology

Flood waters inundate 19th Avenue from the northeast.

17.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

The Pima Freeway will be constructed along the Beardsley Road alignment in the near future. However, no freeway corridors are planned for this site in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. Beginning in April of 1999, the City will begin construction of 19th Avenue arterial street improvements and storm drain system from Beardsley Road to Deer Valley Road

17.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1215H, dated September 30, 1995. The site is located in Zone X (shaded), which denotes areas of 500-year flood; areas of the 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 100-year flood.

17.8 Alternative Solutions

Alternative 1 - No Action

This alternative consists of maintaining the existing flooding conditions until the proposed roadway and storm drain system proposed in the 5-year plan are constructed. Due to the City of Phoenix implementing a 5-year plan to improve 19th Avenue and constructing a storm drain at the time of this construction, no other alternatives need to be investigated.

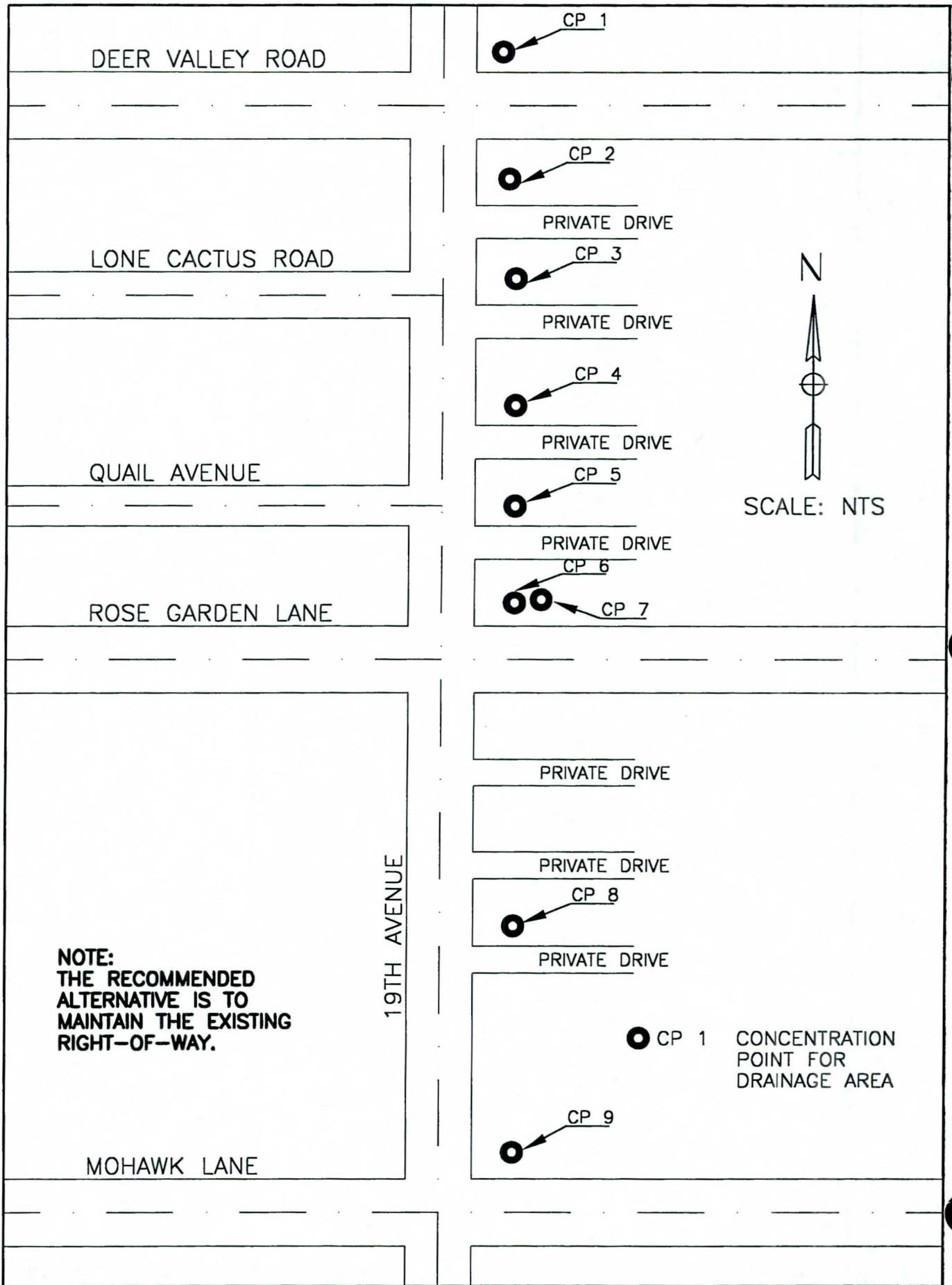
17.9 Recommended Alternative

The City of Phoenix has recommended Alternative 1. Although this alternative does not provide immediate protection for the existing flooding condition, it will provide an ultimate solution (see

Site 42 - Preferred Alternative, Figure 3). The City has expressed an interest in coordinating with Deer Valley Airport to control flows originating from the west field. This may provide interim relief until the 19th Avenue project has been completed.

17.10 Cost Estimate

None needed.



**NOTE:
THE RECOMMENDED
ALTERNATIVE IS TO
MAINTAIN THE EXISTING
RIGHT-OF-WAY.**

SITE 45 - PREFERRED ALTERNATIVE

FIGURE 3

CENTRAL DISTRICT SITES

18. Site 17 — 1327 E. Cheryl Drive and Site 18 — 10035 N. 13th Place

18.1 Location and Site Description

Sites 17 and 18 are located 0.25-mile south of intersection of Cave Creek Road and Peoria Avenue in Township 3 North, Range 3 East, Sections 21, 22, 27, and 28 of the Gila and Salt River Base and Meridian. The neighborhood is part of the Nicholas Place and was platted in Maricopa County; since that time, it has been annexed into the City of Phoenix. (See Sites 17 and 18 - Vicinity Map, Figure 1.)

The area is developed except for the mountains east of the site and the wash which runs from northeast to southwest across the property. The developed areas include single-family residences, apartments, commercial uses, and trailer parks.

Cave Creek Road is approximately 100 feet west of the tee intersection of Cheryl Drive and 13th Place. Cheryl Drive continues east for approximately 1,600 feet and ends at the foothills.

18.2 Problem Identification

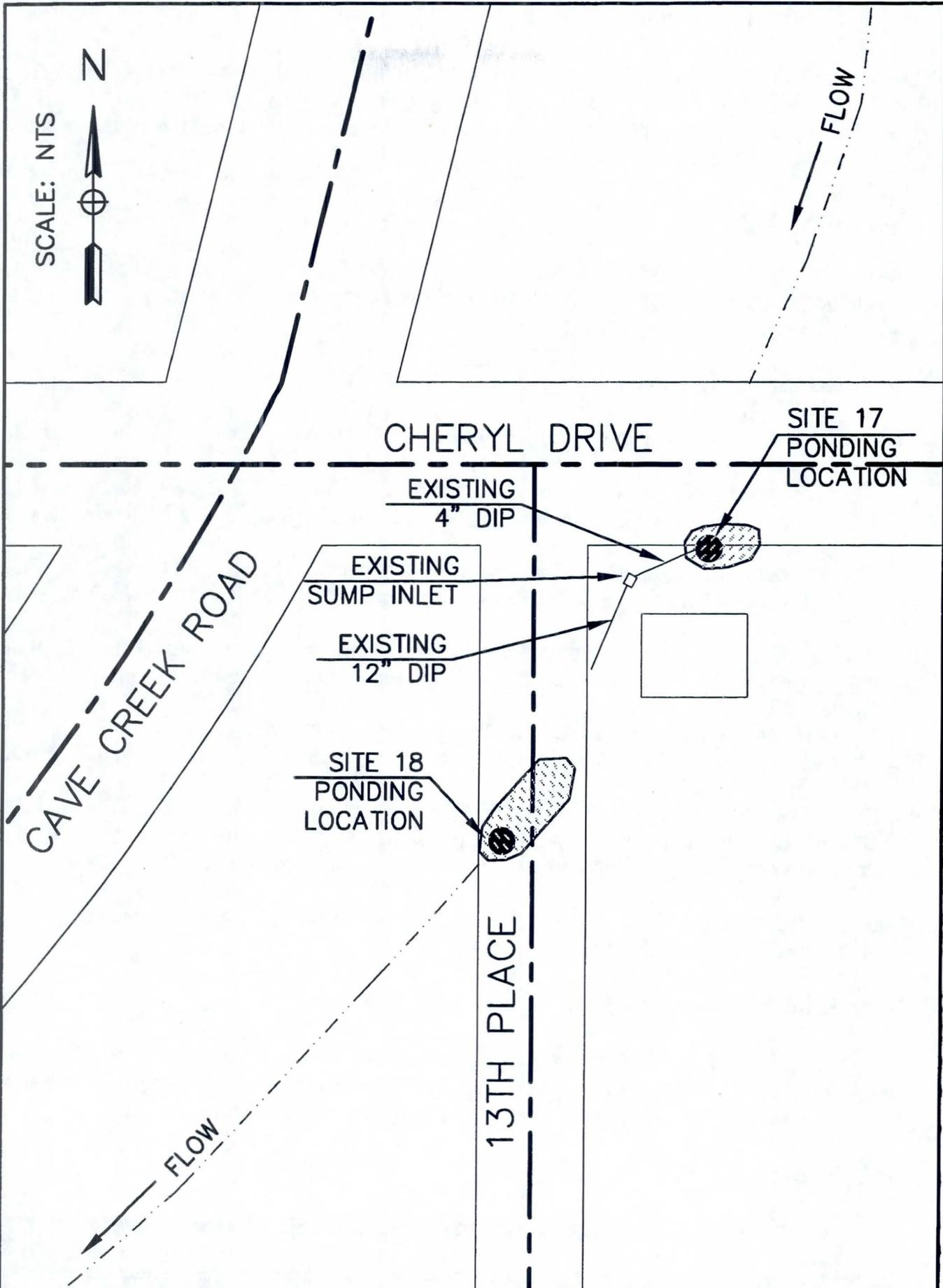
The area in concern sits in the course of a wash with headwaters generated from the mountain area to the east. The problem is the result of improper site engineering when the property on 1327 East Cheryl Drive was developed. Site 17 is located at the upstream end of the property and Site 18 is located at the downstream side. (See Sites 17 and 18 - Problem Identification, Figure 2.)

Site 17 - 1327 E. Cheryl Drive

A dip section exists in Cheryl Drive just east of the tee intersection of 13th Place and Cheryl Drive. The flow path of the natural washes which historically ran across this property are blocked. The dip at Cheryl Drive is connected by a 4-inch iron pipe to a sump location in the yard of 1327 E. Cheryl Drive. An iron pipe extends southwest from the sump and discharges at the property line into 13th Place where the flows run south to Site 18. All on-site flows generated discharge to this sump which appears to be at a high point of a reverse slope. The site may become completely isolated by heavy rainfall and its associated runoff.

The City Transportation Department has recorded ponded water depths in excess of two feet. Because this property dams the flow path, City crews have pumped the ponded water at Site 17 west to the intersection of 13th Place and Cheryl Drive where it runs south along 13th Place to Site 18.

SCALE: NTS



SITE 17 & 18 - PROBLEM IDENTIFICATION

FIGURE 2

Site 18 - 10037 N. 13th Place

There is a dip section in 13th Place approximately 210 feet south of the tee intersection of 13th Place and Cheryl Drive. An outflow channel located on the west side of 13th Place appears to have been partially blocked by heavy vegetation and siltation that intensifies the ponding condition at this dip section.

18.3 History

Historically, the flow followed a trace of a wash and drained to the well defined 10th Street Wash at Cinnabar Avenue approximately 200 feet from Cave Creek Road. The existing trailer park has partially blocked this drainage path.

18.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 28-30, revised October 22, 1992; 28-31, Revised July 30, 1993; 29-30, revised May 18, 1994; and 29-31, revised August 22, 1990.
- City of Phoenix Topographic Quarter Section Map Numbers: 28-30, flown October 24, 1967; 28-31, flown October 24, 1967; 29-30, flown October 24, 1967; and 29-31, flown October 24, 1967.
- City of Phoenix Wastewater Quarter Section Map Numbers: 28-30, revised July 28, 1993; 28-31, revised July 31, 1992; 29-30, revised September 24, 1994; and 29-31, revised January 22, 1990.
- City of Phoenix Water Quarter Section Map Numbers: 28-30, revised October 12, 1993; 28-31, revised May 26, 1993; 29-30, revised October 20, 1995; and 29-31, revised January 23, 1990.
- City of Phoenix Engineering Storm Drain Map K-9 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope, which contains Sites 17 and 18, their upstream drainage area, and downstream flow path, photo revised 1982.

The COP, FCDMC, and MCDOT were contacted to obtain paving, water, and sanitary sewer plans for these two sites without much success.

18.5 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1660F, revised September 30, 1995. The area is designated as Zone A which denotes special flood hazard areas inundated by the 100-year flood with no base flood elevation determined.

18.6 Hydrology

The upstream contributing drainage area, as delineated on a USGS 7.5-minute quadrangle map,

is approximately 37 acres. Using the rational equation, the discharge at the dip section of Cheryl Drive is 120 cfs, while the 2-year flow is 44 cfs.

18.7 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to construct roadway or storm drain improvements around the area of Sites 17 and 18.

Maricopa County Flood Control District - 10th Street Wash Project

This area is located upstream of the 10th Street Wash Project as proposed by the Flood Control District of Maricopa County. Improvement of this area can be sized to accommodate up to 100-year flows and discharge to 10th Street Wash Detention Basin No. 2.

18.8 Alternative Solutions

Sites 17 and 18 are located in fully developed areas of Phoenix. The roadway grades and finished building pad elevations may be substantially different from those shown on City quarter section maps.

No easements for these historical drainage paths are shown in any City documents. To proceed with improvement, it is necessary to obtain the permission of property owners in the area to secure drainage and construction easements. Existing channels require cleaning and surveys to establish a positive drainage path to the southwest.

Site 17 - 1327 E. Cheryl Drive

Alternative 1 - Solution to Facilitate Draining of the Ponded Water

This alternative involves the construction of a catch basin on the south side of Cheryl Drive at the existing dip section. This catch basin will be connected to an existing Cave Creek Road 18-inch storm drain line. A flap gate will be installed to regulate draining of the dip in Cheryl Drive when there is no disruption to the Cave Creek Road line. This design will allow the ponded water to drain within hours after a storm event.

Alternative 2 - Solution to Eliminate the Ponded Water for Frequent Storms

A catch basin at the existing dip and a 170-foot, 24-inch concrete pipe will be constructed to

drain flows of approximately 34 cfs. This capacity is set to meet the existing downstream wash capacity.

Alternative 3 - Solution to Eliminate the 100-Year Flood

A trench drain will be constructed which extends from the existing dip across Cheryl Drive to intercept flows. A 240-foot 6'x3' concrete box culvert which extends from the trench box to the 10th Street Wash at 13th Place will be constructed to accommodate the 100-year flow. This alternative can only be implemented in conjunction with the Site 18 Alternative 2 improvements.

Site 18 - 10035 N. 13th Place

Alternative 1 - Improvement to Drain

This alternative involves cleaning and regrading of the existing channel located 210 feet south of the tee intersection of Cheryl Drive and 13th Place. This channel extends through a trailer park to the southwest and eventually drains to the 10th Street Wash. A drainage easement through the trailer park has not been verified on any of the City's documents and will need to be pursued before any work proceeds. This site, once cleared, can handle approximately 34 cfs of flow at a depth of 1 foot.

Alternative 2 - Improvement to Carry the 100-Year Flow

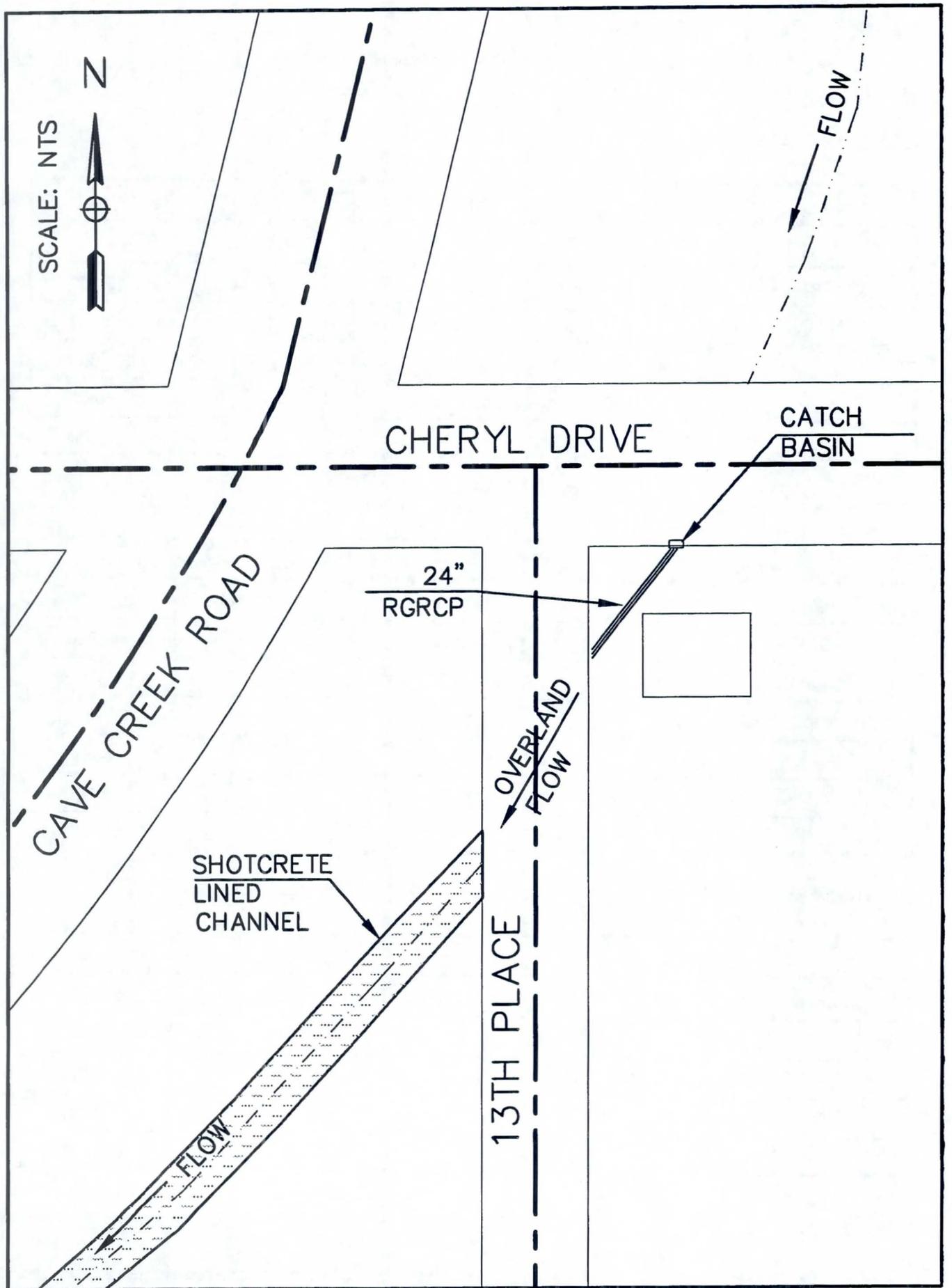
This alternative involves the construction of an 800-foot-long channel. The channel will be a trapezoidal shape with a bottom width of 6 feet and a depth of 2 feet at a slope of 1.5 percent. The channel will be shotcrete lined to accommodate the 100-year flood of 120 cfs. This alternative will correct the system to drain at the 10th Street Wash at Cinnabar Avenue.

18.9 Recommended Alternative

Alternative 2 for Site 17 and Alternative 2 for Site 18 are the recommended alternatives. (See Sites 17 and 18 - Preferred Alternative, Figure 3.)

For Site 17, the City of Phoenix will obtain a written agreement from the property owner to access the property and perform the proposed construction. This construction can be completed by City forces. If a written agreement is not obtained, the City will prefer Alternative 1, and an underground contractor will be hired.

Alternative 2 for Site 18 is the preferred alternative, as this will require less maintenance by City forces than Alternative 1. However, political and public response may become an issue. Also, the City must work on acquiring anywhere from a temporary construction easement, at a minimum, to a drainage easement which would be preferable. The construction of this alternative can be completed by City forces.



SITE 17 & 18 - PREFERRED ALTERNATIVE

FIGURE 3

18.10 Cost Estimate

Site 17

Alternative 1*

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
P-1570 Catch Basin	Each	\$1,200/Each	\$1,200
18" RGRCP	240 LF	\$80.00/LF	19,200
P-1520 Manhole	2 Each	\$3,200/Each	6,400
<i>Subtotal</i>			\$26,800
<i>20% Contingency</i>			5,400
<i>Total</i>			\$32,200

Alternative 2*

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Drop Inlet	1 Each.	\$1,000 Each.	\$ 1,000
24" RGRCP	170 LF	\$75/LF	12,800
Downstream Channel Excavation	52 YD ³	\$3.00/YD ³	200
Asphalt Replacement	10 Tons	\$60/Ton	600
<i>Subtotal</i>			\$14,600
<i>20% Contingency</i>			2,900
<i>Total</i>			\$17,500

Alternative 3*

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Trench Drain	30 LF	\$230/LF	\$ 6,900
6x3 RCBC	220 LF	\$180/LF	39,600
<i>Subtotal</i>			\$46,500
<i>20% Contingency</i>			9,300
<i>Total</i>			\$55,800

Site 18

Alternative 1*

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Cleaning and Regrading	Lump Sum	\$4,000	\$4,000
<i>Subtotal</i>			\$4,000
<i>20% Contingency</i>			800
<i>Total</i>			\$4,800

Alternative 2*

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Concrete Channel	800 LF	\$40/LF	\$32,000
<i>Subtotal</i>			\$32,000
<i>20% Contingency</i>			6,400
<i>Total</i>			\$38,400

*Does not include right-of-way or easement acquisition costs.

19. Site 19 — 10210 N. 15th Avenue

19.1 Location and Site Description

Site 19 is between Cheryl Drive and Beryl Drive on 15th Avenue in Township 3 North, Range 3 East, Section 30 of the Gila and Salt River Base Meridian. The street address of the local drainage problem is 10210 N. 15th Avenue. This is located on the west side of 15th Avenue, approximately 1,100 feet south of Peoria Avenue and 4,100 feet north of Dunlap Avenue. (See Site 19 - Vicinity Map, Figure 1.)

The area surrounding the site is developed except for mountainous outcroppings and foothills. The development includes single-family residences, apartments, and commercial businesses.

19.2 Problem Identification

Local storm water flows into the streets in the area around the site until it discharges into earthen washes. Located south of Site 19 is a mountainous outcropping that creates a high point in 15th Avenue immediately southwest of the tee intersection of Cheryl Drive with 15th Avenue. Therefore, flows conveyed west in Cheryl Drive are directed north at 15th Avenue. 15th Avenue has a superelevated street section beginning north of Cheryl Drive that directs the flow to the west at Beryl Drive.

15th Avenue does not have the capacity to convey the flow which concentrates at this site. The property owner at 10210 N. 15th Avenue has complained that his garage often becomes flooded, and that the water has been three to five inches deep. Because the contributing drainage area is almost completely developed, runoff concentrates quickly. The owner has observed that it takes about 10 minutes from the start of the rainfall for storm water to overtop the curb and run down his driveway. (See Site 19 - Problem Identification, Figure 2.)

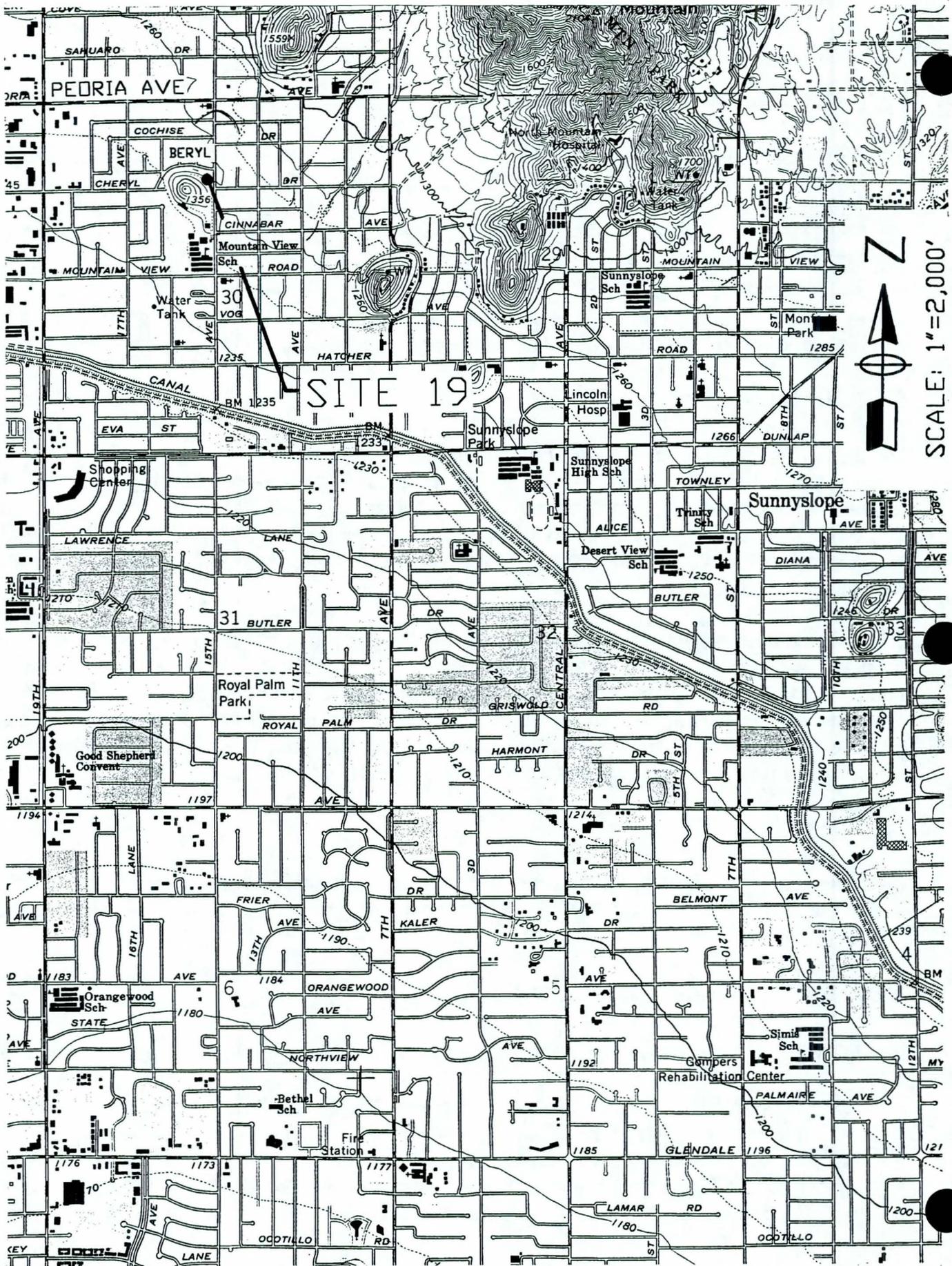
19.3 History

Previously, an asphalt mound was constructed at the centerline of 15th Avenue in an attempt to prevent all the flow from concentrating at the west curb. However, this has not corrected the flooding problem.

19.4 Site Specific Data Acquisition

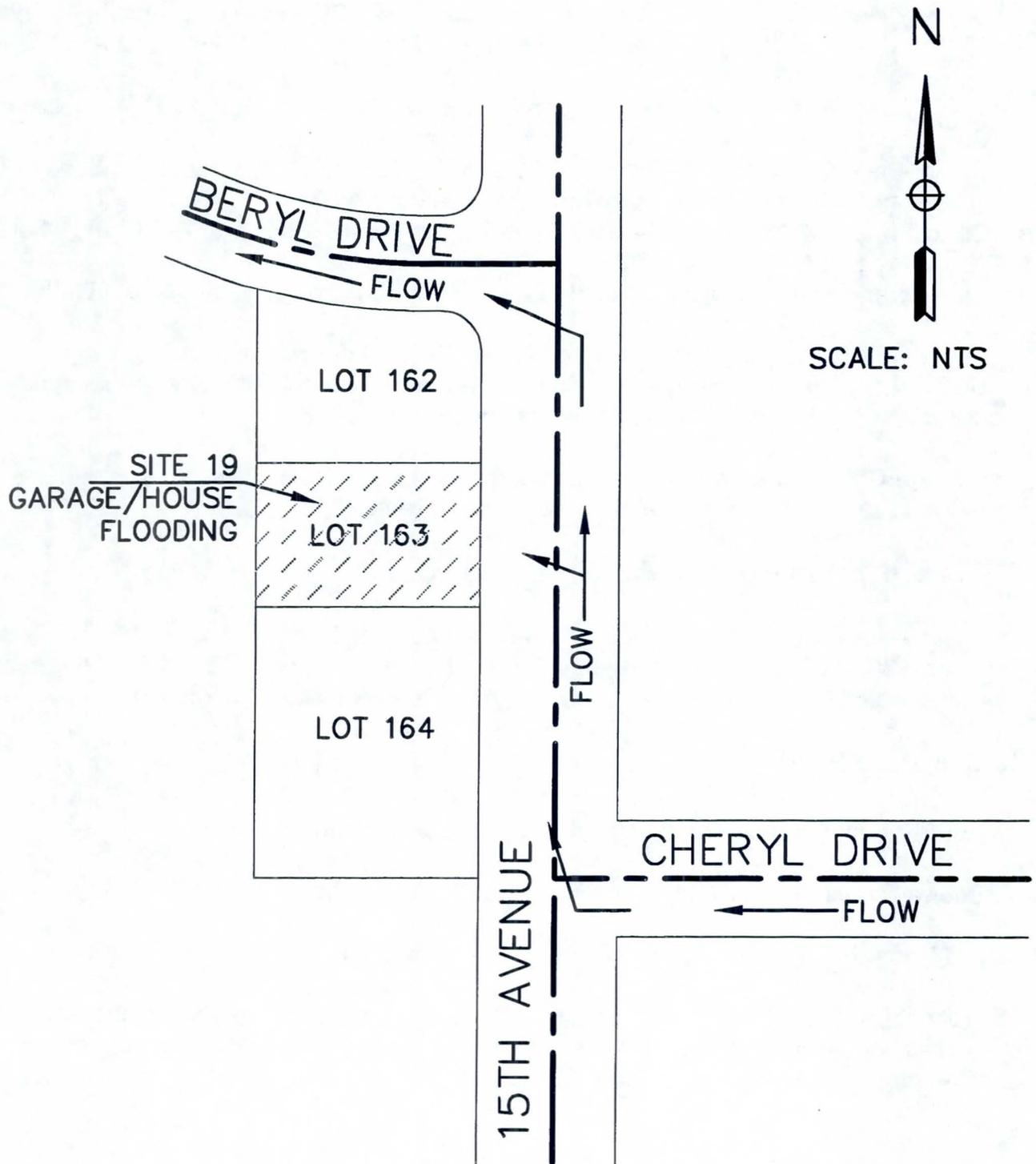
The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 28-26, revised May 23, 1991; 28-27, Revised October 7, 1993; 29-26, revised April 22, 1993; 29-27, revised August 22, 1990; and 28-25, revised December 7, 1990.
- City of Phoenix Topographic Quarter Section Map Numbers: 28-26, flown October 24, 1967; 28-27, flown October 24, 1967; 29-26, flown October 24, 1967; 29-27, flown October 24,



SITE 19 - VICINTY MAP

FIGURE 1



SITE 19 - PROBLEM IDENTIFICATION

FIGURE 2

- 1967; 28-25, flown October 24, 1967; 28-30, flown October 24, 1967; 28-31, flown October 24, 1967; 29-30, flown October 24, 1967; and 29-31, flown October 24, 1967.
- City of Phoenix Wastewater Quarter Section Map Numbers: 28-26, revised August 26, 1994; 28-27, revised January 1990; 29-26, revised February 10, 1993; and 28-25, revised September 24, 1992.
 - City of Phoenix Water Quarter Section Map Numbers: 28-26, revised September 15, 1995; 28-27, revised September 27, 1995; 29-26, revised September 15, 1995; and 28-25, revised September 15, 1995.
 - City of Phoenix Job Number P-60026, Paving Plans, Sheets 2 and 14 of 20, As-builts dated December 17, 1964.
 - City of Phoenix Job Number W-78045.00 and W-78046.00, Water Lines for Sunny High N.I.D., sheets 2 and 5 of 33, As-builts dated January 4, 1979.
 - City of Phoenix Job Number W-61015 (BI), Water Line Plans, Sheets 2, 17, 20, and 21 of 26, As-builts dated October 18, 1962.
 - City of Phoenix Job Number S-59069, Sewer Plans, Sheets 3, 25, and 33 of 85, As-builts dated December 3, 1963.
 - City of Phoenix Engineering Storm Drain Maps K-7 and K-8 (not dated).
 - USGS 7.5-minute quadrangle map for Sunnyslope, which contains Site 19, its upstream drainage area, and downstream flow path, photo revised 1982.

The COP, FCDMC, and MCDOT were contacted to obtain paving, water, and sanitary sewer plans for these two sites; however, they were not available.

19.5 Federal Emergency Management Agency

This site is on FEMA Flood Insurance Rate Map Panel Number 04013C1655H, revised September 30, 1995. The area is designated shaded Zone A which denotes special flood hazard areas inundated by the 100-year flood with no base flood elevation determined.

19.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to construct roadway or storm drain improvements around the area near Site 19.

19.7 Hydrology

The local drainage concentrating in 15th Avenue at the problem site has a watershed area of 60 acres. The flow rates for the 2-, 5-, 10-, 25-, 50-, and 100-year storms are 59, 83, 98, 118, 138, and 155 cfs, respectively.

Break-out from a wash located east of the site on Cheryl Drive was considered as contributory to the local drainage runoff. However, upon field reconnaissance, it was determined that this wash does not contribute to the flooding of this site.

19.8 Alternative Solutions

Site 19 is located in a fully developed area of Phoenix. Existing topographic maps were used to assess the areas to recommend the alternative solutions. It should be noted, however, that there have been observable changes in existing roadway grades and finished pad elevations from the data represented on City quarter section maps. A detailed survey of 15th Avenue between Cheryl and Beryl Drives will be required prior to implementing any of the proposed alternatives.

Alternative 1 - Construct a Ridge to Contain Flow in Roadway

This alternative involves constructing a ridge along the west edge of 15th Avenue to prevent flows from flooding the property at Site 19 and the neighboring property to the north. The ridge will begin at the southern edge of Site 19 and extend to Beryl Drive. The ridge can be created by either raising the curb and sidewalk or by regrading the existing ground behind the sidewalk to form a hump. With both options, the driveways on both properties will have to be regraded to match the ridge elevation.

Assuming that the existing cross slope of 15th Avenue is 1.5 percent, an 11-inch curb on the west side will contain the 100- and 50-year flows provided this does not exceed the existing east curb elevation. Similarly, a 10-inch curb will contain the 25-year flow and a 9-inch curb will contain the 10-year and smaller storms.

Alternative 2 - Increase Conveyance Capacity of 15th Avenue by Constructing Inverted Crown

This alternative requires that a new street section be designed with an inverted crown for 15th Avenue to increase the conveyance capacity of 15th Avenue between these two streets. The 100-year flow can be conveyed in an inverted crown section with a 6-inch curb and equal gutter elevations. If the gutter elevations of the inverted crown section are not equal, a combination of an inverted crown and a raised west curb similar to Alternative 1 may be required.

This inverted crown section will begin just north of Cheryl Drive and end just north of Beryl Drive to allow a transition of 15th Avenue back to a superelevated street section so that existing flow paths are not altered.

19.9 Recommended Alternative

Alternative 2 is the recommended solution. This alternative is preferred by City maintenance staff as it will eliminate the need to maintain a berm constructed on private property. (See Site 19 - Preferred Alternative, Figure 3.)

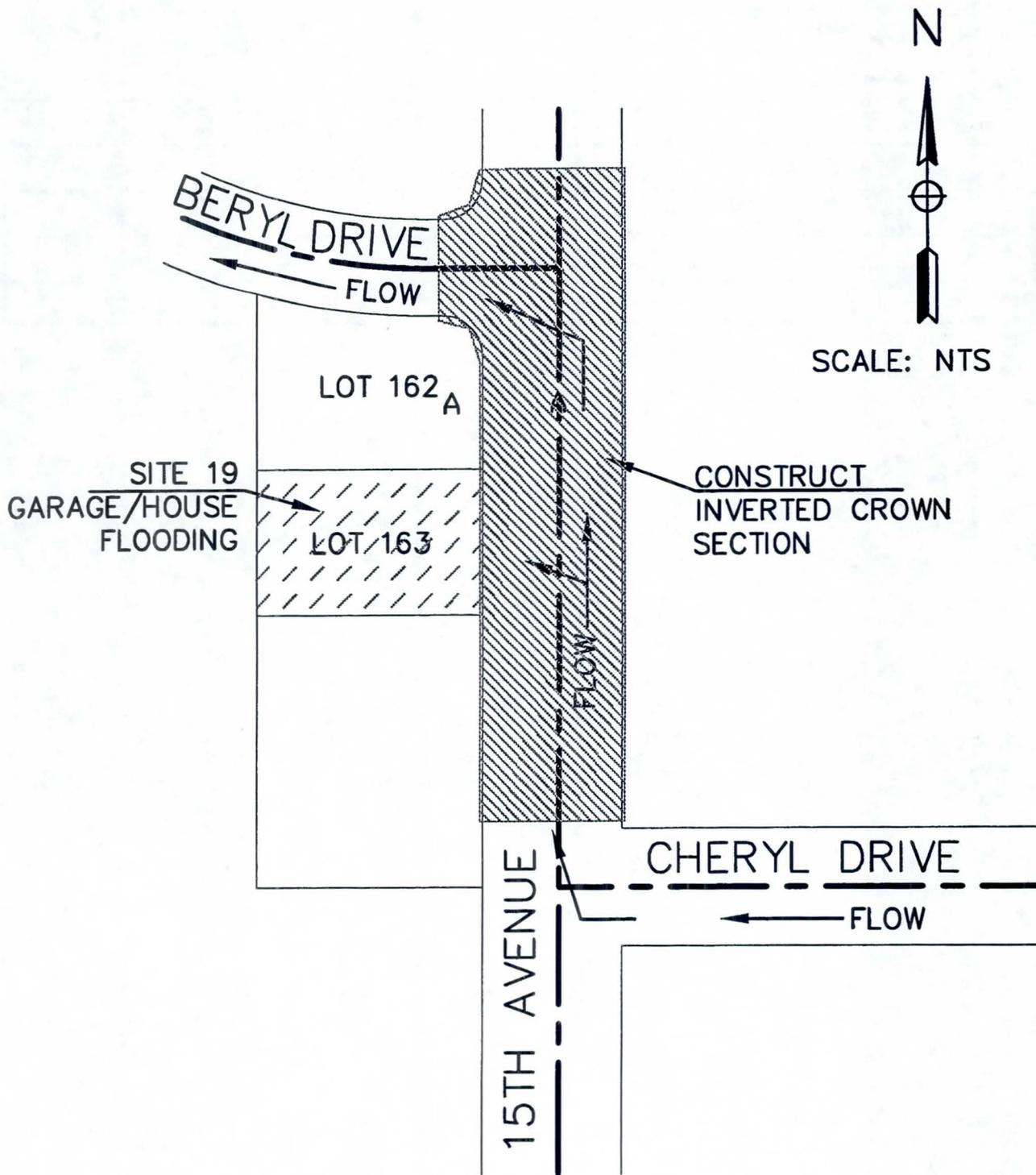
As previously mentioned, detailed survey and design will be required to implement this alternative. The curb elevations must be verified to ensure that an inverted crown section will convey the flow within the roadway without break-out to Lot 163.

The construction of this alternative will be by contracted forces.

19.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Concrete Curb - 9 Inches	135 LF	\$6/LF	\$ 800
Concrete Sidewalk - 5 Foot	675 SF	\$2/SF	1,400
Mounding	25 YD ³	\$3/YD ³	100
Revegetation	75 SY	\$3/SY	200
Driveway Entrance	2 Each	\$180/Each	400
Remove Curb & Sidewalk	1 LS	\$540/LS	500
<i>Subtotal</i>			\$3,400
<i>20% Contingency</i>			700
<i>Total</i>			\$4,100.00



SITE 19 - PERFERRED ALTERNATIVE

FIGURE 3

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Subgrade Preparation	1,100 SY	\$2/SY	\$2,200
AC D-1/2 (2 Inches Thick)	120 Tons	\$32/Ton	3,800
AC A-1-1/2 (5 Inches Thick)	300 Tons	\$32/Ton	9,600
Concrete Curb & Gutter	270 LF	\$6/LF	1,600
Remove Pavement & Curb	1 LS	\$1,000/LS	1,000
<i>Subtotal</i>			\$18,200
<i>20% Contingency</i>			3,600
<i>Total</i>			\$21,800

20. Site 21 — 5608 North 9th Street

20.1 Location and Site Description

This site is a house located at the southwest corner of 9th Street and San Juan Avenue where each street terminates. San Juan Avenue, 9th Street, and San Miguel Avenue form a horseshoe-shaped drive west of 10th Street and south of Bethany Home Road (see Site 21 - Vicinity Map, Figure 1). The property is at the lowest local elevation in a residential neighborhood and is the focal point for all local drainage.

20.2 Problem Identification

An inlet grate is located in the curb at the front edge of the property. The catch basin below the grate is connected to a drain pipe which terminates at a grated outlet located in the parking lot of an apartment complex behind the property at 800 E. Missouri. The water flows through the complex parking lot to Missouri Avenue. Debris clogs the grate, preventing the local drainage from exiting the site and resulting in flooding of the property on 9th Street (see Site 21 - Problem Identification, Figure 2).

20.3 History

The property on 9th Street has become flooded when debris such as grass clippings has clogged the outlet grate. The property owner has been able to alleviate the problem by removing the outlet grate, which allows the debris to be pushed out of the pipe. This allows the local drainage to flow normally through the system. To reduce the flow to the site, City of Phoenix crews have also created a berm at the San Juan Avenue and San Miguel Avenue intersections with 10th Street.

20.4 Site Specific Data Acquisition

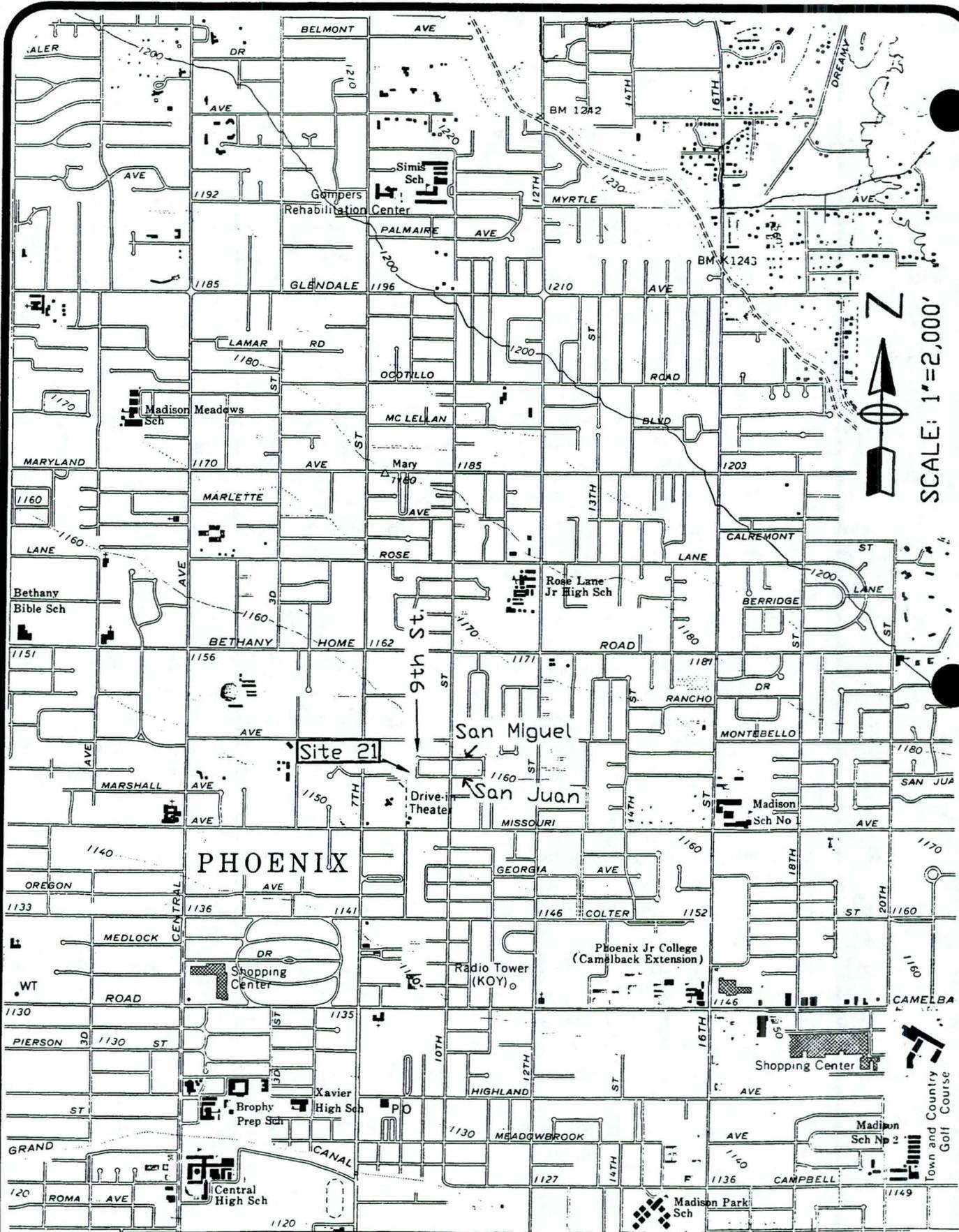
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 21 and its upstream drainage area, Revised 1982.
- City of Phoenix Storm Drain Map, I-8.
- City of Phoenix Quarter Section Topographic Maps.
- City of Phoenix Quarter Section Right-of-Way Maps.

The as-builts for the existing storm drain were unavailable from the City of Phoenix.

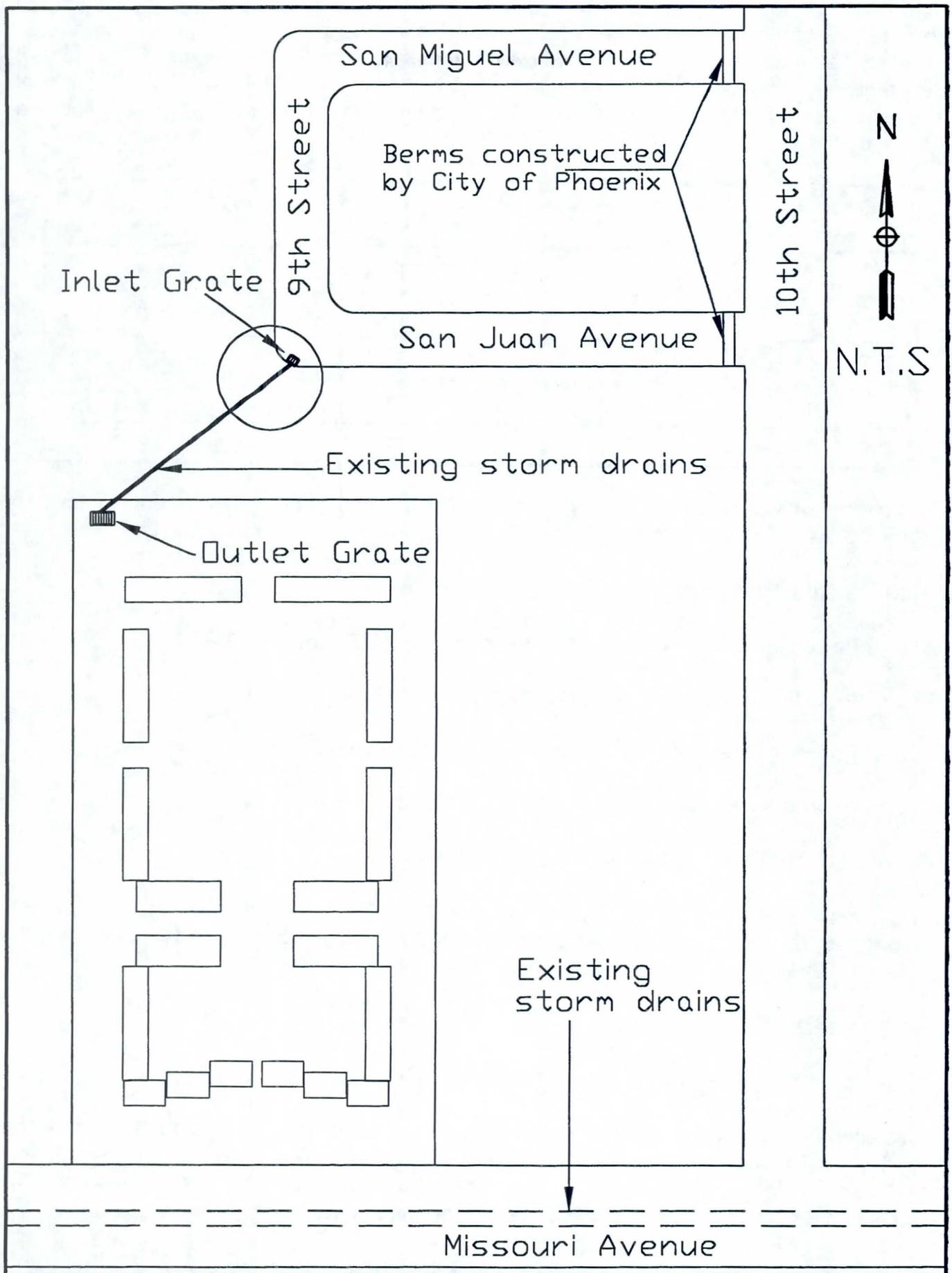
20.5 Hydrology

The values for the runoff amount for the different design periods were calculated using the Rational Method. Due to sufficient lack of supporting data, engineering judgements were used



SITE 21 - VICINTY MAP

FIGURE 1



SITE 21 - PROBLEM IDENTIFICATION

FIGURE 2

to make assumptions required to facilitate calculations. The runoff along 10th Street was calculated assuming that 25% of the flow from the intersection of 10th Street and Montebello will be carried by 10th Street. The local flow is that flow which results from runoff of the local drainage area, which is west of 10th Street. The estimated values for the amount of flow are shown below.

<i>Frequency (yr)</i>	<i>10th St. Discharge (cfs)</i>	<i>Local Discharge (cfs)</i>	<i>Total Discharge (cfs)</i>
100	11.7	11.6	14.3
50	10.5	10.4	11.9
25	9.4	9.3	9.7
10	8.2	8	8
2	5	5	5

The flow in 10th Street, past San Miguel and San Juan, should be contained entirely on 10th Street by the berm constructed by City of Phoenix crews for values less than 9 cfs.

20.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no projects planned which will impact this site.

20.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1670G, revised September 30, 1995. The area is designated as Shaded Zone X, which denotes areas within the 500-year floodplain.

20.8 Alternative Solutions

Alternative 1- Connect to Existing Storm Drain on Missouri Avenue

This alternative proposes to connect the existing storm drain that runs from 9th Street to the parking lot of the apartment complex with the existing storm drain on Missouri Avenue. A new 54-inch storm drain will run beneath the parking lot of the apartment complex to the existing 70-inch storm drain beneath Missouri Avenue. The existing outlet grate will be removed.

Alternative 2- Replace Grates at Inlet and Outlet

This alternative proposes improvements to both the outlet and inlet grates so that debris does not clog the system. The opening size and spacing of the slats will be improved to prevent large debris from passing the inlet grate and allow larger debris to pass through the outlet grate. This should allow the water to flush out the larger debris. However, dirt swept into the system through the outlet grate in the apartment complex parking lot could combine with water which enters during light storms to form a hardened mud dam which may continue to clog the system. Additionally, smaller inlet grates may become blocked with larger debris during storms. This could prevent water from properly draining into the system. While this alternative will be inexpensive to implement, it may not adequately solve the flooding problem.

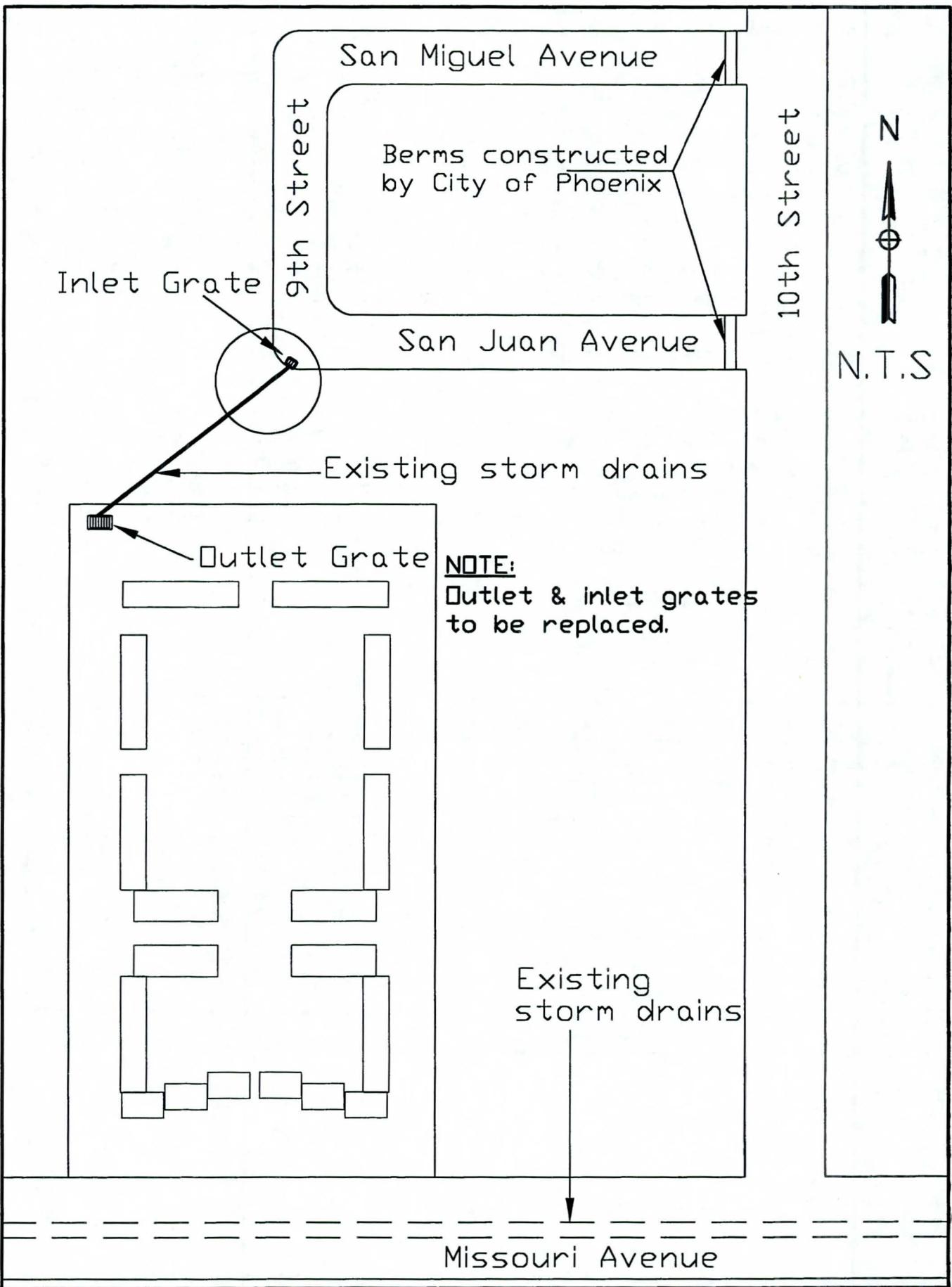
20.9 Recommended Alternative

The City of Phoenix has indicated that the preferred solution is Alternative 2 (see Site 21 - Preferred Alternative, Figure 3). In addition, this location can be placed on a biweekly cleaning schedule by the Vactor. The City has also indicated that if a problem persists after Alternative 2 has been constructed, then Alternative 1 will be implemented. If Alternative 1 is implemented in the future, a detailed study of the site and the existing storm drain at Missouri Avenue will be required to properly design the new system.

20.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Structural Excavation	1,000 YD ³	\$9.00/YD ³	\$ 9,000
Backfill	1,000 YD ³	\$15.00/YD ³	15,000
54-Inch Concrete Pipe	500 LF	\$50.00/LF	25,000
Modify Storm Drain	1 Each	\$2,000/Each	2,000
Asphalt Paving	73 Ton	\$32.00/Ton	2,300
<i>Subtotal</i>			\$53,300
<i>20% Contingency</i>			10,700
<i>Total</i>			\$64,000



SITE 21 - PREFERRED ALTERNATIVE

FIGURE 3

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Outlet Grate	1 Each	\$200/Each	\$200
Inlet Grate	1 Each	\$200/Each	200
<i>Subtotal</i>			\$400
<i>20% Contingency</i>			100
<i>Total</i>			\$500

21. Site 22 — Intersection of 11th Avenue & Tuckey Lane

21.1 Location and Site Description

This site is located on 11th Avenue beginning at its intersection with Tuckey Lane, which is south of Glendale Avenue. This is a residential neighborhood. Water flows down 11th Avenue to an existing, grass-lined, earthen ditch. The ditch discharges into an existing pipe that carries the water under a neighboring trailer park (see Site 22 - Vicinity Map, Figure 1).

21.2 Problem Identification

Flooding of the site occurs when discharges exceed the capacities of the existing drainage pipe and flows back up at the existing headwall. Three properties immediately adjacent to the ditch are affected by the flooding: a mobile home park and two private residences (see Site 22 - Problem Identification, Figure 2).

21.3 History

The ditch has been augmented by an earthen berm constructed by City crews. The pipe which carries the flow away from the property is not shown on City of Phoenix storm drain maps. McLellan Boulevard intersects 11th Avenue south of Tuckey Lane, where the ditch is located. It is now a dirt road, without markings, that appears to have been abandoned by the City.

21.4 Site Specific Data Acquisition

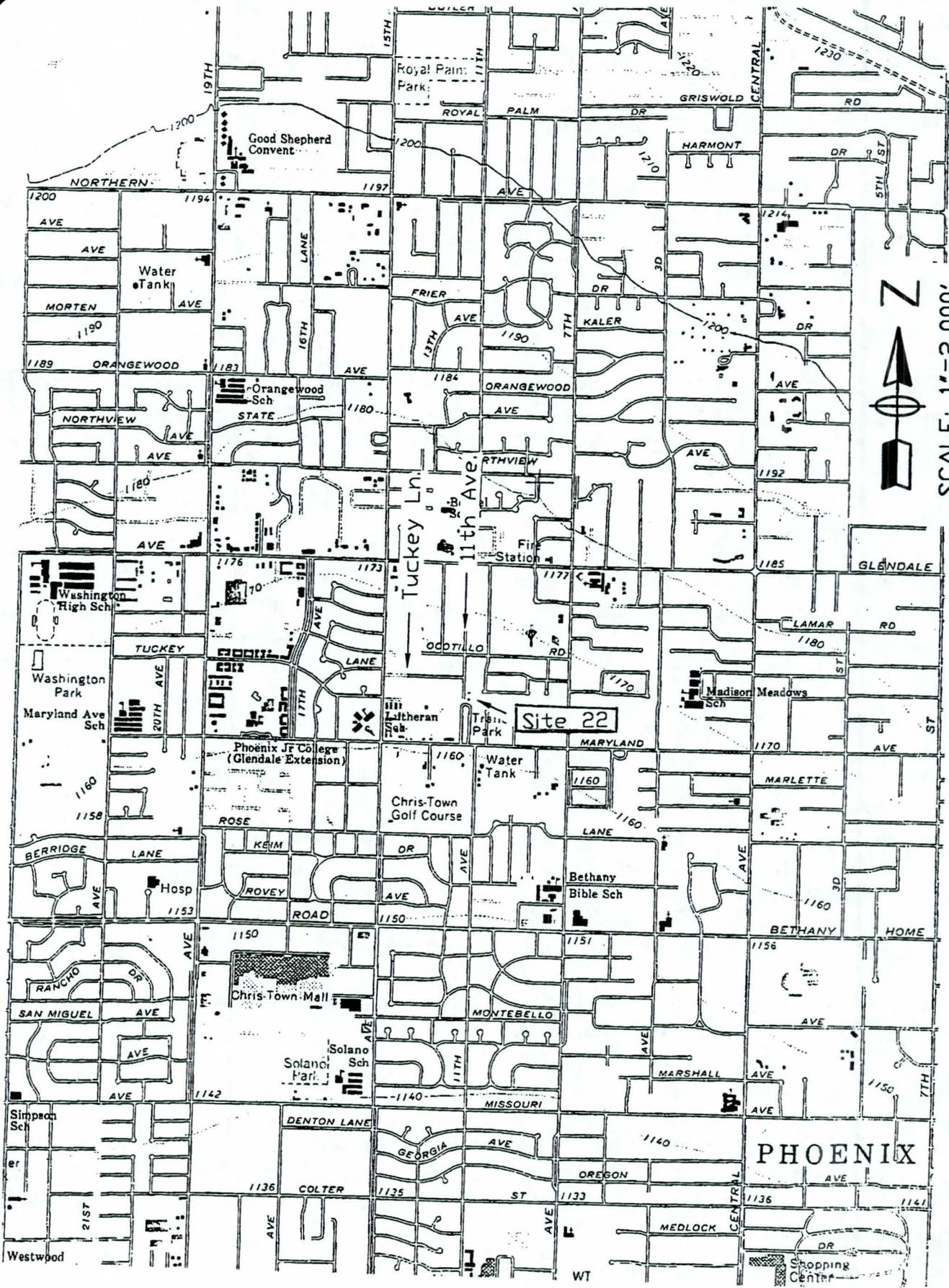
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 22 and its upstream drainage area, Revised 1982.
- City of Phoenix Storm Drain Map I-8.
- City of Phoenix Storm Drain As-builts, Project No. ST- 75087.00.
- City of Phoenix Quarter Section Right-of-Way Maps.

As-built plans and design information for the storm drain and inlets at Missouri Avenue and Tuckey Lane were unavailable from the City of Phoenix.

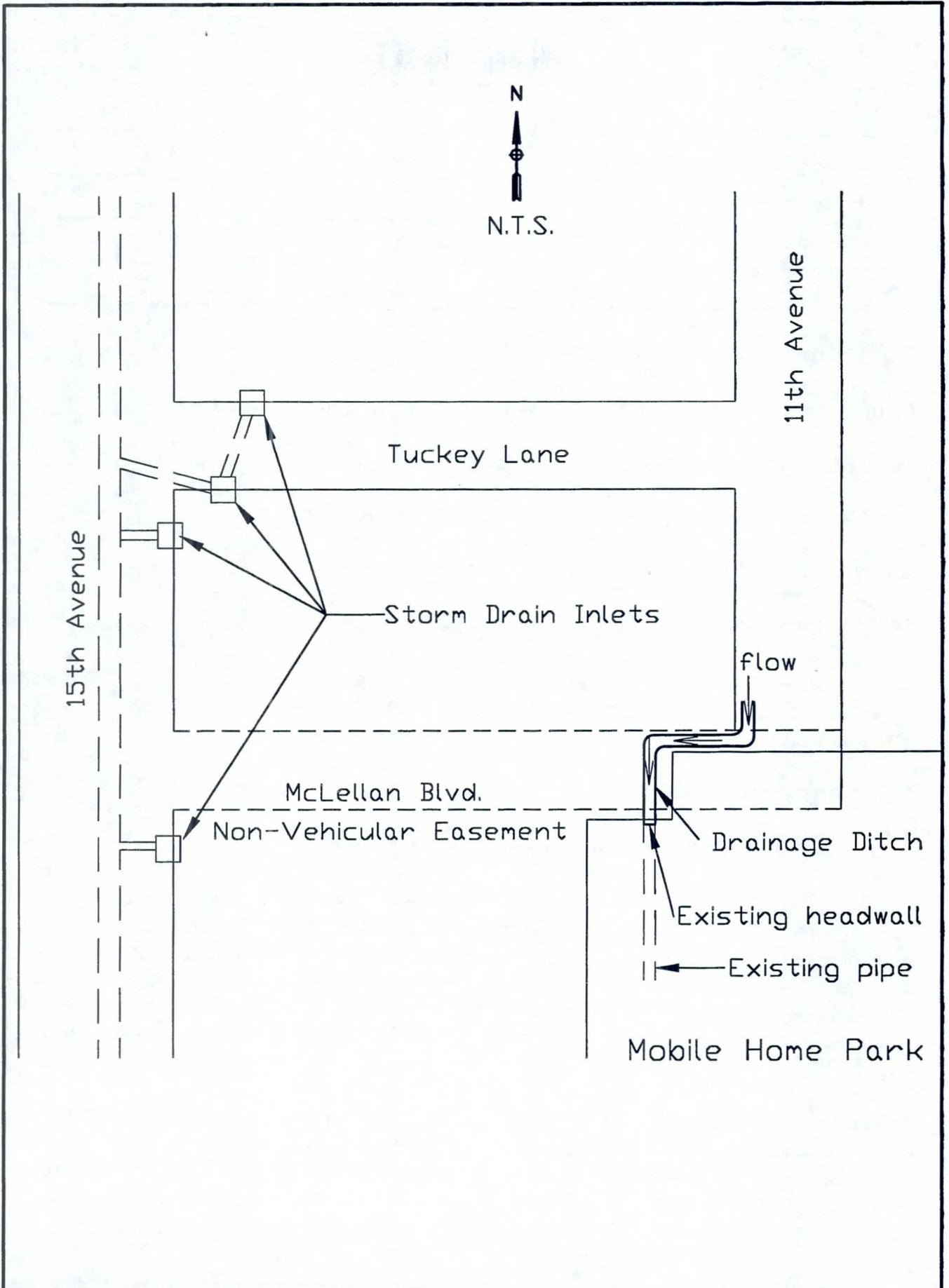
21.5 Hydrology

Using the Rational Method, 11th Avenue is estimated to carry the flows shown below for each design period. Local flow is from the drainage area south of Tuckey Lane. Distant flow is the estimated flow from the upstream drainage area not diverted to other streets or intercepted by storm drain inlets.



SITE 22 - VICINITY MAP

FIGURE 1



SITE 22 - PROBLEM IDENTIFICATION

FIGURE 2

<i>Frequency (yr)</i>	<i>Local Discharge (cfs)</i>	<i>Distant Discharge (cfs)</i>	<i>Total Discharge (cfs)</i>
100	3.5	15.7	19.2
50	3.2	14	17.2
25	2.8	12	14.8
10	2.5	11.3	13.8
2	1.6	7	8.6

21.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no projects planned which will impact this site.

21.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1665G, revised September 30, 1995. The area is designated as Zone X, which denotes areas outside the 500-year floodplain.

21.8 Alternative Solutions

Alternative 1- New Drainage Ditch in McLellan Boulevard

This alternative consists of constructing a drainage ditch to direct flow down McLellan Boulevard to the storm drain inlet at 15th Avenue. The ditch shall have sufficient capacity to carry the 50-year flow. The ditch will be constructed to end in a headwall with a grated inlet to a pipe connected to the catch basin in 15th Avenue. The headwall will be constructed in accordance with MAG Standard Detail 501-1. The ditch shall have a 4-foot base width, 1:1 side slopes, 0.3% slope, and depth of 2.25 feet, which includes 1 foot of freeboard. A 30-inch pipe is required to carry the flow to the existing catch basin.

These dimensions are based upon topographic assumptions made due to lack of available data. Before construction can begin, a survey of the site and reassessment of the proposed dimensions will be required to properly engineer the design. McLellan Boulevard is shown as a non-vehicular easement on City of Phoenix Right-of-Way maps. The size and capacity of

the existing storm drain at 15th Avenue is not available and a study of the system will have to be performed to determine if it can handle the additional flow.

Alternative 2 - New Drainage Pipe Beneath McLellan Boulevard

This alternative encompasses installation of a storm drain pipe under McLellan Boulevard with a grated inlet at 11th Avenue to carry the 50-year flow to the existing storm drain on 15th Avenue. The pipe could be constructed to discharge directly into the inlet catch basin, storm drain, or 15th Avenue gutter. The pipe shall have a 56-inch diameter, be 1,100 feet in length, and be installed at a 0.5% slope. A lack of sufficient supporting data will require that a detailed study be performed prior to the implementation of this alternative.

Alternative 3 - Improve Existing Drainage Pipe

This alternative includes increasing the capacity of the existing drainage pipe. This will require that the layout of the existing drainage pipe and its point of discharge be determined. This pipe is not shown on any City of Phoenix maps. No design parameters or cost estimation is available for this alternative due to the lack of sufficient supporting information.

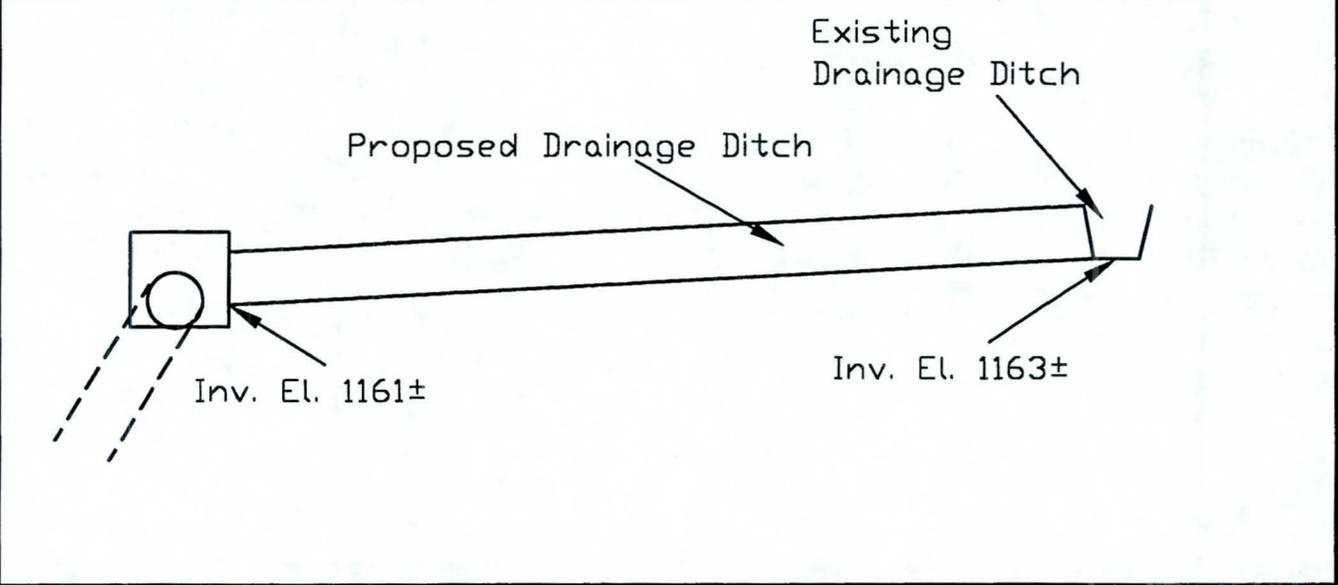
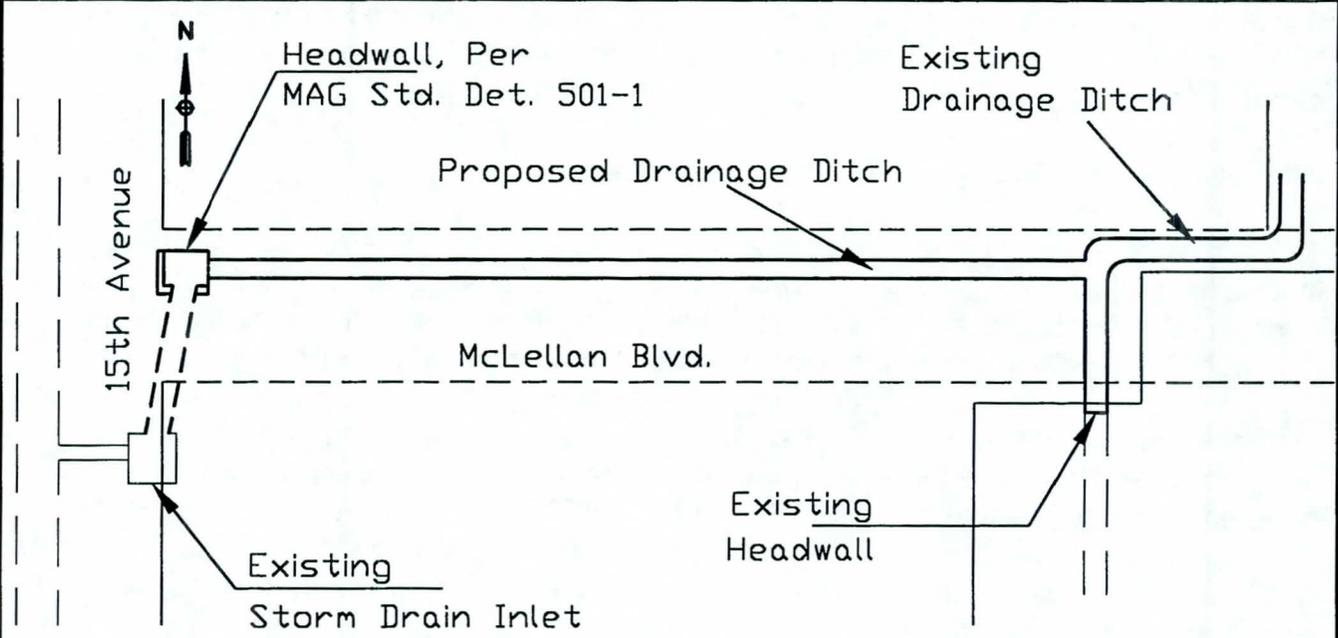
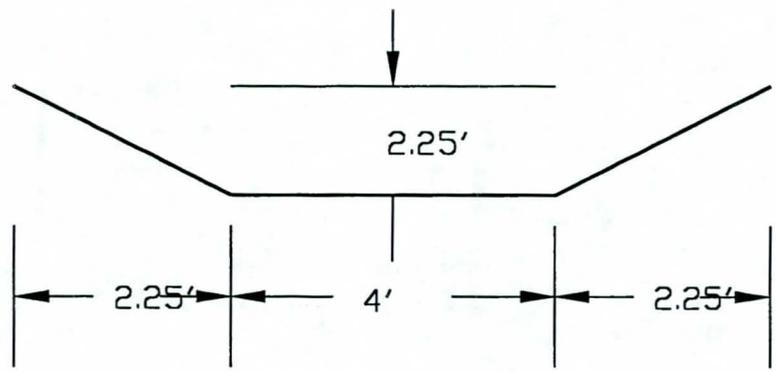
Alternative 4 - Restrictive Berm Across 11th Avenue

This alternative consists of constructing a berm across 11th Avenue at the Tuckey Lane intersection. Flow will be directed down Tuckey Lane to the existing storm drain inlets at 15th Avenue. The existing drainage ditch and pipe will then only be required to handle the local drainage. A 6-inch berm is required to protect against the 50-year design flow.

Further investigation is recommended to determine the layout, capacity, and discharge point of the pipe. In addition, the capacity of the storm drain inlets on Tuckey Lane will have to be checked to ensure that they can handle the increased flow down Tuckey Lane. The design plans for these inlets are not available. It is possible that directing the flow down Tuckey Lane may create flooding problems for other properties. This issue will require further study before this alternative may be implemented.

21.9 Recommended Alternative

According to the City of Phoenix, this site is not currently a serious problem. The City maintains or inspects the ditch on a regular basis. The City also indicated that Alternative 1 is recommended to address the flooding problems on 11th Avenue (see Site 22 - Recommended Alternative, Figure 3). However, it should not be implemented until further complaints of flooding problems are documented.



SITE 22 - PREFERRED ALTERNATIVE

FIGURE 3

21.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	350 YD ³	\$3.50/YD ³	\$ 1,200
Pipe	30 LF	\$35.00/LF	1,100
Modify Catch Basin	1 Each	\$600/Each	600
Headwall	1 Each	\$1,200/Each	1,200
<i>Subtotal</i>			\$4,100
<i>20% Contingency</i>			800
<i>Total</i>			\$4,900

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Structural Excavation	1,020 YD ³	\$9.00/YD ³	\$ 9,200
Pipe	1,100 LF	\$75.00/LF	82,500
Modify Catch Basin	1 Each	\$600/Each	600
Backfill	1,020 YD ³	\$15.00/YD ³	15,300
<i>Subtotal</i>			\$107,600
<i>20% Contingency</i>			21,500
<i>Total</i>			\$129,100

Alternative 4

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
40-Foot Berm	1 Each	\$1,000/Each	\$1,000
<i>Subtotal</i>			\$1,000
<i>20% Contingency</i>			200
<i>Total</i>			\$1,200

22. Site 24 — 1307 West Lawrence

22.1 Location and Site Description

This site is located at the end of a cul-de-sac at 1307 W. Lawrence Road, which is south of Glendale Avenue between 7th Avenue and 15th Avenue (see Site 24 - Vicinity Map, Figure 1).

22.2 Problem Identification

Lawrence Road slopes from 14th Avenue to the east and ends at a cul-de-sac. The house located at 1307 W. Lawrence Road has the lowest pad elevation among all the houses in the cul-de-sac. Discharges from Glendale Avenue spill into a fire/service alley and drain southerly to the site as well as into 14th Avenue, which connects to the site from the west (see Site 24 - Problem Identification, Figure 2).

22.3 History

The property owner has complained of flooding of his property and house. City crews have constructed a berm, equal to the height of the curb, across Lawrence just east of 14th Avenue to prevent the flows from the north. No flooding complaints have been received since this was constructed; however, there has been no major storm or flood event to gauge the effectiveness of this berm.

22.4 Site Specific Data Acquisition

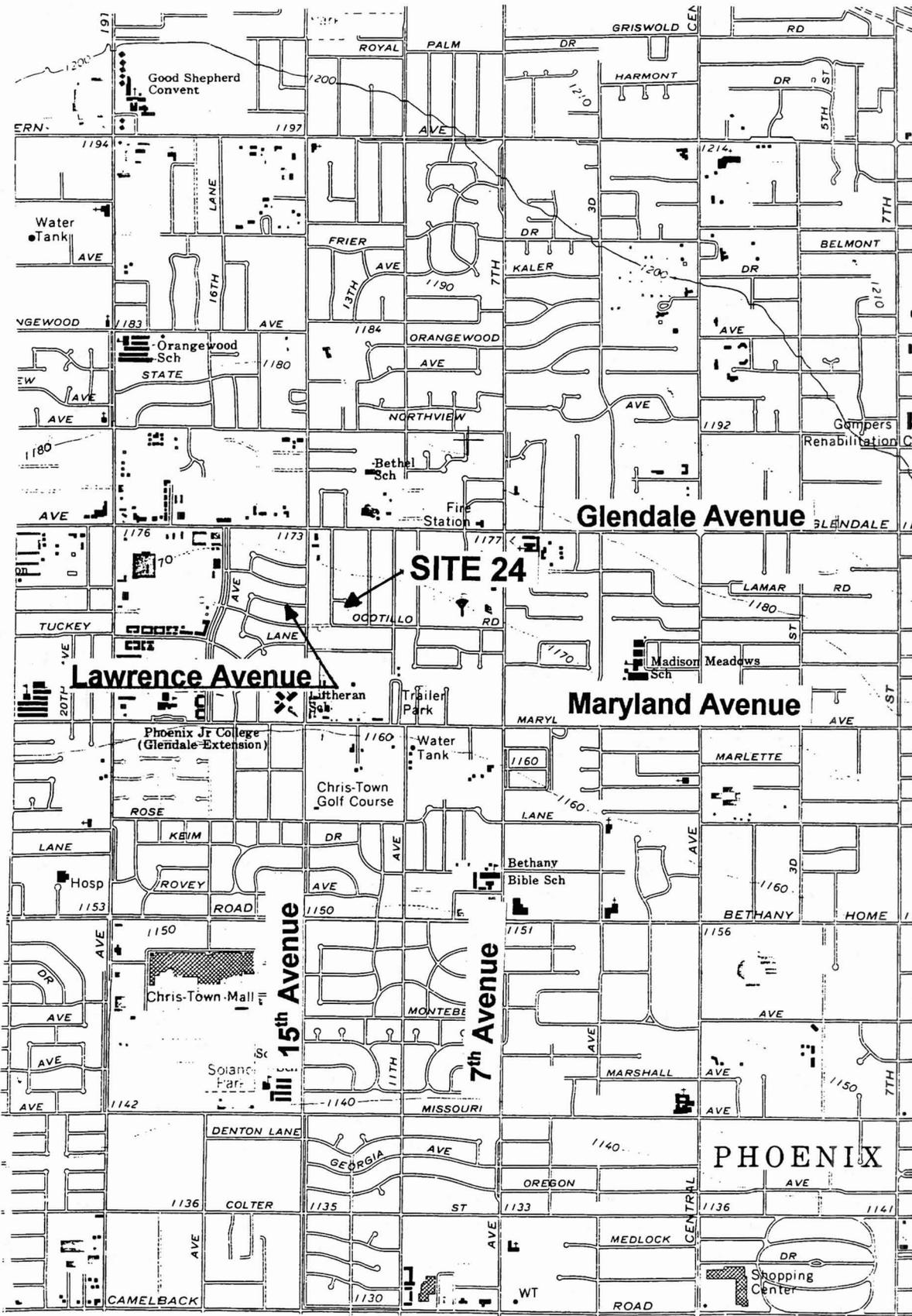
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 24 and the surrounding area topography, Revised 1982.

22.5 Hydrology

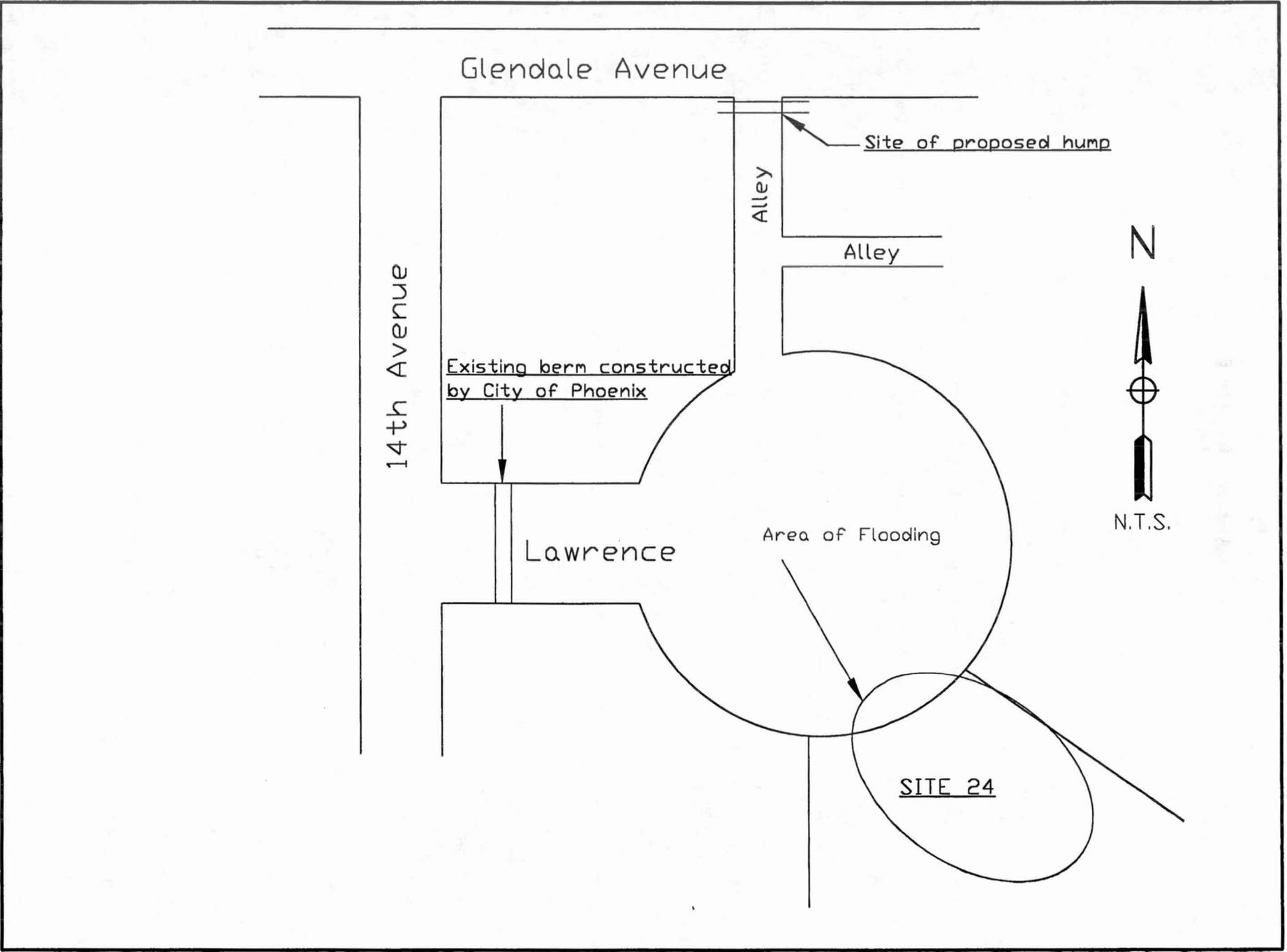
The Rational Method was used to calculate flow values for the different storm events. Due to limited available information about the storm drain system and inlet capacities, certain assumptions were made to facilitate calculations. These assumptions are:

- 50% of the flow is intercepted by the storm drain inlets along the arterial streets feeding into Glendale Avenue.
- There is a 50% diversion of the flow from Glendale Avenue to the major arterial streets that intersect with Glendale Avenue from 12th Street to 7th Avenue.
- Storm drain inlets are assumed to be constructed in accordance with MAG Standard Detail #530.
- The *City of Phoenix Storm Drain Design Manual* was used to calculate the flow intercepted by the storm drain inlets.



SITE 24 - VICINITY MAP

FIGURE 1



The flow along Glendale Avenue is collected by its gutter to storm drain inlets located between 14th Place and 15th Avenue. The 50-year storm event is approximately 62 cfs at the alley entrance (between 14th and 15th Avenues). A portion of this flow crests the curb and flows into the alley. The 100-year storm event generates a flow of 85 cfs at the alley entrance.

22.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no plans within this program to improve Lawrence Road or Glendale Avenue between 15th and 7th Avenues.

22.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1665G, revised September 30, 1995. The area is designated as Zone X, which denotes areas outside the 500-year floodplain.

22.8 Alternative Solutions

Alternative 1 - Construct a Hump at the Entrance of the Fire/Service Alley at Glendale Avenue

This alternative is to prevent flow from entering the alley from Glendale Avenue by increasing the depth of flow required to crest into the alley. A 4-inch hump will protect against the 50-year flood event of 62 cfs. A 6-inch hump will protect against the 100-year flood event of 85 cfs.

Alternative 1 will not require extensive construction or interfere with traffic on Glendale Avenue. The hump shall be of a sufficient width so as not to impede traffic through the alley.

Alternative 2 - Regrade Lawrence Road

This alternative involves regrading Lawrence Road to prevent flow from the alley from draining onto the property. This may be accomplished by raising the bulb of the cul-de-sac to an elevation greater than the alley.

This alternative will prevent flow from discharging into Lawrence Road, but may force the flow onto other properties that adjoin the alleyway. These properties appear to be protected by a berm between the property and the alley.

Alternative 3 - Increase Capacity of Storm Drain and Inlets Along Glendale Avenue

This alternative consists of improving the drainage capacity of Glendale Avenue, including the storm drain and its inlets. This will require extensive work along Glendale Avenue which will disrupt traffic flow.

22.9 Recommended Alternative

As indicated in Section 1.3, History, no flooding complaints have been received since the berm was constructed by City crews across Lawrence at 14th Avenue. The City has decided to take no action at this site until it is determined whether the Lawrence berm has solved the problem. If there is a continued problem at Site 24, the City will construct a berm in the alley at Glendale Avenue as recommended by Alternative 1 (see Site 24 - Preferred Alternative, Figure 3). The City will then monitor the berm to ensure that the solution does not cause flooding problems at some location downstream.

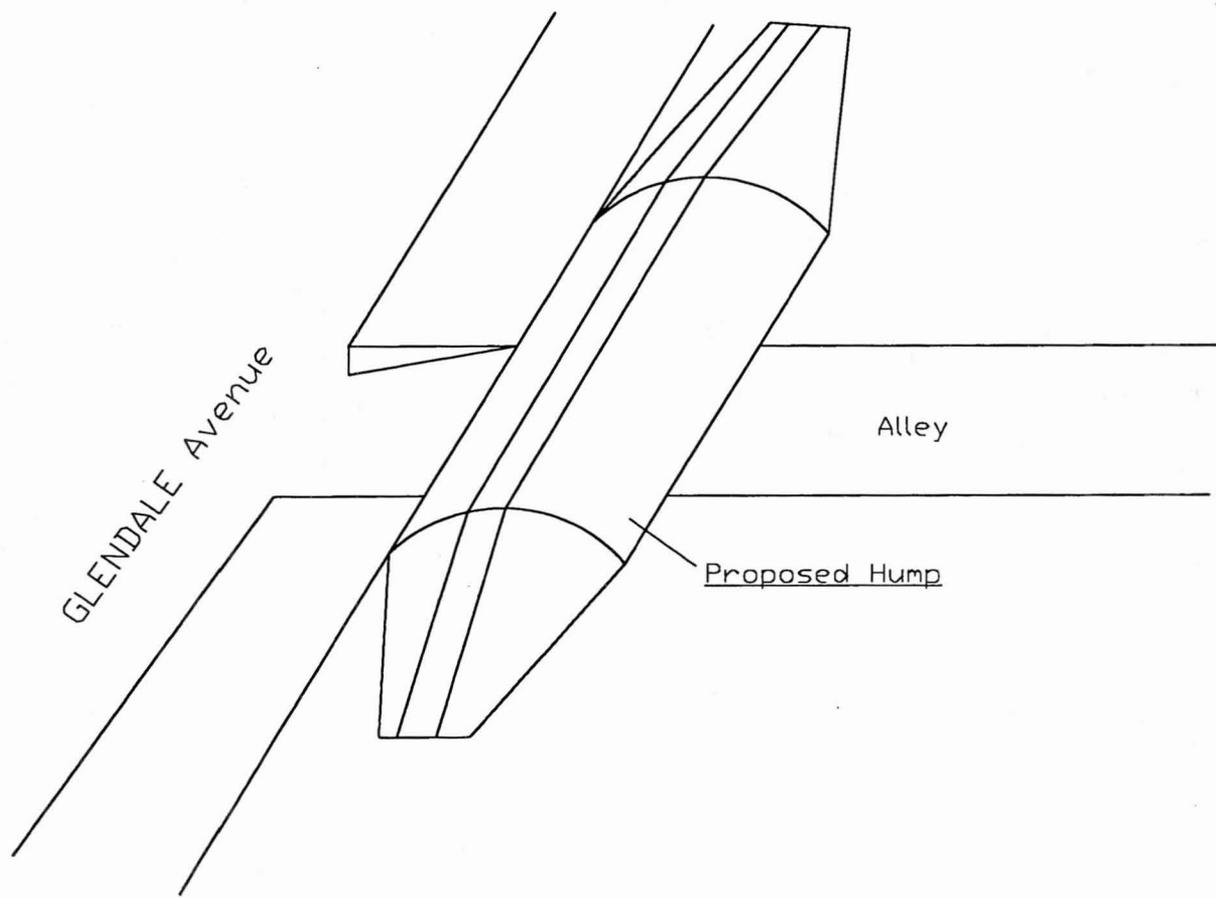
22.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Hump Construction	Lump Sum		\$1,000
<i>Subtotal</i>			\$1,000
<i>20% Contingency</i>			200
<i>Total</i>			\$1,200

Alternatives 2 and 3

These alternatives are not within the scope of this project, so cost estimates are not provided.



23. Site 25 — 525 West Hayward

23.1 Location and Site Description

This site is located at 525 W. Hayward Avenue. It is situated between Northern and Orangewood Avenues, and Central and 7th Avenues. Hayward Avenue extends westerly from a tee-intersection at 5th Avenue and ends at a cul-de-sac. The house is located at the southern portion of the bulb of the cul-de-sac. Site 25 is in Township 2 North, Range 3 East, Section 5 of the Gila and Salt River Base and Meridian (see Site 25 - Vicinity Map, Figure 1).

23.2 Problem Identification

Storm waters generated in 5th Avenue and Hayward Avenue collect in the cul-de-sac in front of 525 W. Hayward Avenue. They drain onto this property through a 4-inch steel pipe located in the curb and pond in the yards. During periods of heavy rainfall, the storm waters threaten to flood the house (see Site 25 - Problem Identification, Figure 2).

23.3 History

No information available.

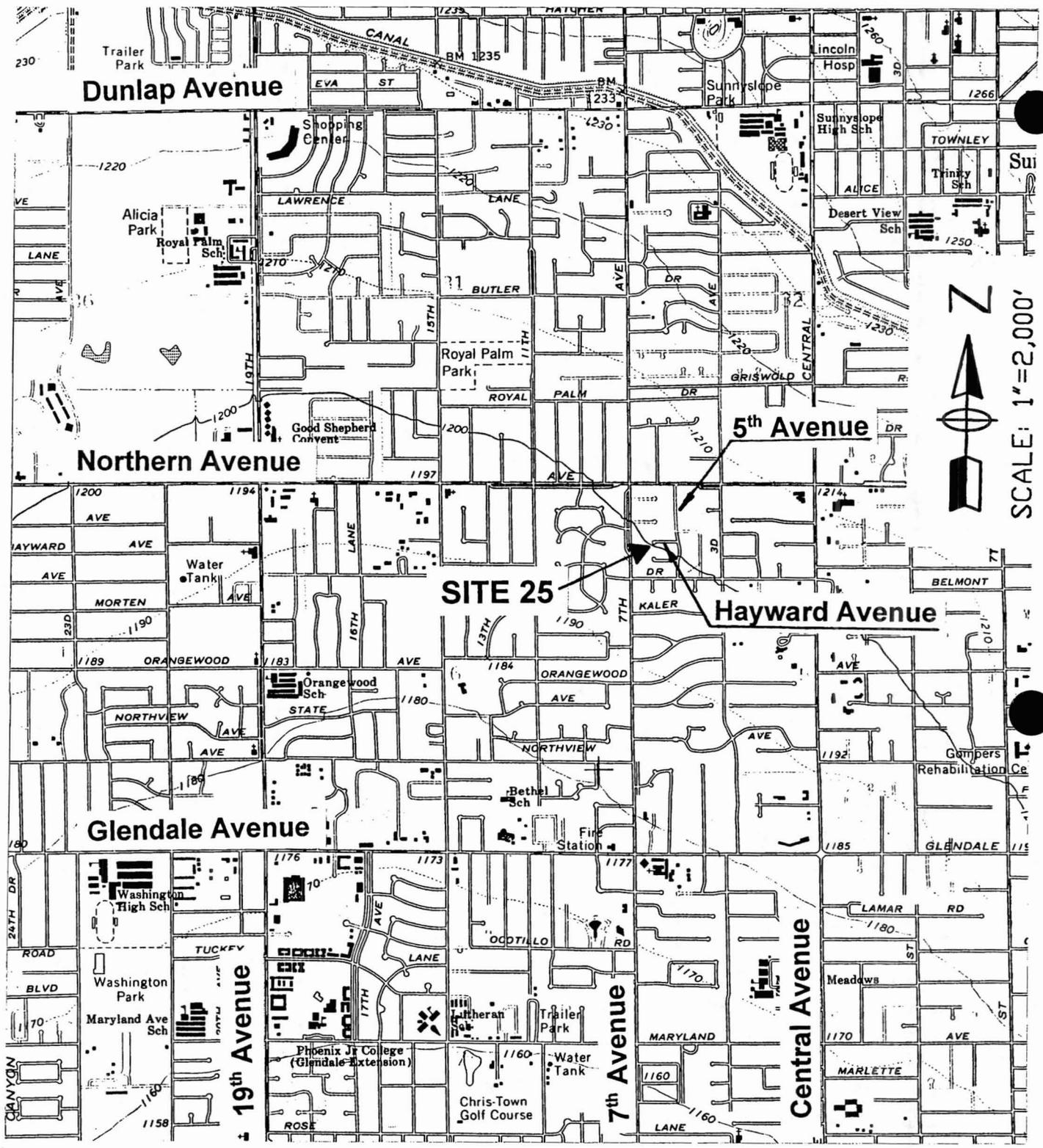
23.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 24-26, Revised 4-22-94; 24-27, Revised 3-27-86; 25-27, Revised 5-25-93.
- City of Phoenix Topographic Quarter Section Map Numbers: 24-27, Flown 5-1-82; 25-27, Flown 5-1-82.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 24-26, Flown 6-12-95; 24-27, Flown 6-12-95; 25-27, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 24-26, Revised 1-18-96; 24-27, Revised 11-22-95; 25-27, Revised 7-27-94.
- City of Phoenix Water Quarter Section Map Numbers: 24-26, Revised 3-28-96; 24-27, Revised 11-7-94; 25-27, Revised 11-15-95.
- City of Phoenix Engineering Storm Drain Maps J7 and J8 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 25, its upstream drainage area, and downstream flow path, Photo Revised 1982.

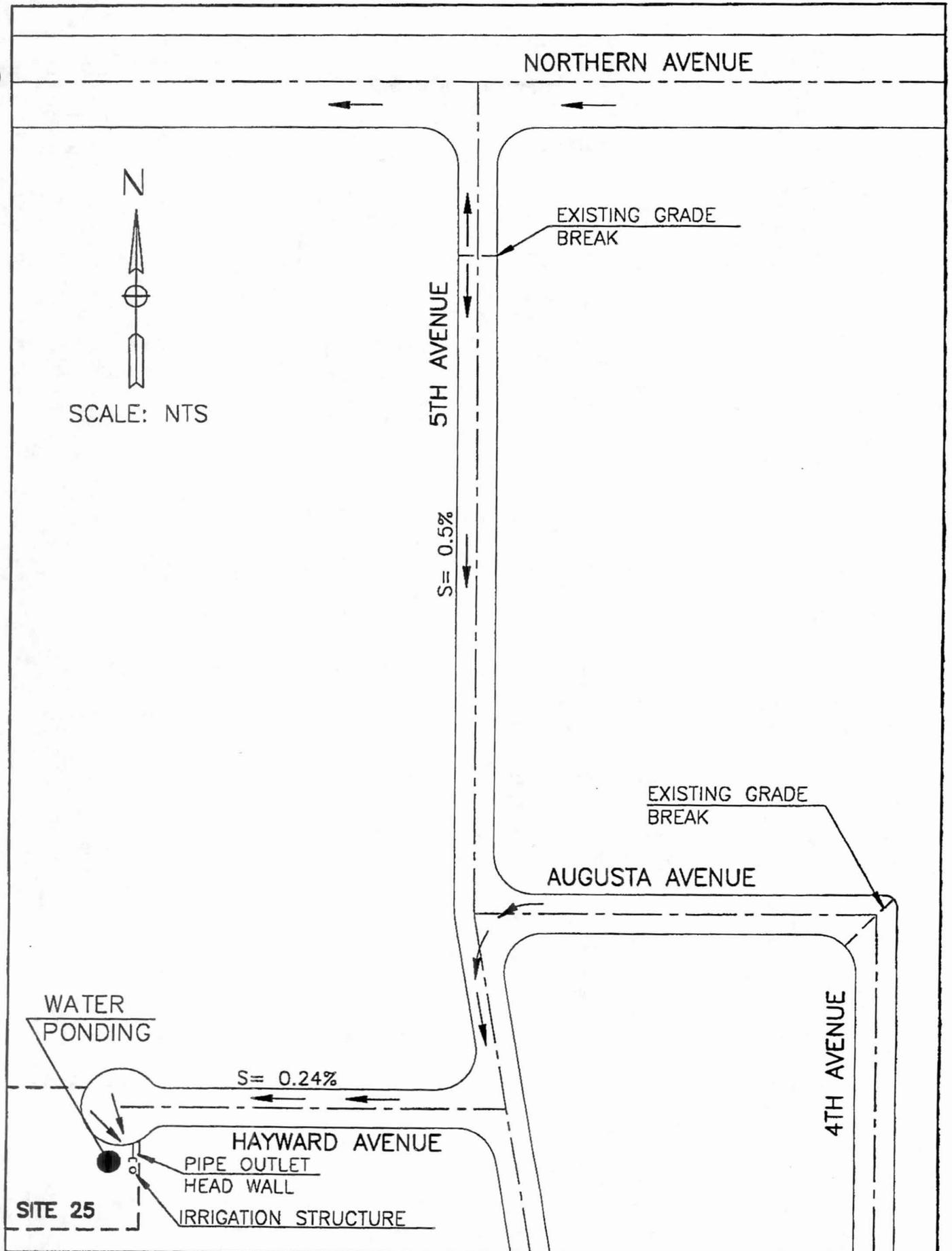
23.5 Hydrology

There are no published discharges for this area of the City. However, the following flow rates were calculated using the Rational Method:



SITE 25 - VICINITY MAP

FIGURE 1



SITE 25 - PROBLEM IDENTIFICATION

FIGURE 2

<i>Location</i>	<i>Frequency</i>	<i>Discharge</i>
Intersection of Hayward Avenue and 5th Avenue	100	6.3
Intersection of Hayward Avenue and 5th Avenue	10	4.3
Intersection of Hayward Avenue and 5th Avenue	2	2.4
Hayward Avenue at the Cul-de-sac (No Flow From 5th Avenue)	100	2.2
Hayward Avenue at the Cul-de-sac (No Flow From 5th Avenue)	10	1.5
Hayward Avenue at the Cul-de-sac (No Flow From 5th Avenue)	2	1.0

Flows that affect this site originate in the northeast. A portion of the flow along 5th Avenue splits at the Hayward Avenue intersection and continues west along Hayward to eventually drain to the property in concern.

23.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

23.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1670E. The area is shown to be in shaded Zone X, which means that no base flood elevation or discharge has been determined.

23.8 Alternative Solutions

Alternative 1 - Drain Pondered Water Through an Irrigation Structure

This alternative involves draining the flood waters which pond on the resident's property through the existing private irrigation inflow/outflow structure. This structure, which is usually screwed tight, is located about 10 feet southwest of the outlet headwall for the existing pipe that directs flows from the cul-de-sac to the property.

Staff from Arizona Department of Environmental Quality (ADEQ) stated that draining surface flows to a private irrigation service are the same as draining to waters of the US and will not violate the National Pollutant Discharge Elimination System statutes.

The City of Phoenix will have to meet with the property owner and representatives from the private irrigation entity to acquire permission to use their structures and system to drain surface runoff.

The name of the private irrigation company and plans for the irrigation piping system were not available. Also, the outlet of the structure is unknown. It is possible that this irrigation structure is at the end of the piping system and will require some modification to the diversion structure so that the valve at this location can also serve as an irrigation return. Further research and study beyond the scope of this project is required to determine if this alternative is feasible.

Alternative 2 - Regrade Hayward Avenue to Drain to the East

Presently, Hayward Avenue is graded to drain from 5th Avenue to the cul-de-sac. This alternative involves regrading Hayward Avenue to drain to the east and contribute its flow to 5th Avenue.

Alternative 3 - Build a Berm at the Intersection of 5th Avenue and Hayward Avenue

This alternative is to construct a 2.5-inch asphalt berm on the west side of 5th Avenue at its intersection with Hayward Avenue to prevent flows from 5th Avenue from contributing to Hayward Avenue. Since all of the properties along Hayward Avenue from 5th Avenue to the cul-de-sac are bermed to provide on-site retention, the only flow that will concentrate at the cul-de-sac will be that generated within the right-of-way. The 100-year discharge is 2.2 cfs. This will reduce the discharge concentrating in the cul-de-sac.

Alternative 4 - Retention Basin in Property Owner's Front Yard

This alternative involves the City working with the property owner to acquire a drainage easement which includes his front yard. Once this easement has been acquired, the area will be depressed sufficiently to hold the flow concentrating in Hayward Avenue at the cul-de-sac. It may be necessary to provide dry wells to ensure drain times are less than 36 hours.

The volume of runoff for the 100-year storm is 0.15 acre-foot. The front yard is approximately 0.12 acre-foot, excluding the driveway. An approximate 1.25-foot depression will be required to retain the runoff.

This alternative will continue to drain public waters onto private property, thereby exposing the City to maintenance and liability issues.

23.9 Recommended Alternative

Flooding may not be a problem at this site. The City has decided that no action shall be taken at this location until flooding is documented based on a complaint from the residents. If a problem is identified in this manner, the City will construct a berm at the intersection of 5th

Avenue and Hayward Avenue (see Site 25 - Preferred Alternative, Figure 3). Construction of a berm will prevent flows from 5th Avenue from contributing to Hayward and, therefore, reduce the discharge concentrating in the cul-de-sac.

The long-term solution is Alternative 2, which will drain the flows away from the cul-de-sac.

23.10 Cost Estimate

Alternative 1

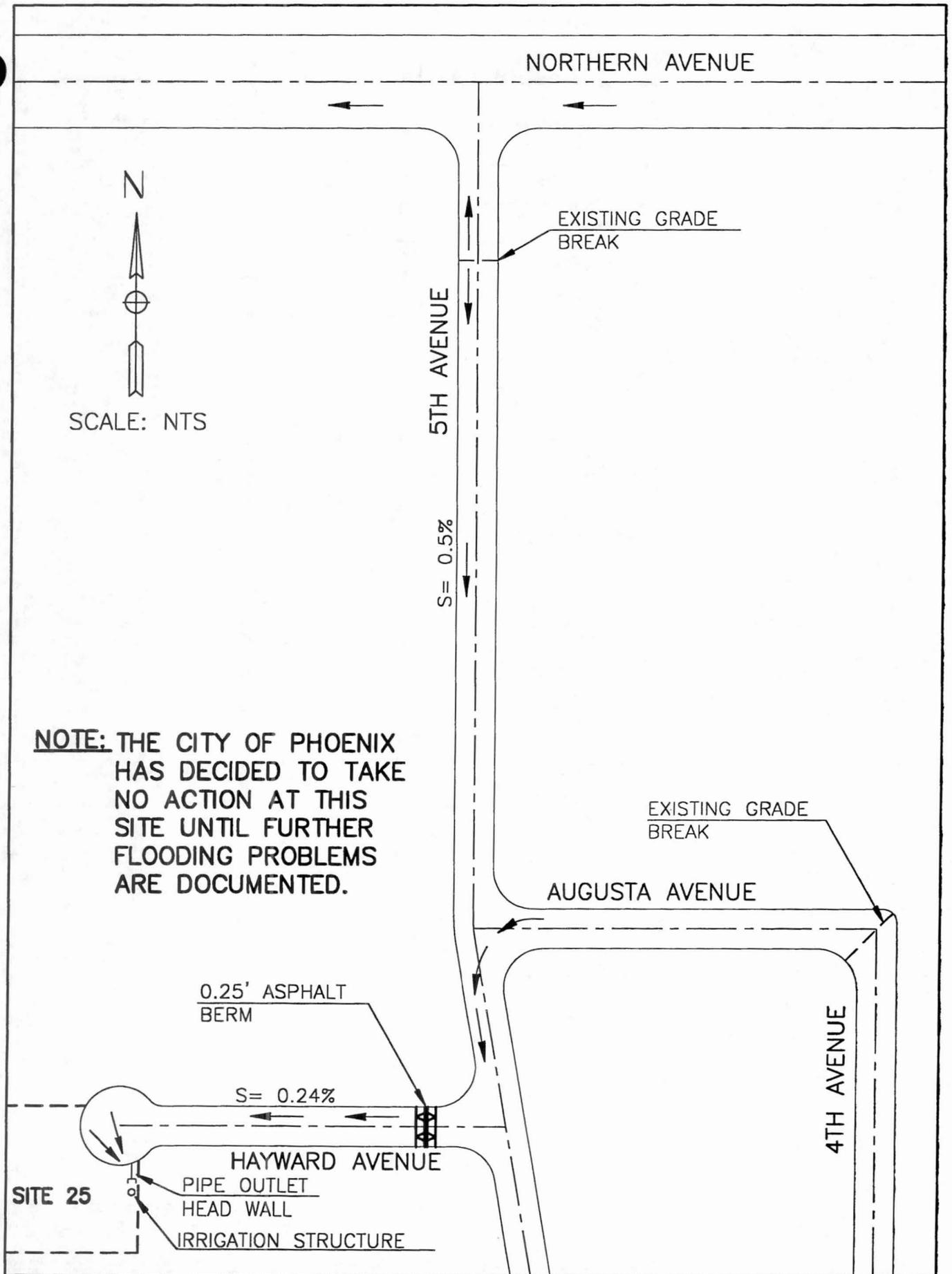
This alternative is not within the scope of this project, so a cost estimate is not provided.

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Roll Curb & Gutter	620 LF	\$2.00/LF	\$ 1,300
Remove Asphalt	820 SY	\$1.80/SY	1,500
Fill	240 YD ³	\$8.00/YD ³	1,900
2" Lift Asphalt	100 Tons	\$60.00/Ton	6,000
6" Lift ABC	160 YD ³	\$21.00/YD ³	3,400
Install 4" Roll Curb & Gutter	620 LF	\$6.00/LF	3,700
Subtotal			\$17,800
20% Contingency			3,600
Total			\$21,400

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
2-1/2" High Asphalt Berm	Lump Sum		\$500
Subtotal			\$500
20% Contingency			100
Total			\$600



NOTE: THE CITY OF PHOENIX HAS DECIDED TO TAKE NO ACTION AT THIS SITE UNTIL FURTHER FLOODING PROBLEMS ARE DOCUMENTED.

SITE 25 - PREFERRED ALTERNATIVE

FIGURE 3

Alternative 4

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Volume of Excavation 1.3' Deep	6,800 YD ³	\$3.00/YD ³	\$20,400
Sod	5,300 SF	\$0.30/SF	1,600
<i>Subtotal</i>			\$22,000
<i>20% Contingency</i>			4,400
<i>Total</i>			\$26,400

24. SITE 26 — 6516 - 6542 North 17th Avenue

24.1 Location

This site is an apartment complex located along the west side of north 17th Avenue, south of Glendale Avenue and north of Maryland Avenue. There is a grass median, bounded by a concrete curb, on 17th Avenue and an alley behind the complex (see Site 26 - Vicinity Map, Figure 1).

24.2 Problem Identification

Flooding of the apartments occurs when water flows from Glendale Avenue to Maryland Avenue along 17th Avenue (see Site 26 - Problem Identification, Figure 2). The water overtops the sidewalk curb on the west side of 17th Avenue and floods several apartments. Water is also believed to flow from the alley behind the complex into the apartments. The finished elevation of the apartments is lower than that of the sidewalk and alley so that water flows into the apartments from both the alley and the street.

24.3 History

The apartment complex experiences flooding to several apartments when water overtops the curb on 17th Avenue. Apartment owners have constructed a berm on the alley side of the complex which prevents flow from 17th Avenue from draining into the alley behind the complex. This berm ponds the water, backing flows into the apartments and storage sheds.

24.4 Site Specific Data Acquisition

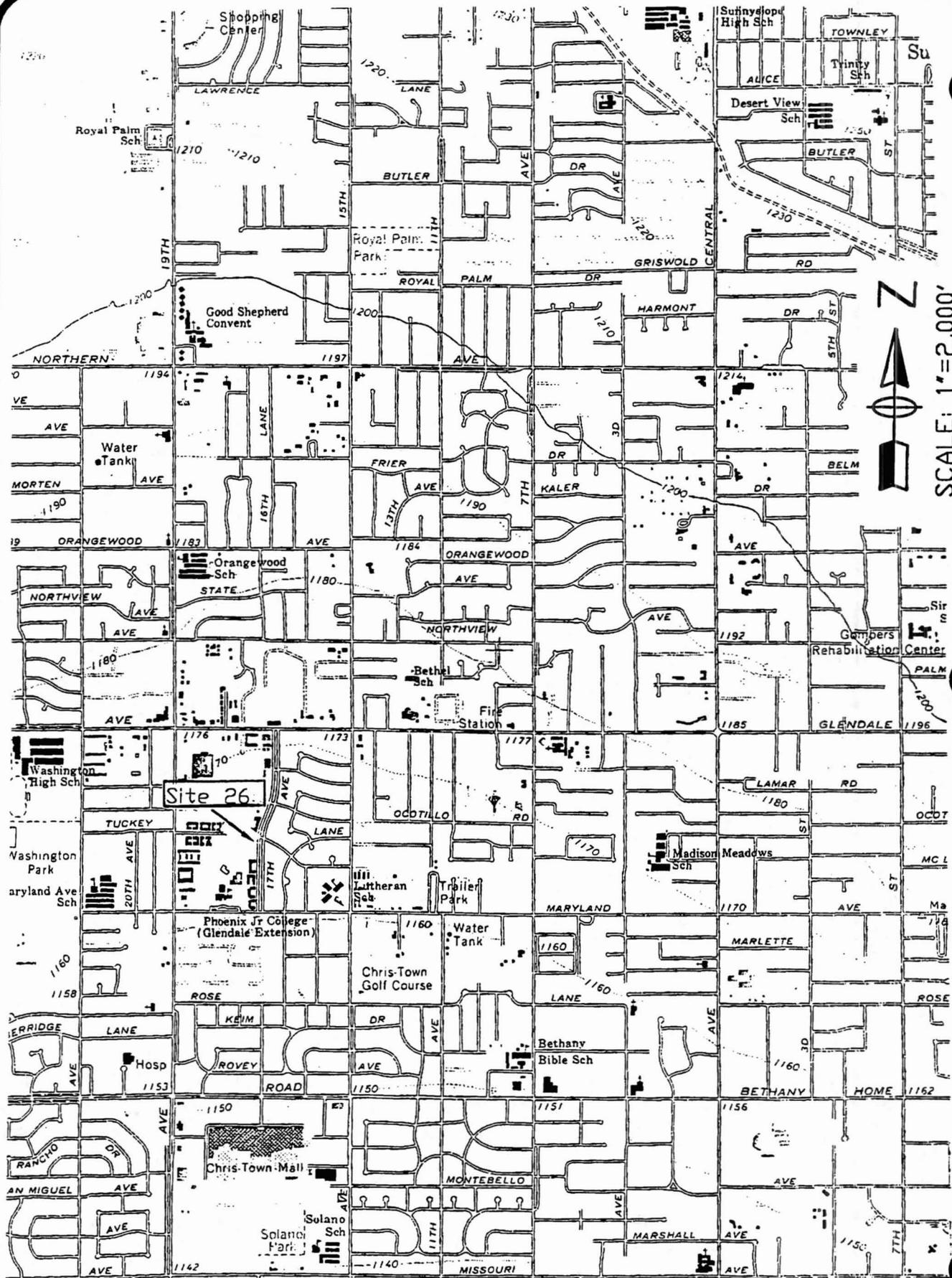
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 26 and its upstream drainage area, Revised 1982.
- City of Phoenix Storm Drain Map I-7.
- City of Phoenix Quarter Section Right-of-Way maps

24.5 Hydrology

The values calculated were determined after several basic assumptions were made. These assumptions were based upon engineering judgement to obtain values to allow an assessment of the proposed alternatives. A detailed hydrologic study will be necessary to implement any of the design options. The assumptions made were:

- That all flow along Glendale Avenue east of 15th Avenue is intercepted at 15th Avenue.
- That 10% of the flow along Glendale Avenue west of 15th Avenue, due to local drainage, is diverted to 17th Avenue.

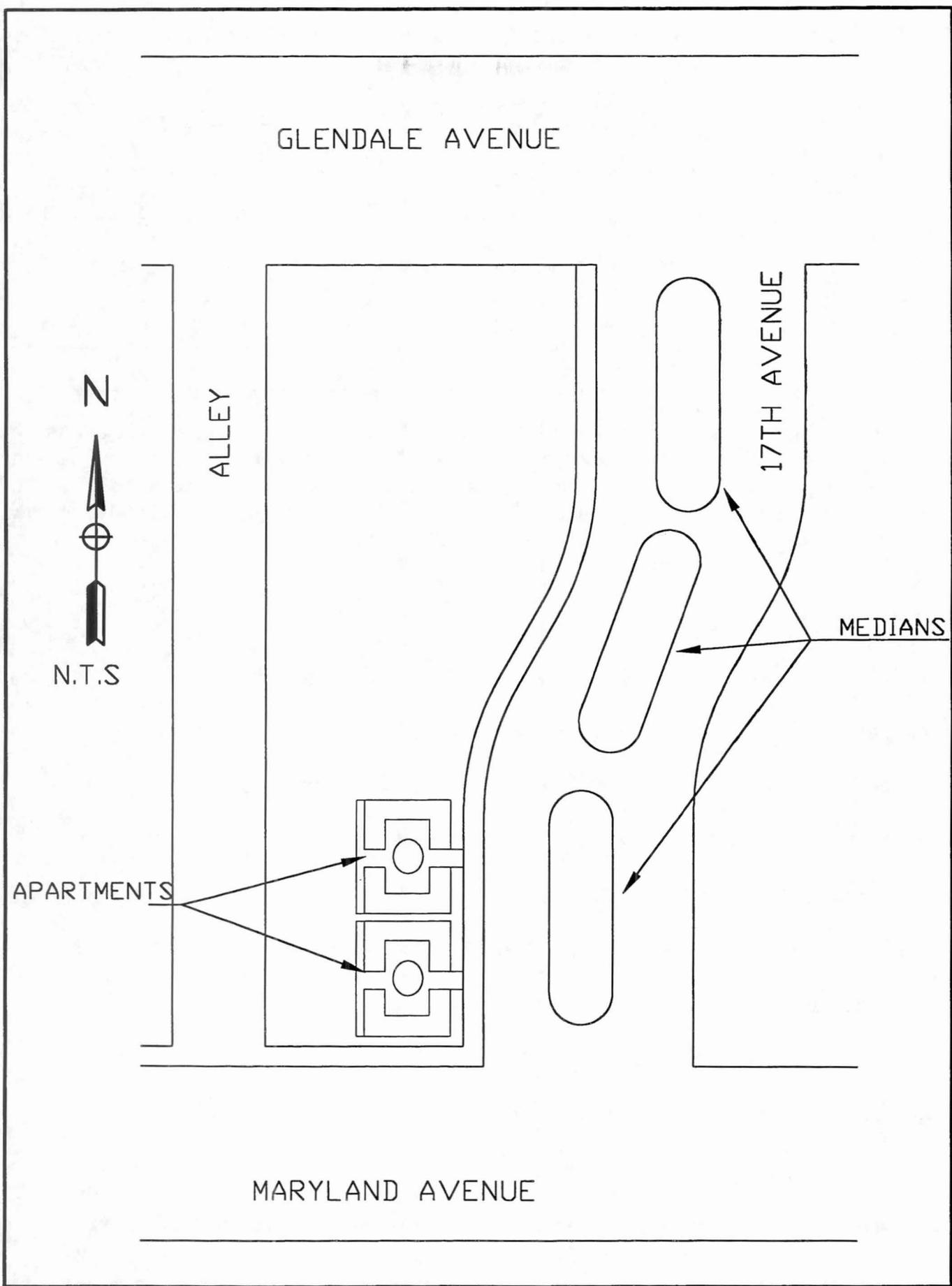


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 SCALE: 1"=2,000'

SITE 26 - VICINITY MAP

FIGURE 1



SITE 26 - PROBLEM IDENTIFICATION

FIGURE 2

The flows for this reach, as calculated by the Rational Method for different design frequencies, are:

<i>Frequency (yr)</i>	<i>Glendale Discharge (cfs)</i>	<i>17th Ave. Discharge (cfs)</i>	<i>Total Discharge (cfs)</i>
100	140	101	115
50	125	90	103
25	112	81	93
10	98	71	80
2	60	45	51

Topography and storm drain design plans were not available to facilitate calculations so topographic assumptions were based on a USGS 7.5-minute quadrangle map. The current street and gutter design, with an assumed grade of 2% and a slope of 1.5%, is estimated to carry 54 cfs without overtopping the sidewalk curb. This is approximately equivalent to the flow from the 2-year storm event. This indicates that flooding will probably occur only for storm events greater than the 2-year event.

24.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no projects planned which will impact this site.

24.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1665G, revised September 30, 1995. The area is designated as Zone X, which denotes areas outside the 500-year floodplain.

24.8 Alternative Solutions

Alternative 1 - Creation of a Detention Basin in the 17th Avenue Medians

This alternative proposes to create a detention basin in the median on 17th Avenue to store flood waters until they can be normally dissipated without overtopping the west curb. Pipes will be placed into the curbs to allow water to pass into the basins. The medians will be excavated

to create the needed capacity. The capacity of the basin required to hold the flows which exceed the gutter capacity, up to the 100-year storm event, is estimated to be 5.1 acre- feet. This calculation is based upon an assumed storm duration of 1 hour.

The City of Phoenix does not have topographic maps available for this area and City of Phoenix right-of-way maps do not show the 17th Avenue medians. Therefore, the extent of excavation required to create the detention basins will require further study before this alternative can be implemented.

Alternative 2 - Construct a New Storm Drain Beneath 17th Avenue

This alternative proposes to construct a storm drain and inlets along 17th Avenue to carry flow to the existing storm drain in Maryland Avenue. An inlet constructed per MAG Standard Detail #530, Type B, will intercept 7 cfs. This will require 7 inlets along 17th Avenue to intercept the flow from the 50-year storm event which is not carried by the street gutter and overtops the sidewalk curb. It is estimated that a 60-inch storm drain will be required to carry this flow to existing storm drain on Maryland Avenue.

Due to a lack of supporting information, a detailed study of the site will be required, including the size and capacity of the Maryland Avenue storm drain, prior to implementation of this alternative.

Alternative 3 - Create a Diversionary Flow Path Around the Apartments

This alternative proposes to create a diversionary flow path through the apartment complex to carry the water to the alley behind the complex which shall be regraded to direct the flow to Maryland Avenue. The recommended channel shape to convey 15 cfs around the buildings is a trapezoid with a 1:2 side slope, base width of 3 feet, and flow depth of 9 inches. The channel slope shall be 0.3%. When the channel reaches the paved parking area, it shall transition to a channel with a 6-foot base width and a flow depth of 3 inches. This shall allow traffic to drive over the channel if necessary. The design capacity of the channel is limited by the area available to build a channel without obliterating private landscaping or creating a safety hazard.

24.9 Recommended Alternative

Due to the complexity of this problem as well as to the lack of supporting information, there is no recommended alternative made to address this flooding problem. Therefore, the solution to the problem is beyond the scope of this project. The alternatives presented are meant to provide direction for further study. The City of Phoenix has indicated that they will coordinate with the Flood Control District of Maricopa County to try to incorporate this site into the Metro ADMS.

24.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	8,240 YD ³	\$2.00/YD ³	\$ 16,500
Curb and Pipe Work	7,500 LF	\$5.00/LF	37,500
Reseed Median Vegetation	12,500 YD ²	\$2.00/YD ²	25,000
Headwall	1 Each	\$1,200/Each	1,200
<i>Subtotal</i>			\$80,200
<i>20% Contingency</i>			16,000
<i>Total</i>			\$96,200

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Grading	18,000 SF	\$1.00/SF	\$18,000
Asphalt Paving	438 Tons	\$32.00/Tons	14,000
Concrete Channel	600 LF	\$5.00/LF	3,000
<i>Subtotal</i>			\$35,000
<i>20% Contingency</i>			7,000
<i>Total</i>			\$42,000

25. SITE 27 — 23rd Avenue, Dunlap - Northern Avenue

25.1 Location and Site Description

This site is the storm drain system beneath 23rd Avenue which runs between Dunlap and Northern Avenues (see Site 27 - Vicinity Map, Figure 1).

25.2 Problem Identification

Pressure build-up occurs when a high volume of water, which exceeds capacity, enters the system. The resulting pressure build-up causes the manhole lids in the center of 23rd Avenue to pop off their bases. This may result from either too much water entering through the inlets above Dunlap, or from too much water already being carried by the mainline on Northern. If the Northern mainline is already at capacity, then water will back up in the 23rd Avenue storm pipes (see Site 27 - Problem Identification, Figure 2).

25.3 History

The manhole lids for the storm drain system pop off their bases, presenting a serious safety concern. City crews have tried different methods to relieve the problem without success. The first solution attempted was to bolt the solid manhole lids to their bases, which resulted in the entire manhole being lifted above the adjacent asphalt. The slotted lids were then replaced with solid lids and each was bolted to their base. The entire manhole system was again lifted above the adjacent asphalt. Baffles have also been installed to reduce the velocity in the storm drain system.

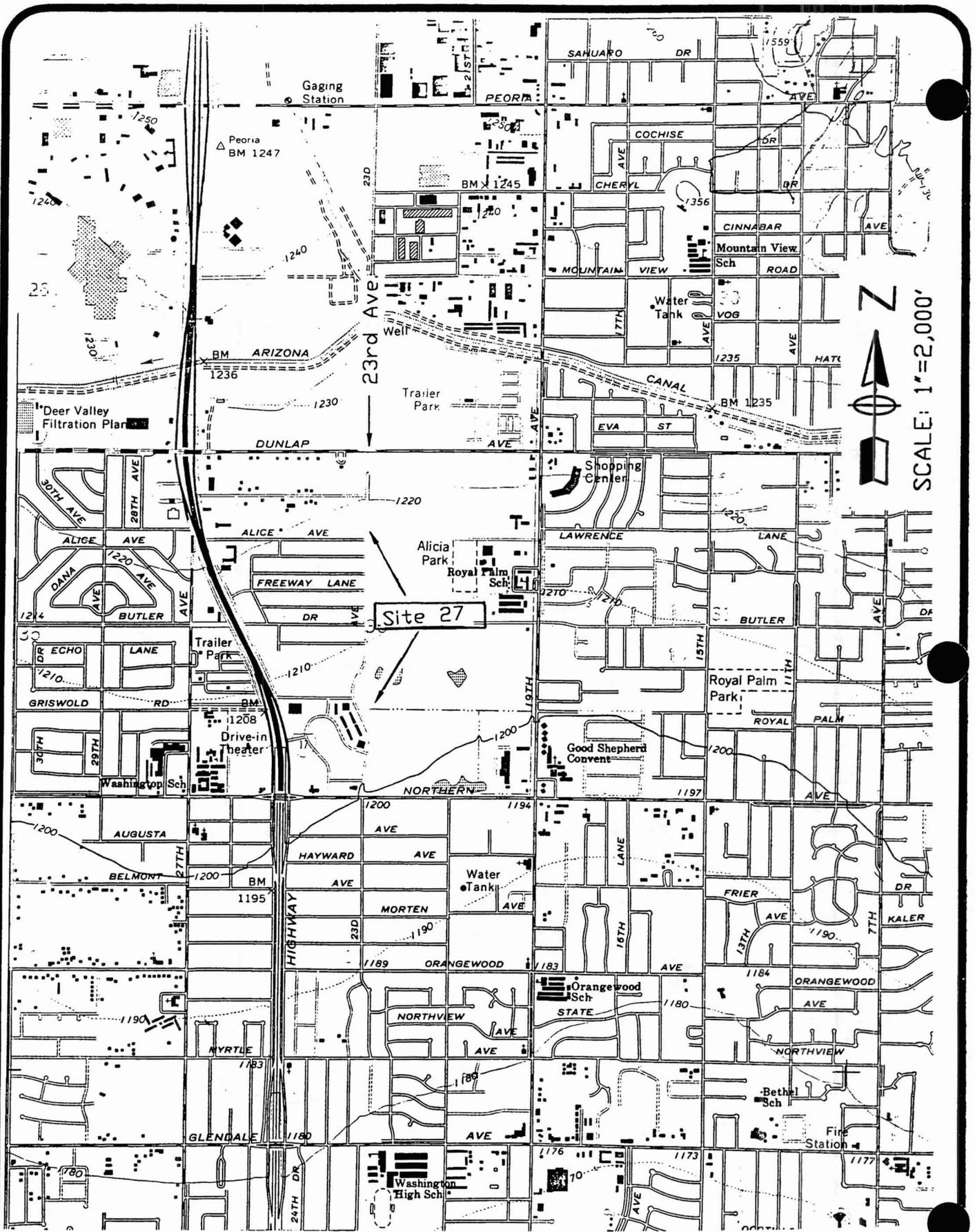
25.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 27 and its upstream drainage area, Revised 1982.
- City of Phoenix Storm Drain Map Section J-7.
- City of Phoenix Engineering Department Storm Sewer As-builts, Project No. ST-74205.05.

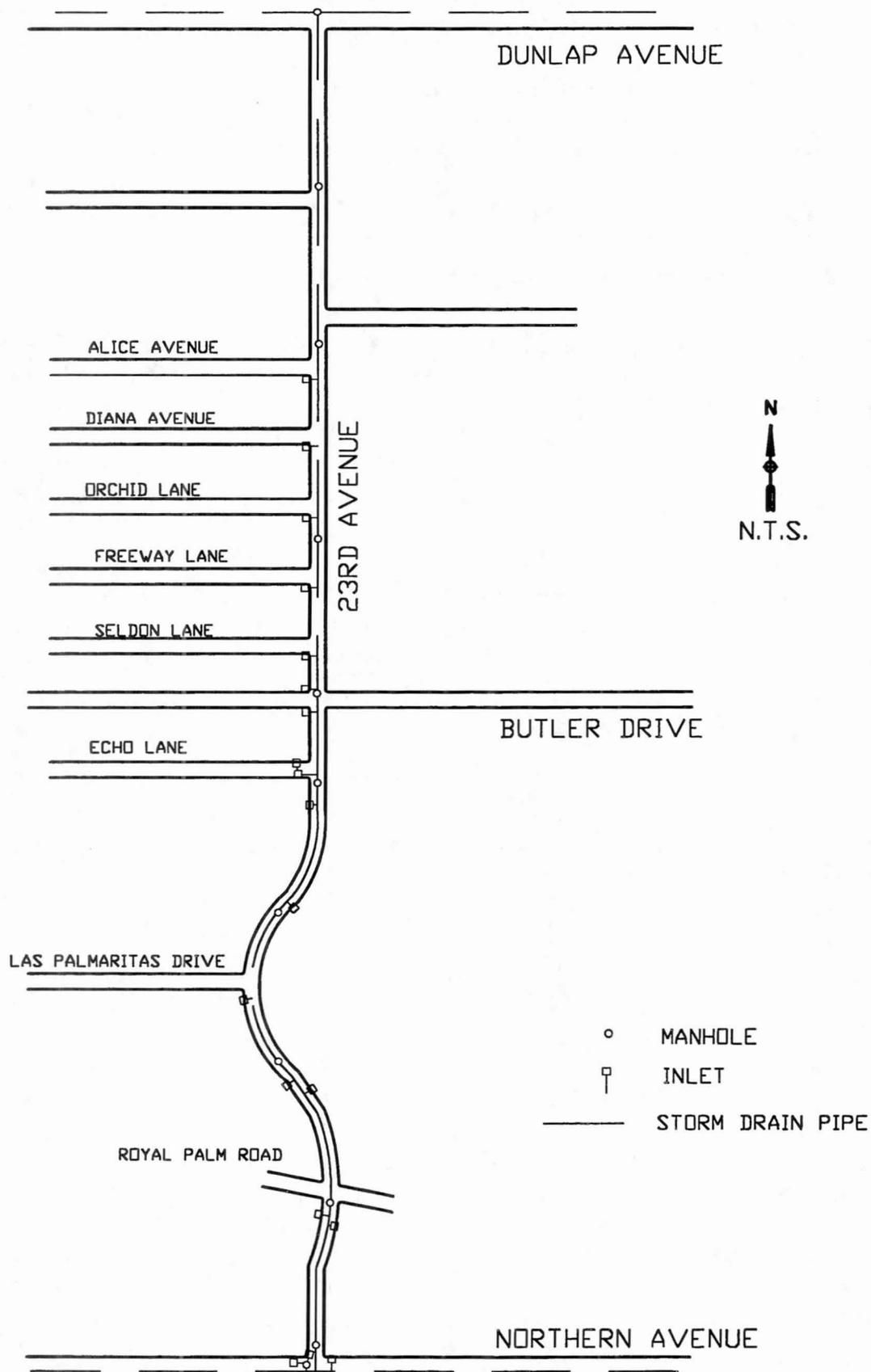
25.5 Hydrology

No hydrologic analysis was performed for this site. The nature and severity of the problem require that an in-depth analysis of all contributing drainage areas and storm drain systems be performed which is beyond the scope of this project.



SITE 27 - VICINTY MAP

FIGURE 1



SITE 27 - PROBLEM IDENTIFICATION

FIGURE 2

25.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no projects planned which will impact this site.

25.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C-1665G, and -1655G, revised September 30, 1995. The area is designated as shaded Zone X, which denotes areas within the 500-year floodplain.

25.8 Alternative Solutions

Alternative 1

Install a parallel system to the existing line.

Alternative 2

Reduce the upstream inlet capacity.

Alternative 3

Install pressure release lines which can drain the system into an alternate flow channel or detention basin.

Alternative 4

Attach slotted manhole covers and frame to the concrete manhole shaft with high strength, galvanized bolts.

25.9 Recommended Alternative

While Alternative 4 is the preferred alternative by the City of Phoenix, all of the discussed alternatives are beyond the scope of work for this project. It is recommended that a detailed study be made of the entire system to determine exactly where all contributing problem areas exist. This should include sizing all inlets which feed the system to determine their capacity. After the system parameters are known, then a possible implementation of an alternative may be discussed. The City has indicated that they will coordinate with the Flood Control District of Maricopa County for incorporation of this site into the Metro ADMS.

26. Site 28 — 10th Street Wash and El Caminito Drive

26.1 Location and Site Description

This site extends along El Caminito Drive from the 10th Street Wash east to 12th Street. The area has been developed as residential; however, the area also contains low lying hills. It is located between Butler Drive and Northern Avenue, and between 7th Street and 12th Street in Township 3 North, Range 3 East, Section 33 of the Gila and Salt River Base and Meridian (see Site 28 - Vicinity Map, Figure 1).

In 1986, Harza Engineering Company designed a storm drain system to function as a syphon. The system terminates at the bottom of a manhole located at the east bank of the 10th Street Wash and El Caminito Drive.

26.2 Problem Identification

Residents complain of mosquitos and odors generated by stagnant water which has collected in the storm drain located in El Caminito Drive. The City has recently installed a submersible pump in an existing manhole which was designed to automatically sense standing water and pump it into the 10th Street Wash (see Site 28 - Problem Identification, Figure 2).

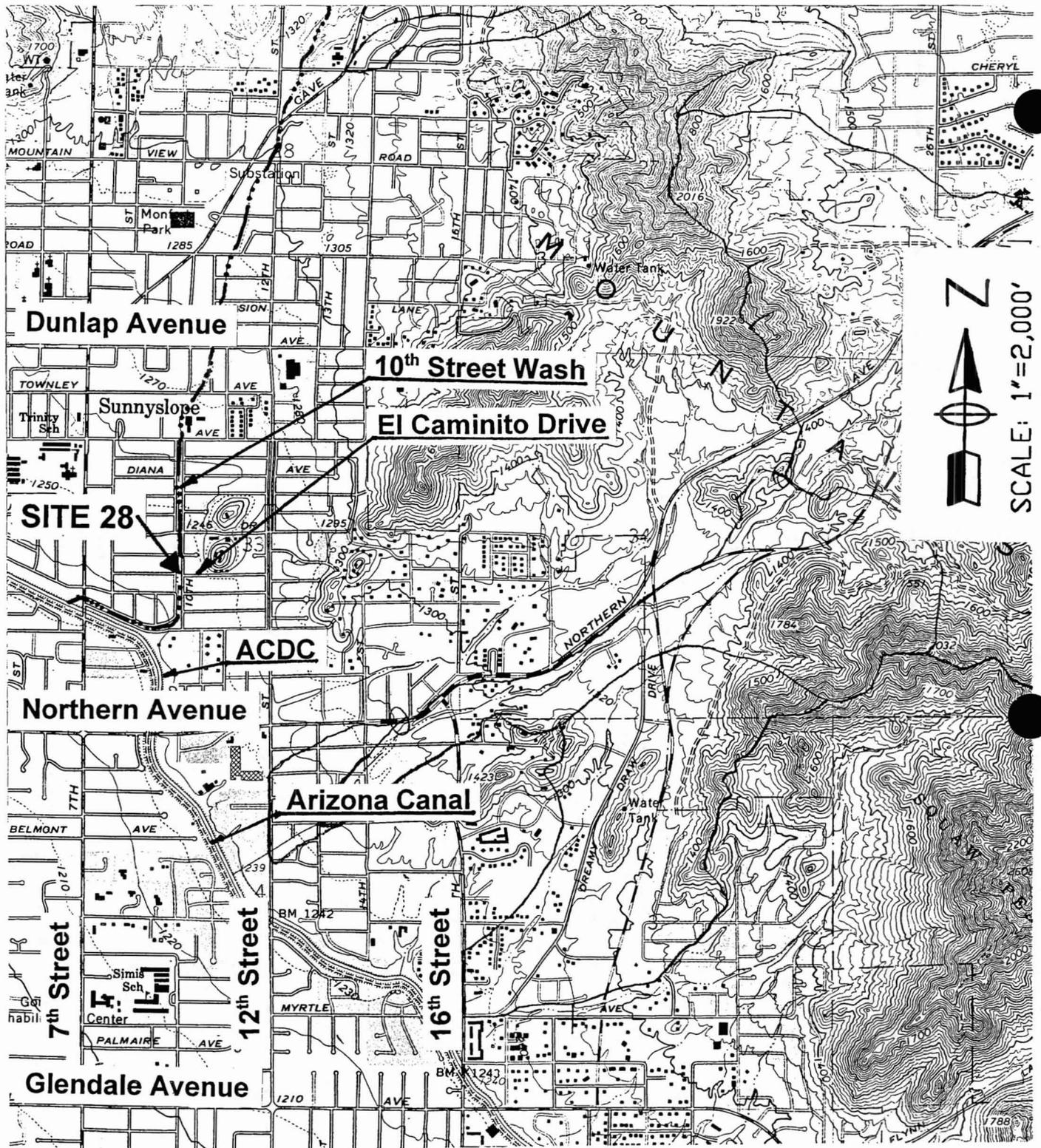
26.3 History

The existing storm drain in El Caminito Drive was designed by Harza Engineering Company for the City of Phoenix in March 1986 (Contract Number 39981, Index Number ST-853614). The line terminates at the 10th Street Wash and extends east in El Caminito Drive. Three lateral lines branch off the trunk line. The first lateral branches off to the north in El Caminito Drive approximately 280 feet west of 12th Street. This lateral is approximately 270 feet in length and ends in the cul-de-sac of Echo Lane on the west side of 12th Street. The second and third laterals split north and south at a junction structure located at the intersection of 12th Street and El Caminito Drive. The lateral extending to the north in 12th Street is approximately 600 feet in length. It terminates at Butler Drive with catch basins located on all four corners of the intersection. The southern lateral, which is approximately 430 feet in length, terminates at the southeast corner of 12th Street and El Camino Drive with a catch basin.

The trunk line terminates with a 66-inch concrete pipe at the downstream end at the 10th Street Wash in the bottom of a manhole. The invert of this pipe is approximately 10 feet below the top of the 10th Street Wash bank. The City installed a manually operated submersible pump, which was salvaged from another site, in the bottom of the manhole. Recently, the City constructed a remote, automatic switching system for pump operation.

26.4 Site Specific Data Acquisition

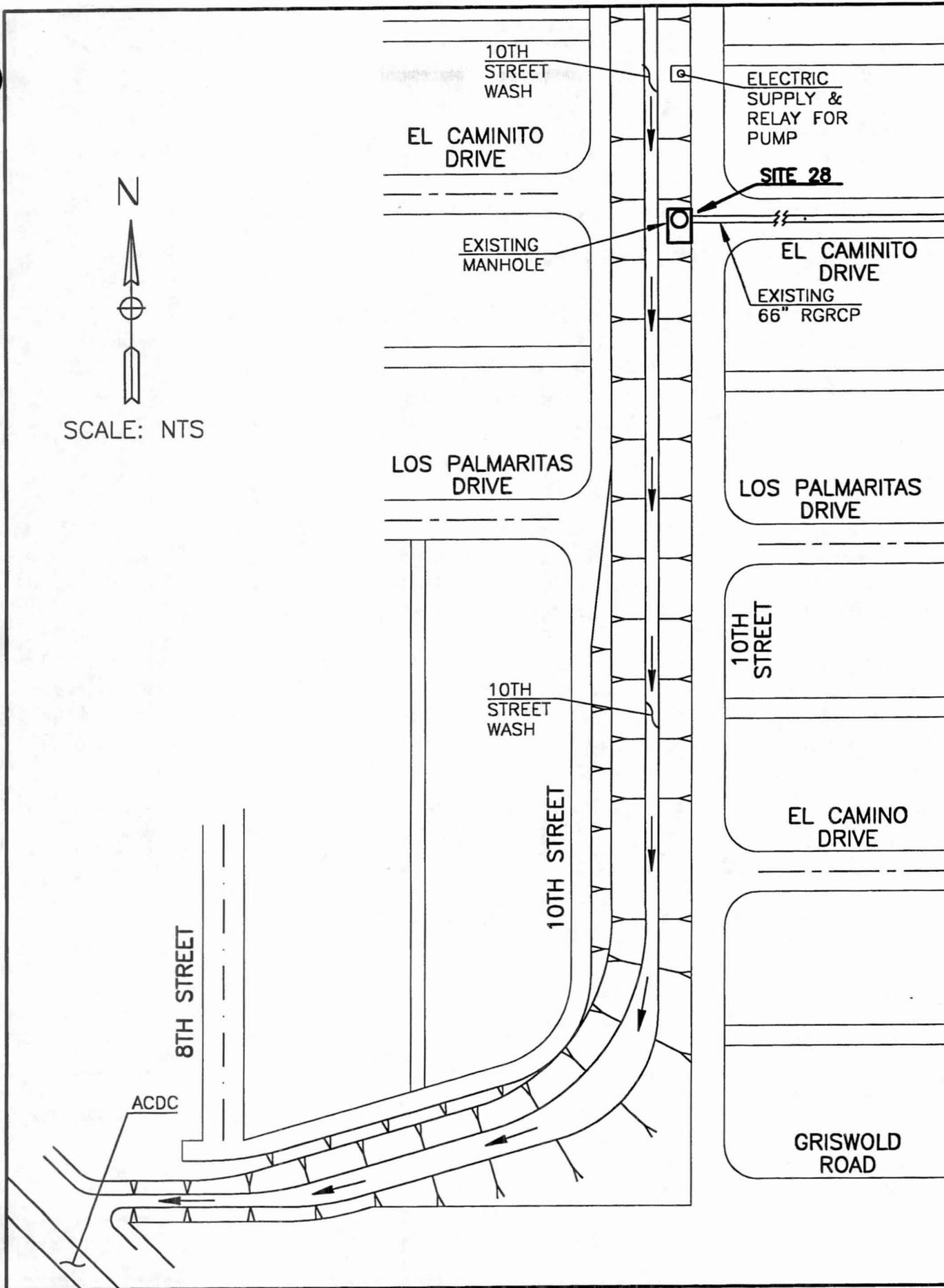
The following documentation was acquired from various sources for evaluating this site:



SCALE: 1"=2,000'

SITES 28 - VICINTY MAP

FIGURE 1



SITE 28 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 25-29, Revised 8-4-95; 25-30, Revised 7-30-93.
- City of Phoenix Topographic Quarter Section Map Numbers: 25-29, Flown 10-24-67; 25-30, Flown 10-24-67.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 25-29, Flown 6-12-95; 25-30, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 25-29, Revised 7-21-94; 25-30, Revised 7-24-95.
- City of Phoenix Water Quarter Section Map Numbers: 25-29, Revised 12-14-95; 25-30, Revised 12-16-95.
- City of Phoenix Engineering Storm Drain Maps J8 and J9 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 28, its upstream drainage area, and downstream flow path, Photo Revised 1982.
- El Caminito Storm Sewer Report Hydrologic Analysis for the City of Phoenix Engineering Department, Contract Number 39981, Index Number ST-853614, March 1986.

26.5 Hydrology

Flood waters intercepted by the storm drain system originate from the northeast in a mountainous area. The storm drain system was designed to intercept the 10-year, 24-hour storm. The total contributing drainage area is 104 acres and the discharge is 137 cfs, as calculated by the Soil Conservation Service hydrologic computer program TR-20.

The 100-year discharge for the 10th Street Wash at El Caminito Drive, as taken from the 10th Street Wash Feasibility Study prepared for the FCDMC by DMJM dated August 1, 1995, Contract FCD 93-23, is 1,548 cfs after Detention Basin A had been constructed. The following table documents frequency, discharge values, runoff volumes, and flow depths and velocities in the 10th Street Wash at this location:

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>	<i>10th Street Wash Flow Depth (ft)</i>	<i>10th Street Wash Flow Velocity (fps)</i>
100	1,548	580	6.20*	5.35
50	1,320	512	5.73*	5.13
25	1,010	448	5.00*	4.76
10	700	363	4.14*	4.29
2	310	207	2.68	3.38

* Flow depth overtops the east bank of the 10th Street Wash (east bank is lower in elevation than the west bank).

26.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

26.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1670E. The area is shown to be in shaded Zone X and Zone AE. Base flood elevation and discharge have not been determined for the area that is shaded Zone X. The area that is Zone AE is the 10th Street Wash for which base flood elevation and discharge have been determined. The 100-year water surface elevation is 1243.7 at the 10th Street Wash and El Caminito Drive. The nearest documented discharge location for the 10th Street Wash is at Griswold Road and is 2.69 square miles. The following table presents the discharges as computed for the FIS for the 10th Street Wash at Griswold Road, located approximately 450 feet south of the 10th Street Wash and El Caminito Drive:

<i>Frequency (yr)</i>	<i>Discharge* (cfs)</i>	<i>10th Street Wash Flow Depth (ft)</i>	<i>10th Street Wash Flow Velocity (fps)</i>
500	12,000	-	-
100	4,740	10.6**	4.70
10	1,265	5.61**	5.07

* These values do not consider Detention Basin A. Refer to Section 2.5, Hydrology.

** Flow depth overtops east bank of the 10th Street Wash (east bank is lower in elevation than the west bank).

26.8 Alternative Solutions

Alternative 1 - Replace Existing Submersible Pump

This alternative consists of replacement of the existing submersible pump with a new one equipped to handle the same flow rate as the existing.

Alternative 2 - Install an Additional Submersible Pump

This alternative involves installation of an additional submersible pump in the manhole which is designed to pump the total flow retained in the storm drain. The existing pump will be used as a back-up in the event of pump failure or during maintenance on the new pump.

Alternative 3 - Extend the Existing Storm Drain to the South to Daylight

This alternative involves extending the 66-inch RGRCP 1,280 feet from the manhole at the east bank of the 10th Street Wash to the ACDC. This includes 86 feet of 88-degree prefabricated bend having a minimum radius of 55 feet, and three manholes spaced every 660 feet at a slope of 0.3%. This will also require penetration of the wall of the ACDC.

The tie-down for this option is beyond the scope of work. The presented alternative is a conceptual design and requires a more detailed analysis.

26.9 Recommended Alternative

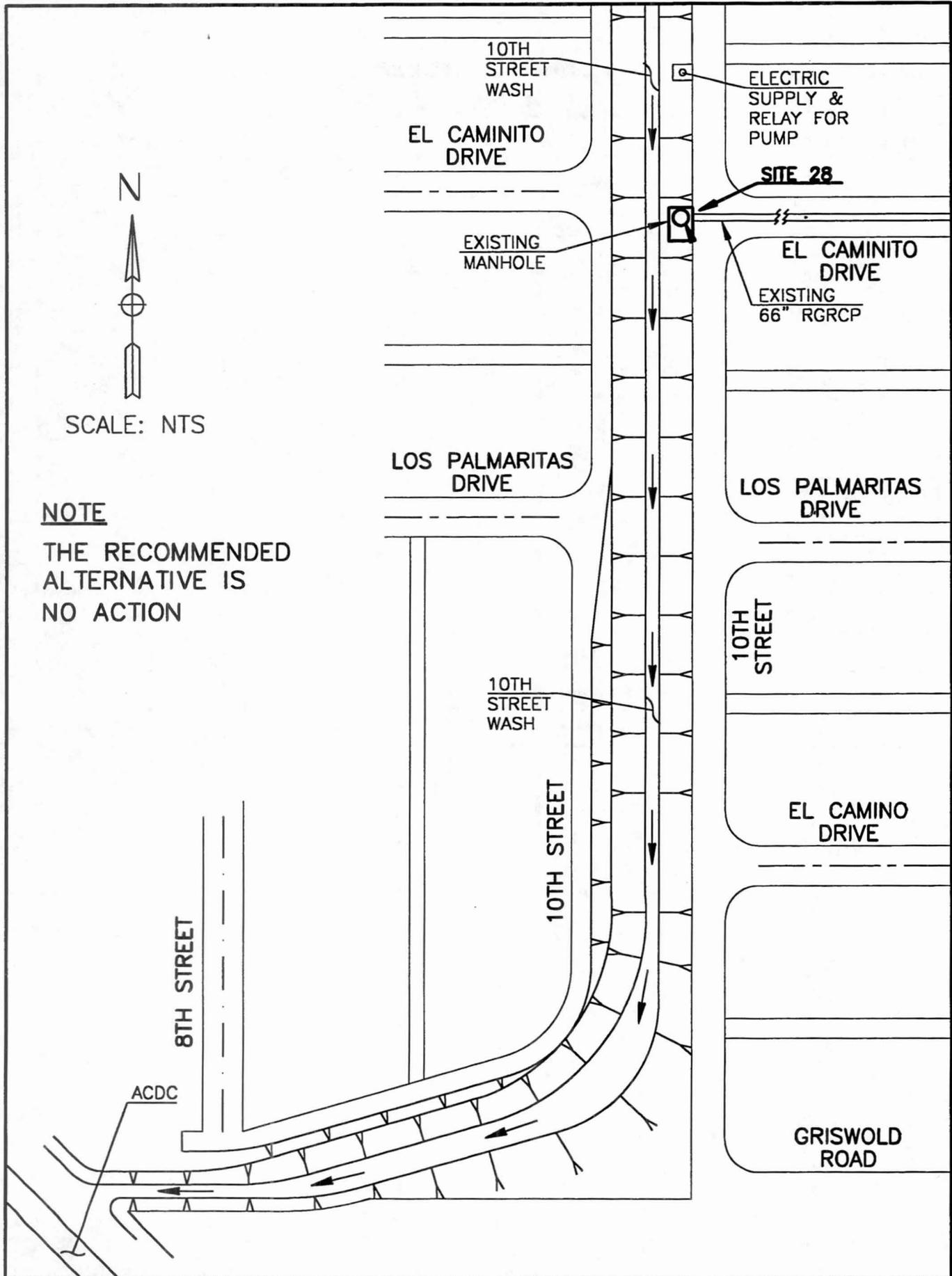
City of Phoenix crews have indicated that there is no problem with the existing pump at this site and, therefore, the recommended alternative is no action (see Site 28 - Preferred Alternative, Figure 3).

26.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Existing Pump	Lump Sum	—	\$1,000
Install New Pump	Lump Sum	—	7,000*
<i>Subtotal</i>			\$8,000
<i>20% Contingency</i>			1,600
<i>Total</i>			\$9,600

*Amount to be confirmed.



SITE 28 - PREFERRED ALTERNATIVE

FIGURE 3

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Install New Pump	Lump Sum	—	\$7,000
<i>Subtotal</i>			\$7,000
<i>20% Contingency</i>			1,400
<i>Total</i>			\$8,400

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	7,017 Yd ³	\$3.00/Yd ³	\$21,100
Fill	5,444 Yd ³	\$8.00/Yd ³	43,600
66-Inch RGRCP	1,194 LF	\$232.00/LF	277,000
66-Inch Prefabricated Bend	Lump Sum		80,200
City of Phoenix Manhole	3 Each	\$2,300/Each	6,900
Penetrate Wall of ACDC	42 LF	\$500.00/LF	21,000
<i>Subtotal</i>			\$449,800
<i>20% Contingency</i>			90,000
<i>Total</i>			\$539,800

**27. Site 29 — 11th Place South of Griswold Road
Site 30 — 11th Place South of Harmont Drive**

27.1 Location and Site Description

Site 29 is located approximately 200 feet south of Griswold Road in 11th Place, in front of the third house south of Griswold Road on the west side. Site 30 is located approximately 180 feet south of Harmont Drive in 11th Place, in front of the third house south of Harmont Drive on the west side of the drive. Site 30 is approximately 670 feet south of Site 29. Both sites are located between Butler Drive and Northern Avenue. The ACDC is west of these sites, and the Squaw Peak Parkway is located to the east. Both sites have been developed as medium density residential. The sites are in Township 3 North, Range 3 East, Section 33 of the Gila and Salt River Base and Meridian (see Sites 29 & 30 - Vicinity Map, Figure 1).

27.2 Problem Identification

Site 29

Water ponds in 11th Place approximately 200 feet south of Griswold Road (see Sites 29 & 30 - Problem Identification, Figure 2).

Site 30

Water Ponds in 11th Place approximately 180 feet south of Harmont Drive (see Sites 29 & 30 - Problem Identification, Figure 2).

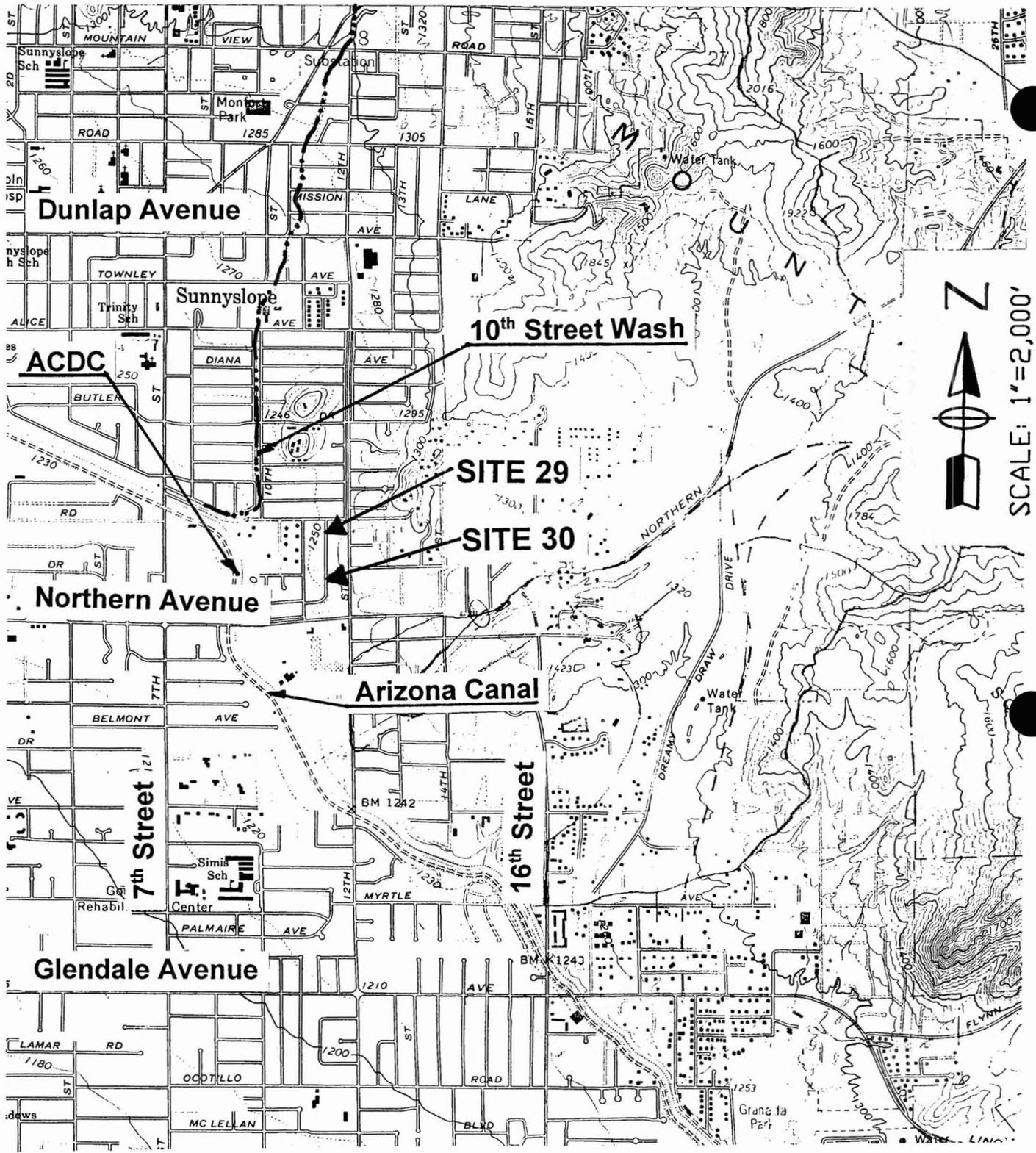
27.3 History

No information available.

27.4 Site Specific Data Acquisition

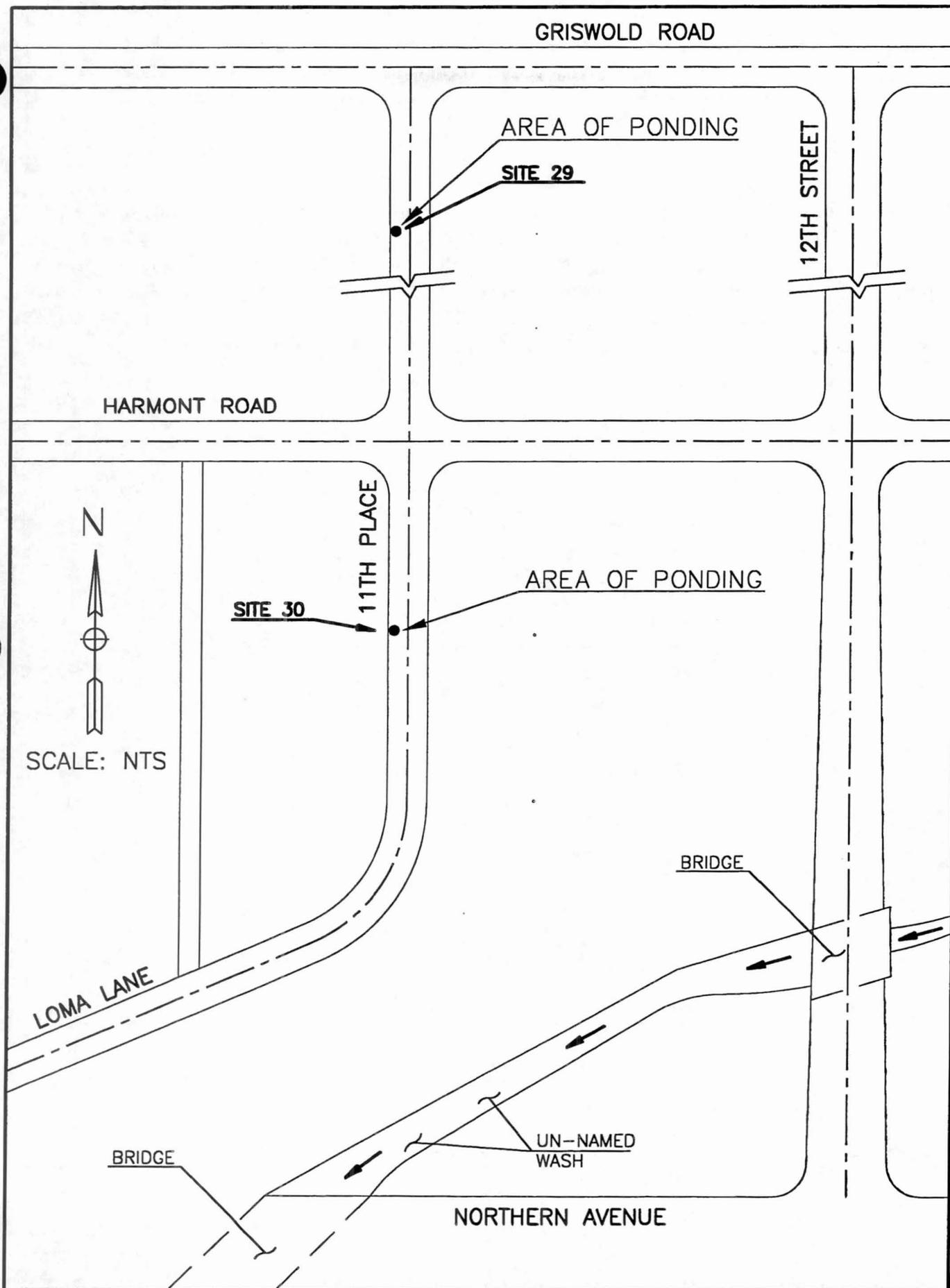
The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 25-29, Revised 8-4-95; 25-30, Revised 7-30-93.
- City of Phoenix Topographic Quarter Section Map Numbers: 25-29, Flown 10-24-67; 25-30, Flown 10-24-67.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 25-29, Flown 6-12-95; 25-30, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 25-29, Revised 7-21-94; 25-30, Revised 7-24-95.
- City of Phoenix Water Quarter Section Map Numbers: 25-29, Revised 12-14-95; 25-30, Revised 12-16-95.



SITES 29 & 30 - VICINITY MAP

FIGURE 1



SITE 29 & 30 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Engineering Storm Drain Maps J8 and J9 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Sites 29 and 30, their upstream drainage area, and downstream flow path, Photo Revised 1982.

27.5 Hydrology

These two sites are located in what appears to have been two separate and distinct wash paths that flowed from northeast to southwest. These paths have been eliminated due to urbanization. All that remain of these washes in this area of the City are two low points in 11th Place. Currently, the contributing drainage areas involve the houses immediately around the low point. Following all rainfall, water ponds in 11th Place at these two locations. The following tables list the hydrologic values for both sites, computed by the rational method:

Site 29

The drainage area is 2.9 acres.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>
100	7.3	0.98
50	6.5	0.86
25	6.3	0.75
10	5.1	0.61
2	3.1	0.35

Site 30

The drainage area is 1.7 acres.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>
100	4.3	0.57
50	3.8	0.51
25	3.7	0.44
10	3.0	0.36
2	1.8	0.20

27.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

27.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1670E. The area is shown to be in shaded Zone X which means that the 100-year flood elevation and the frequency discharges are not determined.

27.8 Alternative Solutions

Alternative 1 - 2-Year Storm Drain Outletting into an Unnamed Wash

Both Sites 29 and 30 are low points in 11th Place. 11th Place is superelevated with the low side on the west side of the street. In order for the catch basin to function properly, it is necessary that it be installed at the low point.

Therefore, this alternative consists of the construction of a City of Phoenix Standard Detail P-1569 Type M1, L=17 catch basin in the low point of each site on the west side of the street. A manhole will be installed at each site in the center of 11th Place opposite the catch basin. The catch basin will be connected to the manhole with an 18-inch RGRCP. The two manholes located in the center of 11th Place will be connected with approximately 618 feet of 18-inch RGRCP (since this distance exceeds the maximum distance between manholes for an 18-inch pipe, an additional manhole will be installed 309 feet south of the northern manhole). The 18-inch RGRCP will be extended to the south in the center of 11th Place for approximately 471 feet to outlet into an unnamed wash which crosses Northern Avenue approximately 470 feet west of the intersection of Northern Avenue and 12th Street.

This design will require five City of Phoenix Standard Detail P-1520 Storm Drain Manholes, one 18-inch flap gate, and approximately 170 feet of 10-foot-wide drainage easement between Lots 1118 and 8021 of the Hacienda del Caballero Development.

The acquisition of land for a drainage easement will need to be assessed with regard to cost and maintenance in the evaluation of the feasibility of Alternatives 1 and 2.

Alternative 2 - 100-Year Storm Drain Outletting into an Unnamed Wash

This alternative is the same as Alternative 1, with the exception of the use of a 24-inch RGRCP rather than the 18-inch RGRCP to convey the larger discharge associated with the 100-year storm. The same size and number of catch basins will be required to intercept the 100-year storm flow as in Alternative 1. Approximately 170 feet of 10-foot-wide drainage easement will be required for this Alternative.

Alternative 3 - 2-Year and 100-Year Storm Drains Outletting into the ACDC

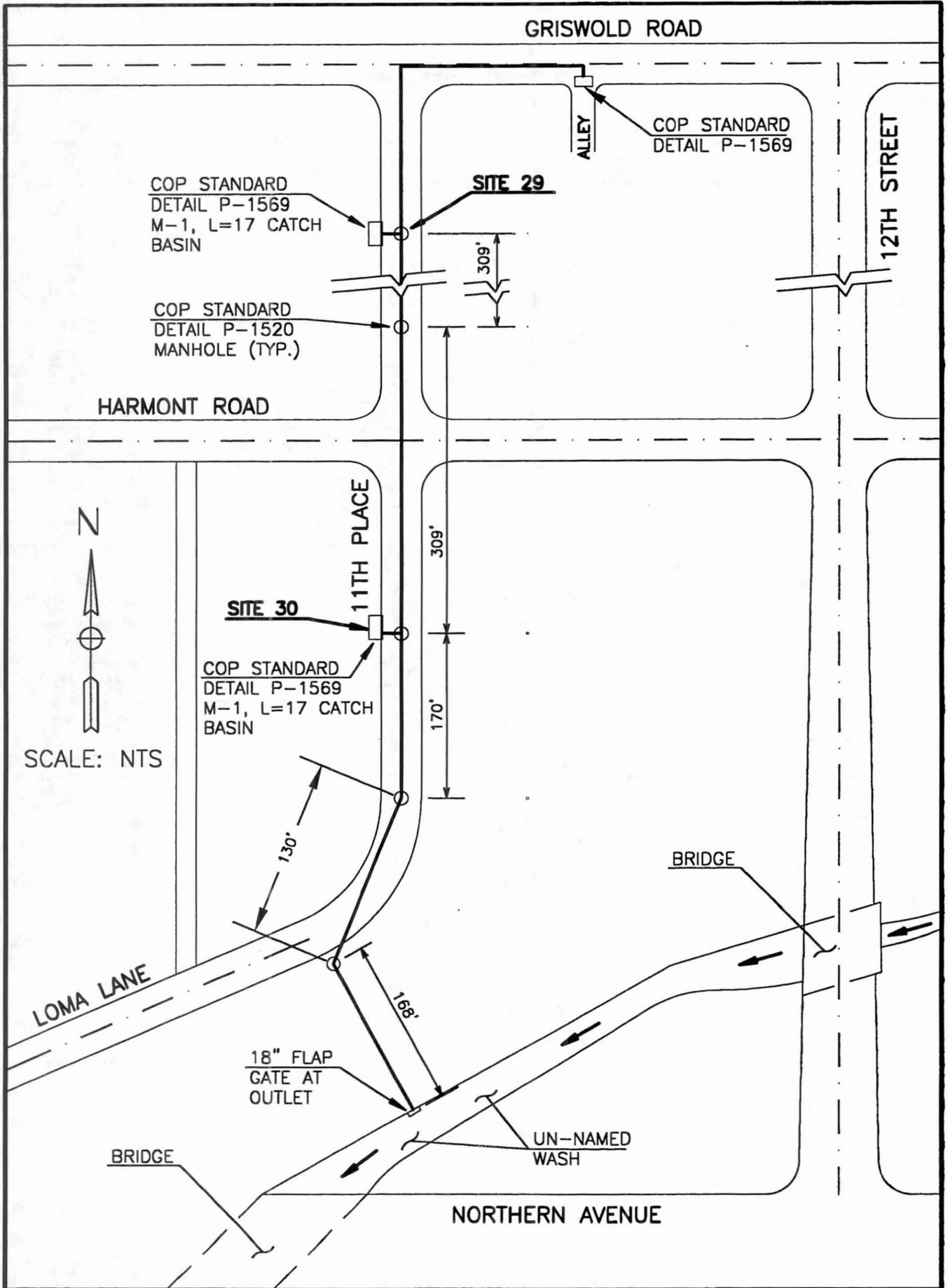
The combined 100-year discharge is 11.6 cfs, and the combined 2-year discharge is 4.9 cfs. An 18-inch RGRCP will be required to drain either of these flow rates to the ACDC. An 18-inch RGRCP will be installed 5 feet south of the centerline of East Harmont Drive from the ACDC to 11th Place. At 11th Place, a lateral will branch north and south from a City of Phoenix P-1520 Manhole in the centerline of 11th Place. The northern lateral will extend for approximately 486 feet and the southern lateral will extend for approximately 168 feet, each ending at a City of Phoenix P-1569 M1, L=17 Catch Basin. These catch basins will be in the same location as described in Alternatives 1 and 2. Two catch basins and eight COP manholes will be required to drain these flow rates.

Caution must be used in penetrating the wall of the ACDC.

27.9 Recommended Alternative

The City of Phoenix's preferred alternative is the construction of a 2-year storm drain at these sites (see Sites 29 and 30 - Preferred Alternative, Figure 3). The storm drain will have a catch basin at each low point and will outlet into an existing wash. The storm drain system will include approximately 1,600 lineal feet of pipe, five manholes, and a flap gate.

This design will also include a catch basin at a low point located in Griswold Road west of 12th Street at the City's request.



SITES 29 & 30 - PREFERRED ALTERNATIVE

FIGURE 2

27.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove 4-Inch Roll Curb & Gutter	54 LF	\$2.00/LF	\$ 100
Remove Asphalt	630 YD ²	\$1.80/YD ²	1,100
18-inch RGRCP	1,111 LF	\$80.00/LF	88,900
COP Standard Detail P-1569 Type M1,L17 Catch Basin	2 Each	\$2,700/Each	5,400
COP Standard Detail P-1520 Manhole	5 Each	\$2,300/Each	11,500
18-inch Flap Gate Valve	1 Each	\$300/Each	300
Excavation	955 YD ³	\$3.00/YD ³	2,900
Fill	868 YD ³	\$8.00/YD ³	6,900
4-Inch Rolled Curb & Gutter	54 LF	\$6.00/LF	300
Asphalt - 2-Inch Lift	69 Tons	\$60/Ton	4,100
ABC - 6-Inch Lift	105 YD ³	\$21/YD ³	2,200
Subtotal			\$123,700
20% Contingency			24,700
Total			\$148,400*

* The costs for drainage easement acquisition were not included in this cost estimate.

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove 4-Inch Roll Curb & Gutter	54 LF	\$2.00/LF	\$ 100
Remove Asphalt	703 YD ²	\$1.80/YD ²	1,300
24-Inch RGRCP	1,111 LF	\$100.00/LF	111,100
COP Standard Detail P-1569 Type M1,L17 Catch Basin	2 Each	\$2,700/Each	5,400
COP Standard Detail P-1520 Manhole	5 Each	\$2,300/Each	11,500
24-Inch Flap Gate Valve	1 Each	\$500/Each	500
Excavation	1,066 YD ³	\$3.00/YD ³	3,200
Fill	844 YD ³	\$8.00/YD ³	6,800
4-Inch Rolled Curb & Gutter	54 LF	\$6.00/LF	300
Asphalt - 2-Inch Lift	78 Tons	\$60.00/Ton	4,700
ABC - 6-Inch Lift	117 YD ³	\$21.00/YD ³	2,500
Subtotal			\$147,400
20% Contingency			29,500
Total			\$176,900*

* The costs for drainage easement acquisition were not included in this cost estimate.

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
4-Inch Roll Curb & Gutter Removal	54 LF	\$2.00/LF	\$ 100
Asphalt Pavement Removal	1,316 YD ²	\$1.80/YD ²	2,400
4-Inch Roll Curb & Gutter Replacement	54 LF	\$6.00/LF	300
Asphalt - 2-Inch Lift	6 Tons	\$60.00/Ton	400
ABC - 6-Inch Lift	220 YD ³	\$21.00/YD ³	4,600
18-Inch RGRCP	1,879 LF	\$80.00/LF	150,300
COP Standard Detail P-1569 Type M1, L17 Catch Basin	2 Each	\$2,700/Each	5,400
COP Standard Detail P-1520 Manhole	8 Each	\$2,300/Each	18,400
Excavation	2,436 YD ³	\$3.00/YD ³	7,300
Fill	2,269 YD ³	\$8.00/YD ³	18,200
Penetrate Wall of ACDC	12 LF	\$500.00/LF	6,000
Subtotal			\$213,400
20% Contingency			42,700
Total			\$256,100

28. Site 31 — 12th Street and Kaler Drive

28.1 Location And Site Description

This site is located at 12th Street just north of the intersection of 12th Street and Kaler Drive. It is situated between Northern Avenue and Orangewood Avenue, and 7th Street and 16th Street. Site 31 is in Township 2 North, Range 3 East, Section 4 of the Gila and Salt River Base and Meridian (see Site 31 - Vicinity Map, Figure 1).

The Dreamy Draw Wash West runs along an alley between Belmont Avenue and Kaler Drive. South of the wash is an apartment complex with a cedar fence and single-family residences bounded by a masonry wall on the north. The channel downstream of 12th Street has a gravel invert with grass banks at a mild slope to the fences. At the end of the downstream channel, a distance of approximately 430 feet, the flow discharges into the ACDC.

28.2 Problem Identification

The Dreamy Draw Wash West crossing between Belmont Avenue and Kaler Drive on 12th Street is a high traffic location. During storm events, traffic is slowed due to the wash crossing being at-grade (see Site 31 - Problem Identification, Figure 2).

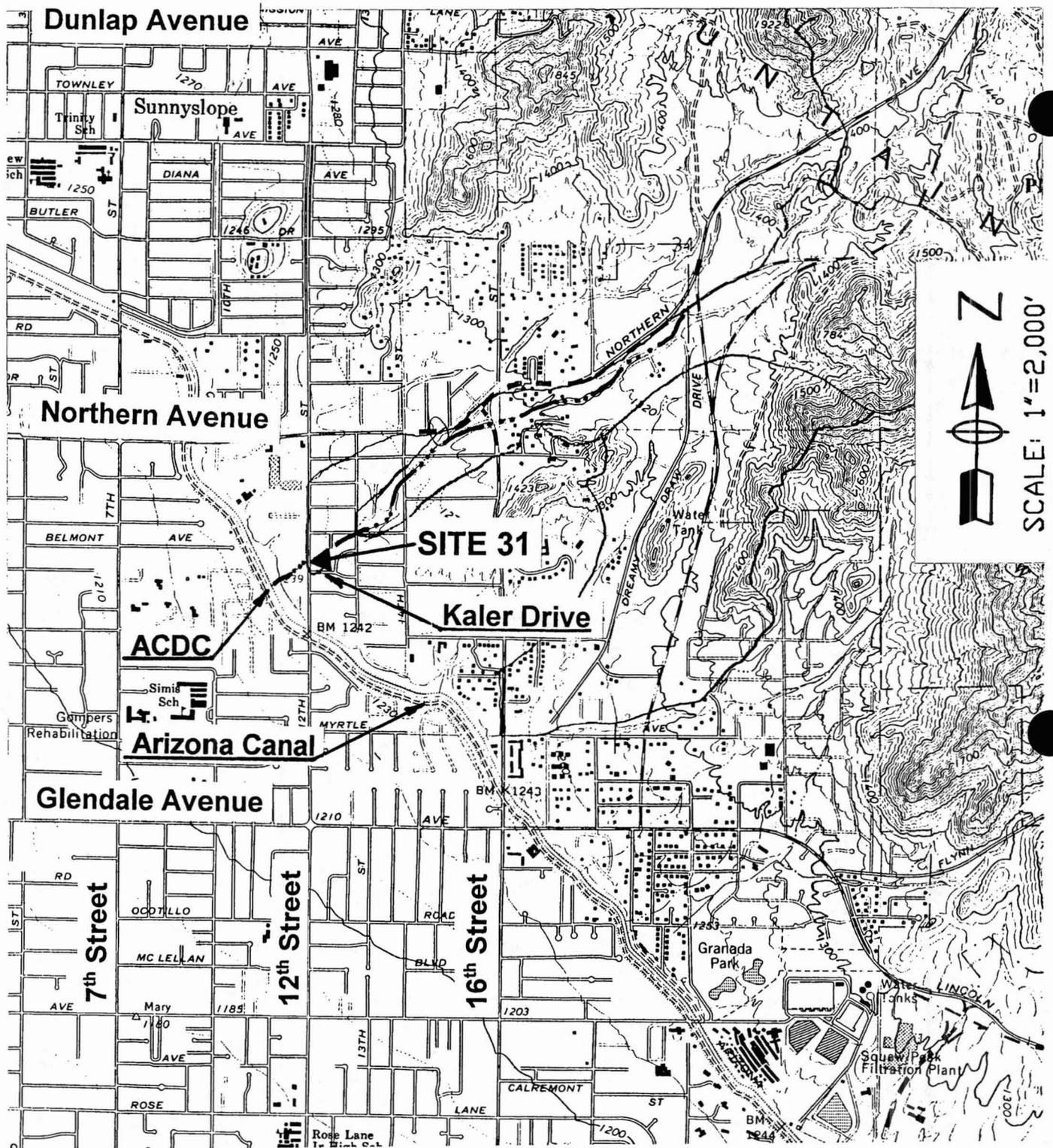
28.3 History

No information available.

28.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 24-29, Revised 6-9-94; 24-30, Revised 7-12-95.
- City of Phoenix Topographic Quarter Section Map Numbers: 24-29, Flown 5-1-82; 24-30, Flown 2-26-73.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 24-29, Flown 6-12-95; 24-30, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 24-29, Revised 6-14-94; 24-30, Revised 4-30-96.
- City of Phoenix Water Quarter Section Map Numbers: 24-29, Revised 11-7-94; 24-30, Revised 1-10-95.
- City of Phoenix Engineering Storm Drain Maps J8 and J9 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 31, its upstream drainage area, and downstream flow path, Photo Revised 1982.



SITE 31 - VICINTY MAP

FIGURE 1



SCALE: NTS

TO NORTHERN AVENUE

BELMONT AVENUE

EXISTING WASH

DREAMY DRAW WASH
WEST CROSSING

SITE 31

EXISTING WASH

SINGLE FAMILY
RESIDENTS

KALER AVENUE

MASONRY
FENCE

12TH STREET

APARTMENTS

TO ACDC

CEDAR
FENCE

TO ORANGEWOOD AVENUE

WAGON WHEEL AVENUE

SITE 31 - PROBLEM IDENTIFICATION

FIGURE 2

- FCDMC Hydrology: Gila River Basin New River & Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology Part 2, US Army Corps of Engineers District, Los Angeles, 1982.

28.5 Hydrology

Storm waters originate east of the Squaw Peak Parkway in the mountains of the Phoenix Mountain Preserve. This location is a part of the flow path of the Dreamy Draw Wash West downstream of the Dreamy Draw Dam. An inter-agency agreement exists between the US Army Corps of Engineers and the FCDMC that the flow will be 1,000 cfs in the event of a dam breach.

The drainage area was delineated on a USGS 7.5-minute quadrangle map and found to be 312 acres. The rational method was used to calculate the discharges at this location and are listed in the following table. The depth of flow at the crossing was also calculated for each frequency.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Depth (ft)</i>	<i>Velocity (fps)</i>	<i>Runoff Volume (ac-ft)</i>
100	580	1.14	5.57	105.0
50	510	1.09	5.43	92.8
25	456	1.06	5.31	81.1
10	378	1.01	5.15	67.8
2	233	0.83	Less than 5.0	37.4

28.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

28.7 Federal Emergency Management Agency

The flooding information prepared for FEMA is found on FIRM Panel Number 04013C1670E. The wash is classified as Zone A, which designates special areas which are inundated by 100-year floods, but neither the base flood elevation nor the discharge have been determined.

28.8 Alternative Solutions

The alternatives formulated under this study will not worsen the dam breach conditions as identified in the inter-agency agreement.

Alternative 1 - 2-Year Storm Drain Under Existing Channel

This alternative involves the installation of a 1-6'x4'x470' concrete box culvert (CBC) crossing under 12th Street. The culvert will extend from approximately 20 feet east of the east gutter line of 12th Street to the Arizona Canal Diversion Canal (ACDC), and will convey the approximate 2-year storm of 210 cfs. This design will reduce the flow depth in 12th Street to approximately one foot for the 100-year discharge, and will reduce the adverse effects of the more frequent discharges on traffic.

Two important considerations must be evaluated with this alternative. First, it must be verified that there will be sufficient cover over the box. Second, the penetration of the ACDC concrete wall must be evaluated for cost and feasibility.

Alternative 2 - 100-Year Storm Drain

This alternative involves extending the 2-10'x4'x470' CBC upstream, beginning at the ACDC, to approximately 20 feet east of the east gutter line of 12th Street to intercept the 100-year flow. A drop inlet will be designed which will intercept the flow and direct it into this culvert. The design of this culvert and drop inlet will eliminate the dip in the maintenance road which runs parallel to the ACDC. It should be noted that it is important to maintain drainage paths from both the north and south to allow local drainage to maintain its current flow path.

The same concerns listed in Alternative 1 must also be considered for this alternative. First, it must be verified that there is sufficient cover for the box. Second, the cost and feasibility of the penetration of the concrete retaining wall that is the north bank of the ACDC must be evaluated.

A less expensive variation of Alternative 2 is to construct a box culvert under the roadway only and leave the existing downstream channel in place. This will require fencing or other safety measures to prevent pedestrians and vehicles from falling off the elevated crossing.

Alternative 3 - Box Culvert at 12th Street to Pass the 1,000 cfs Dam Breach Flow

This alternative requires a 4-10'x4'x52' CBC crossing at 12th Street. The box invert will be at the existing channel grade. Wing walls will be installed upstream and downstream with guardrail along 12th Street. 12th Street may need to be regraded somewhat higher to accommodate the culvert. A gully drain and overchute will be provided to drain 12th Street flows.

Alternative 4 - Maintain the At-Grade Crossing

As documented in the table in the Hydrology section for this site, the existing flow conditions are

adequate for lower flow rates. Even the 100-year flow rate will have a depth of 1'-1.5" and a flow velocity of 5.6 fps. This crossing is adequate for emergency access for vehicles with clearances greater than 1.2 feet, but has the potential to stall passenger vehicles at flood frequencies less than the 2-year event. Flow meters to indicate flow depth and warning signs shall be installed to better inform motorists.

28.9 Recommended Alternative

Alternatives 1, 2, and 3 are beyond the scope of work of this project. Therefore the recommended alternative is Alternative 4 (see Site 31 - Preferred Alternative, Figure 3).

The City has decided to maintain the at-grade crossing. However, the City will work with the Flood Control District to put this site into the Capital Improvement Program (CIP).

28.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	80 YD ²	\$1.80/YD ²	\$ 100
Remove Sidewalk	90 SF	\$1.50/SF	100
Remove Curb & Gutter	36 LF	\$2.00/LF	100
Excavate for Box Culvert	2,510 YD ³	\$3.00/YD ³	7,500
1-6'x4'x470' CBC	Lump Sum		67,700
Fill	2,508 YD ³	\$8.00/YD ³	20,100
Asphalt 2" Lift	10 Tons	\$60.00/Ton	600
ABC 6" Lift	13 YD ³	\$21.00/YD ³	300
Penetrate ACDC Wall	18 LF	\$500/LF	9,000
Install 6" Curb & Gutter	36 LF	\$6.00/LF	200
Install 5' Sidewalk	90 SF	\$2.00/SF	200
Subtotal			\$105,900
20% Contingency			21,200
Total			\$127,100



SCALE: NTS

TO NORTHERN AVENUE

BELMONT AVENUE

EXISTING WASH

MAINTAIN
DREAMY DRAW WASH
WEST CROSSING

EXISTING WASH

SITE 31

SINGLE FAMILY
RESIDENTS

KALER AVENUE

MASONRY
FENCE

12TH STREET

APARTMENTS

TO ACDC

CEDAR
FENCE

TO ORANGEWOOD AVENUE

WAGON WHEEL AVENUE

NOTE: THE PREFERRED
ALTERNATIVE IS TO
MAINTAIN THE AT GRADE
CROSSING.

SITE 31 - PREFERRED ALTERNATIVE

FIGURE 3

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	140 YD ²	\$1.80/YD ²	\$ 300
Remove Sidewalk	165 SF	\$1.50/SF	300
Remove Curb & Gutter	66 LF	\$2.00/LF	100
Excavate for Box Culvert	4,600 YD ³	\$3.00/YD ³	13,800
2-10'x4'x470' CBC	Lump Sum		225,600
Fill	4,590 YD ³	\$8.00/YD ³	36,700
Asphalt 2" Lift	20 Tons	\$60.00/Ton	1,200
ABC 6" Lift	30 YD ³	\$21.00/YD ³	600
Penetrate ACDC Wall	35 LF	\$500/LF	17,500
Install 6" Curb & Gutter	66 LF	\$6.00/LF	400
Install 5' Sidewalk	165 SF	\$2.00/SF	300
Subtotal			\$296,800
20% Contingency			59,400
Total			\$356,200

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	280 YD ²	\$1.80/YD ²	\$ 500
Remove Sidewalk	165 SF	\$1.50/SF	200
Remove Curb & Gutter	132 LF	\$2.00/LF	300
4-10'x4'x52' CBC w/ Wing Walls	Lump Sum		70,000
Asphalt 2" Lift	40 tons	\$60.00/Ton	2,400
ABC 6" Lift	60 YD ³	\$21.00/YD ³	1,300
Install 6" Curb & Gutter	132 LF	\$6.00/LF	800
Install 5' Sidewalk	330 SF	\$2.00/SF	700
Subtotal			\$76,200
20% Contingency			15,200
Total			\$91,400

29. Site 32 — 13th Street and Belmont

29.1 Location And Site Description

This site is located at the intersection of 13th Street and Belmont Avenue. It is situated between Northern Avenue and Orangewood Avenue, and 12th Street and 16th Street. Site 32 is in Township 2 North, Range 3 East, Section 4 of the Gila and Salt River Base and Meridian (see Site 32 - Vicinity Map, Figure 1).

The Dreamy Draw Wash West crosses the intersection of 13th Street and Belmont Avenue. The upstream wash extends through the neighborhood and intersects the north side of Belmont Avenue one house east of the intersection with 13th Street. Downstream of the intersection the wash follows the alley between Belmont Avenue and Kaler Drive from north to south. The local residents at the four corners of the intersection of Belmont Avenue and 13th Street are 2.5 to 3 feet higher than the intersection. The intersection is not a normal crowned roadway; rather, the roadway is at a constant grade from the northeast to the southwest.

29.2 Problem Identification

During a storm event, traffic flow is impeded due to the wash crossing being at-grade. The flow depth in the intersection varies from one to two feet and the velocity is excessive, making this an unsafe crossing for cars and pedestrians (see Site 32 - Problem Identification, Figure 2).

29.3 History

At the alley entrance between Belmont and Kaler from north to south, downstream of the intersection and on the north side of the alley, the property owner has constructed a concrete and rock fence to provide bank protection. City staff expressed that, historically, the bank eroded and the property owner had to import fill material for replacement.

29.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 24-29, Revised 6-9-94; 24-30, Revised 7-12-95.
- City of Phoenix Topographic Quarter Section Map Numbers: 24-29, Flown 5-1-82; 24-30, Flown 2-26-73.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 24-29, Flown 6-12-95; 24-30, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 24-29, Revised 6-14-94; 24-30, Revised 4-30-96.
- City of Phoenix Water Quarter Section Map Numbers: 24-29, Revised 11-7-94; 24-30, Revised 1-10-95.

N



SCALE: NTS

13TH PLACE

BELMONT AVENUE

DREAMY DRAW WASH WEST

SITE 32

12TH PLACE

13TH STREET

KALER AVENUE

SITE 32 - PROBLEM IDENTIFICATION

FIGURE 2

- City of Phoenix Engineering Storm Drain Maps J8 and J9 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 32, its upstream drainage area, and downstream flow path, Photo Revised 1982.
- FCDMC Hydrology: Gila River Basin New River & Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology Part 2, US Army Corps of Engineers District, Los Angeles, 1982.

29.5 Hydrology

Flood waters originate east of the Squaw Peak Parkway in the mountains of the Phoenix Mountain Preserve. This location is part of the flow path of the Dreamy Draw Wash downstream of the Dreamy Draw Dam. An inter-agency agreement exists between the US Army Corps of Engineers and the FCDMC that the flow will be 1,000 cfs in the event of a dam breach.

There is no existing detailed hydrologic study for this area. The drainage area was delineated on a USGS 7.5-minute quadrangle map and found to be 278 acres. The Rational Method was used to calculate the discharges at this location and are listed in the following table.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Depth (ft)</i>	<i>Velocity (fps)</i>	<i>Runoff Volume (ac-ft)</i>
100	533	1.11	10.46	93.6
50	471	1.04	10.02	82.7
25	420	0.97	9.63	72.3
10	355	0.88	9.08	58.6
2	218	0.66	7.61	33.4

29.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

29.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1670E. It is classified as Zone A, which means that the designated areas are subject to 100-year flooding, but no base flood elevation or discharge have been determined.

29.8 Alternative Solutions

With the exception of Alternative 2, the alternatives formulated under this study will not worsen the dam breach conditions as identified in the inter-agency agreement.

Alternative 1 - Increase At-Grade Crossing Flow Capacity to Reduce Depth

The Dreamy Draw Wash West impacts the intersection of 13th Street and Belmont Avenue from the east. Local flows come to this intersection from the north. The intersection will be regraded so that more flow conveyance is provided to increase the conveyance capacity of the crossing, and the slope will be flattened to reduce the velocity of the flow. These two changes will improve the flow characteristics.

The profile of 13th Street south of the intersection should not be modified, as this reach is graded to serve as an overflow during less frequent flooding events. The profile of Belmont west of the intersection has been graded to help turn the flow and direct it down the alley. It is important that its current geometry and profile be maintained.

The downstream channel will produce a backwater effect which will choke the depth created by the modified intersection. Therefore, this alternative is not a feasible option.

Alternative 2 - Raise the Intersection to Accommodate the 100-Year Storm

Since all four corner lots are higher than the intersection, the intersection can be raised approximately 2.5 feet and regraded. This will involve constructing a 2-10'x4'x134' CBC in the existing channel invert beginning immediately upstream of the east edge of the roadway to convey the 100-year flow of 533 cfs under the roadway, and extend it southwest to the alley where flows currently drain.

Alternative 3 - Raise the Intersection to Accommodate the Dam Breach Flow

This alternative is the same as Alternative 2 except the box culvert is to be doubled to a 4-10'x4'x134' CBC. This will require extra channel transition upstream and downstream.

Alternative 4 - Maintain as an At-Grade Crossing

As documented in the table in the Hydrology section for this site, the crossing is not adequate during a flood event due to the high velocity. Warning signs shall be installed.

29.9 Recommended Alternative

Alternatives 1, 2, and 3 are beyond the scope of work of this project. Therefore, the recommended alternative is Alternative 4, maintaining an at-grade crossing but restricting entry during floods (see Site 32 - Preferred Alternative, Figure 3).



SCALE: NTS

**MAINTAIN
AT GRADE
CROSSING**

BELMONT AVENUE

13TH PLACE

DREAMY DRAW WASH WEST

SITE 32

12TH PLACE

13TH STREET

KALER AVENUE

SITE 32 - PREFERRED ALTERNATIVE

FIGURE 3

The City has decided to maintain the at-grade crossing. However, the City will work with the Flood Control District to put this site into the Capital Improvement Program (CIP).

29.10 Cost Estimate

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	830 YD ²	\$1.80/YD ²	\$ 1,500
Remove Sidewalk	1,200 SF	\$1.50/SF	1,800
Remove Curb & Gutter	300 LF	\$2.00/LF	600
Excavate for Box Culvert	1,320 YD ³	\$3.00/YD ³	4,000
2-10'x4'x134' CBC	Lump Sum		64,400
Fill	1,210 YD ³	\$8.00/YD ³	9,700
Asphalt 2" Lift	60 Tons	\$60.00/Ton	3,600
ABC 6" Lift	90 YD ³	\$21.00/YD ³	1,900
Install 6" Curb & Gutter	300 LF	\$6.00/LF	1,800
Install 5' Sidewalk	1,200 SF	\$2.00/SF	2,400
Subtotal			\$ 91,700
20% Contingency			18,300
Total			\$110,000

Alternative 3

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	1,630 YD ²	\$1.80/YD ²	\$2,900
Remove Sidewalk	1,200 SF	\$1.50/SF	1,800
Remove Curb & Gutter	300 LF	\$2.00/LF	600
Excavate for Box Culvert	1,320 YD ³	\$3.00/YD ³	4,000
4-10'x4'x134' CBC w/ Wing Walls	Lump Sum		170,000
Fill	1,210 YD ³	\$8.00/YD ³	9,700
Asphalt 2" Lift	120 Tons	\$60.00/Ton	7,200
ABC 6" Lift	180 YD ³	\$21.00/YD ³	3,800
Install 6" Curb & Gutter	300 LF	\$6.00/LF	1,800
Install 5' Sidewalk	1,200 SF	\$2.00/SF	2,400
Subtotal			\$204,200
20% Contingency			40,800
Total			\$245,000

30. Site 33 — 10th Street Wash and Hatcher Road (East of Cave Creek Rd.)

30.1 Location And Site Description

This site is located about 500 feet east of the intersection of Cave Creek Road and Hatcher Road. It is situated between Mountain View Road and Dunlap Avenue. Site 33 is in Township 3 North, Range 3 East, Section 28 of the Gila and Salt River Base and Meridian (see Site 33 - Vicinity Map, Figure 1).

The upstream wash extends through the neighborhood to the north. Downstream of the intersection the wash flows to the south through the neighborhood. The residents at the four corners adjacent to the wash are at elevation that is 1.0 to 1.5 feet higher than the wash crossing. At the point where the wash crosses, the roadway does not have a normal crown; rather, the roadway is at a constant grade from the north to the south.

30.2 Problem Identification

The 10th Street Wash crosses this location. Since the crossing is at-grade, the flow impedes traffic (see Site 33 - Problem Identification, Figure 2).

30.3 History

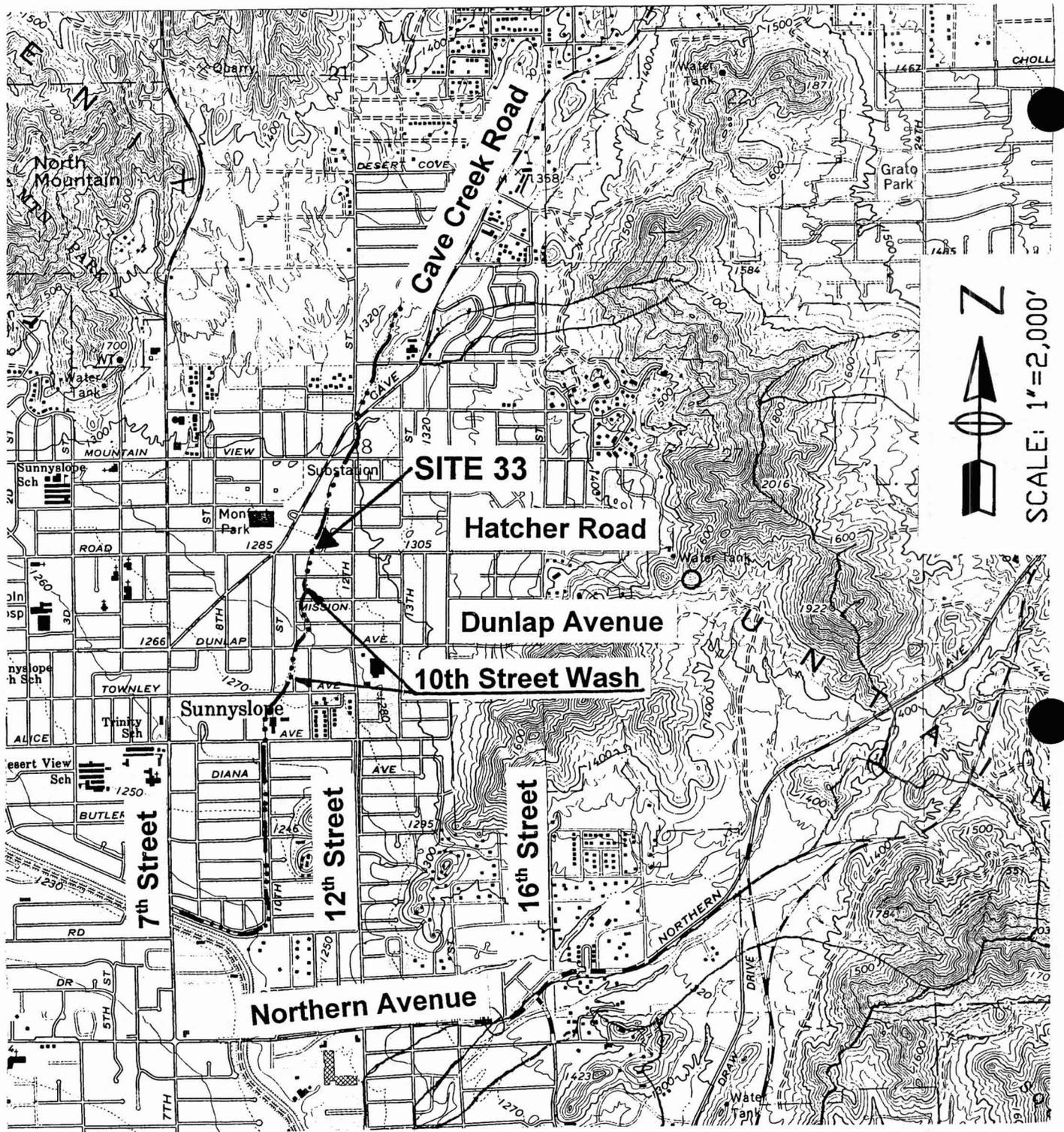
At the beginning of 1996, the construction of Detention Basin A was completed for the FCDMC.

The resident at the southeast corner of the wash crossing, Mr. Lawrence Roe, has lived at this address since 1955. He has maintained the wash since that time. He said that he has pictures showing waves in the wash that are higher than the bank.

30.4 Site Specific Data Acquisition

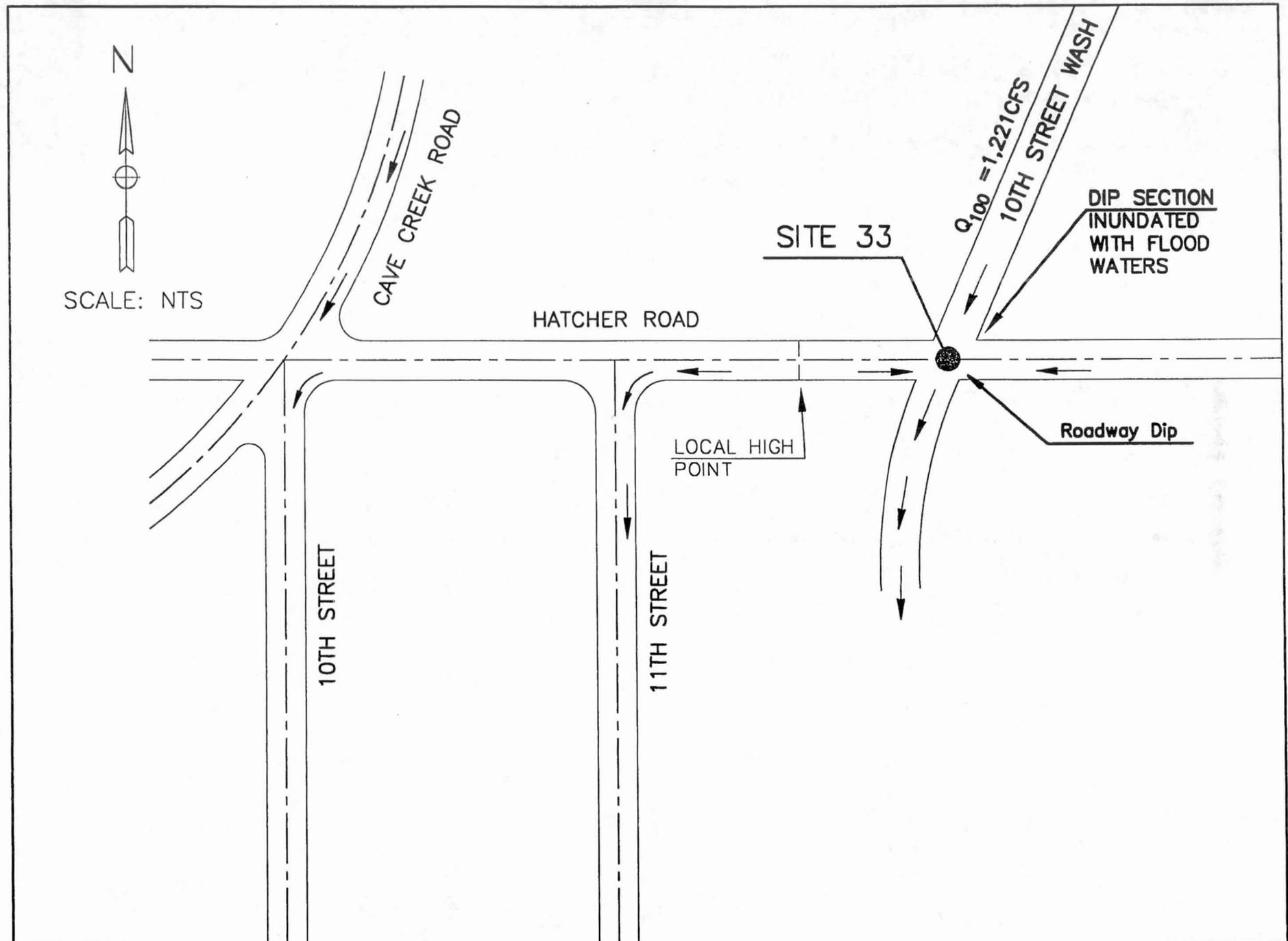
The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 24-29, Revised 6-9-94; 24-30, Revised 7-12-95.
- City of Phoenix Topographic Quarter Section Map Numbers: 24-29, Flown 5-1-82; 24-30, Flown 2-26-73.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 24-29, Flown 6-12-95; 24-30, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 24-29, Revised 6-14-94; 24-30, Revised 4-30-96.
- City of Phoenix Water Quarter Section Map Numbers: 24-29, Revised 11-7-94; 24-30, Revised 1-10-95.
- City of Phoenix Engineering Storm Drain Map J8 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 33, its upstream drainage area, and downstream flow path photo revised 1982.



SITE 33 - VICINTY MAP

FIGURE 1



SITE 33 - PROBLEM IDENTIFICATION

FIGURE 2

30.5 Hydrology

Flows originate in the north in the mountains east of the Point Hilton Resort at Tapatio Cliffs, mountains of the Phoenix Mountain Preserve, and the North Mountain Recreation Area, and concentrate at this wash crossing.

The construction of Detention Basin 1 for the 10th Street Wash was completed for the FCDMC early in 1996. The construction of this basin has substantially decreased the flow rate that has historically reached Site 33. This basin is located north of a church at the northwest corner of Cheryl Drive and Cave Creek Wash. The Feasibility Report for the 10th Street Wash prepared by DMJM lists the discharge at this location to be approximately 1,220 cfs.

<i>Frequency</i>	<i>Discharge</i>	<i>Depth</i>	<i>Velocity</i>
100	1,221	1.1	6.40
50	1040	1.04	6.14
25	850	0.95	5.65
10	610	0.79	4.76
2	310	0.60	3.65

30.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

30.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1660F and is classified as Zone AE. This means that the base flood elevation has been determined to be 1297.4 at this location during a 100-year flood event, and the drainage area has a surface area of 1.59 square miles. Discharges have been calculated to be 910 cfs, 3,400 cfs, and 8,600 cfs for the 10-year, 100-year, and 500-year storms, respectively. These discharges and the associated 100-year

water surface elevation were documented in the Flood Insurance Study, (FIS), revised September 30, 1995, and does not reflect the changes due to the detention basin built at Cheryl Drive and Cave Creek Road by the FCDMC at the beginning of 1996.

30.8 Alternative Solutions

Alternative 1 - Maintain At-Grade Crossing

Due to the recent completion of Detention Basin A located at Cheryl Drive and Cave Creek Road, the discharge has been reduced to 1,221 cfs. Hatcher Road was rated assuming all of the flow is conveyed south. It was determined that the depth of flow is 1.1 feet and the velocity is 6.4 fps for the 100-year storm. Depths for other frequencies are listed in the table in the Hydrology section for this site. Based upon this information, the existing conditions are adequate for the frequent storms such as a 2-year event for an at-grade crossing. A flow depth meter and warning signs will be installed under this alternative to adequately warn motorists.

Alternative 2 - 100-Year Culvert Crossing

This alternative involves regrading the intersection. A culvert will be constructed beginning on the north side of the roadway to convey the 100-year flow under the roadway and extend it south to daylight in the wash downstream of Hatcher Road.

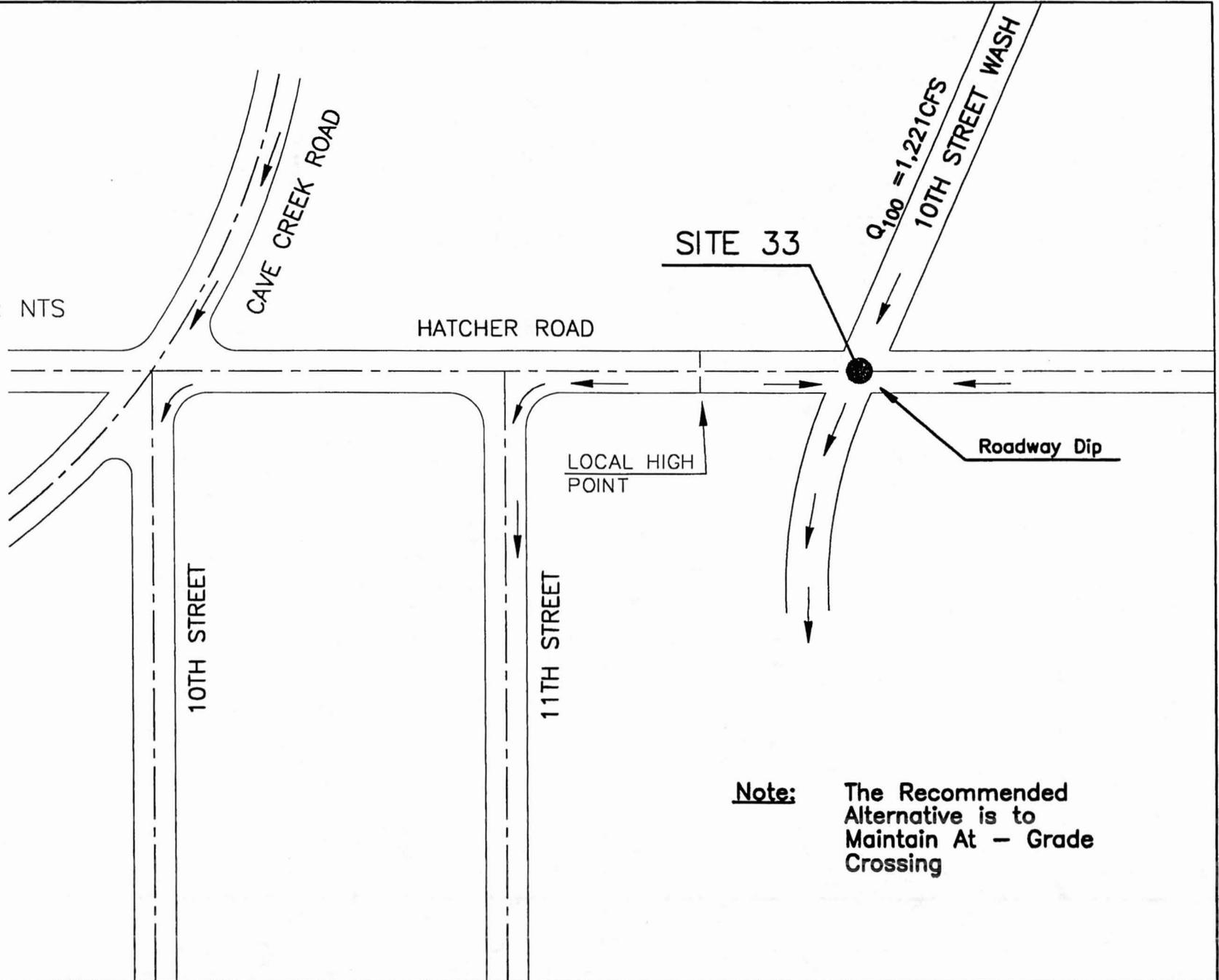
Upstream of the wash crossing the existing channel grade is 0.4%. Downstream of the wash and extending downstream approximately 300 feet to the next street, Sunnyslope Lane, the slope is 1.33%. By regrading this reach of the channel, 2.8 feet of additional depth can be provided at the intersection to install a culvert and still maintain the upstream slope of 0.4%.

30.9 Recommended Alternative

The City of Phoenix has decided to maintain the at-grade crossing at this site, as recommended by Alternative 1 (see Site 33 - Preferred Alternative, Figure 3). Although the wash crossing will still be inundated by waters during storm events, **the reduced flow rates as a result of the new detention basin will have correspondingly low flow depths and velocities.** For all but the least frequent storms, the depth and velocity of flow are within acceptable driving conditions for the scope of this project. The City will monitor this to determine if the problem has been eliminated or if further action is necessary. If a solution is needed, the City will work with the FCDMC to get this location into the Capital Improvement Program (CIP).



SCALE: NTS



Note: The Recommended Alternative is to Maintain At - Grade Crossing

● SITE 33 - PREFERRED ALTERNATIVE ●

● FIGURE 3 ●

30.10 Cost Estimate

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Asphalt	230 YD ²	\$1.80/YD ²	\$ 400
Remove Sidewalk	440 SF	\$1.50/SF	700
Remove Curb & Gutter	88 LF	\$2.00/LF	200
Excavate for Box Culvert	1,100 YD ³	\$3.00/YD ³	3,300
3-10'x5'x80' CBC	Lump Sum		72,000
Fill	800 YD ³	\$8.00/YD ³	6,400
Asphalt 2" Lift*	45 Tons	\$60.00/Ton	2,700
ABC*	67 YD ³	\$21.00/YD ³	1,400
Install 6" Curb & Gutter	88 LF	\$6.00/LF	500
Regrade Channel	1,200 YD ³	\$10.00/YD ³	12,000
Install 5' of Sidewalk	440 SF	\$2.00/SF	900
Subtotal			\$100,500
20% Contingency			20,100
Total			\$120,600

Note: The channel regrading will have to extend about 140 feet south of Sunnyslope Lane.

*Includes construction and demolition at Sunnyslope Lane.

31. Site 37 — 16th Street and Myrtle Avenue

31.1 Location And Site Description

This site is located about 1,500 feet north of the intersection of Glendale Avenue and 16th Street. It is situated between Orangewood Avenue and Glendale Avenue. Site 37 is in Township 2 North, Range 3 East, along the section line between Sections 3 and 4 of the Gila and Salt River Base and Meridian (see Site 37 - Vicinity Map, Figure 1).

The Myrtle Avenue Wash extends upstream to the east and is adjacent to and on the north side of Myrtle Avenue until Dreamy Draw Drive. Flow is conveyed in Myrtle Avenue beginning at the intersection of Myrtle Avenue and Dreamy Draw Drive and extending east for about 300 feet. Downstream of 16th Street, the wash goes under a building and discharges its flow into the ACDC.

31.2 Problem Identification

This location is a crossing of the Myrtle Avenue Wash, which is at-grade and impedes traffic flow. It has been frequently reported that the flow depths in 16th Street range from 0.5 to 1.0 foot and are very swift. Sediment varying from about six inches in diameter and smaller are left on the road after large flows (see Site 37 - Problem Identification, Figure 2).

31.3 History

Before the construction of the Squaw Peak Parkway, City maintenance crews frequently had to place traffic barricades due to deep, swift flows. During the initial field visit, staff from the Central Area Maintenance District stated that the property at the southeast corner of Dreamy Draw Drive and Myrtle Avenue was consistently inundated during flooding events.

31.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

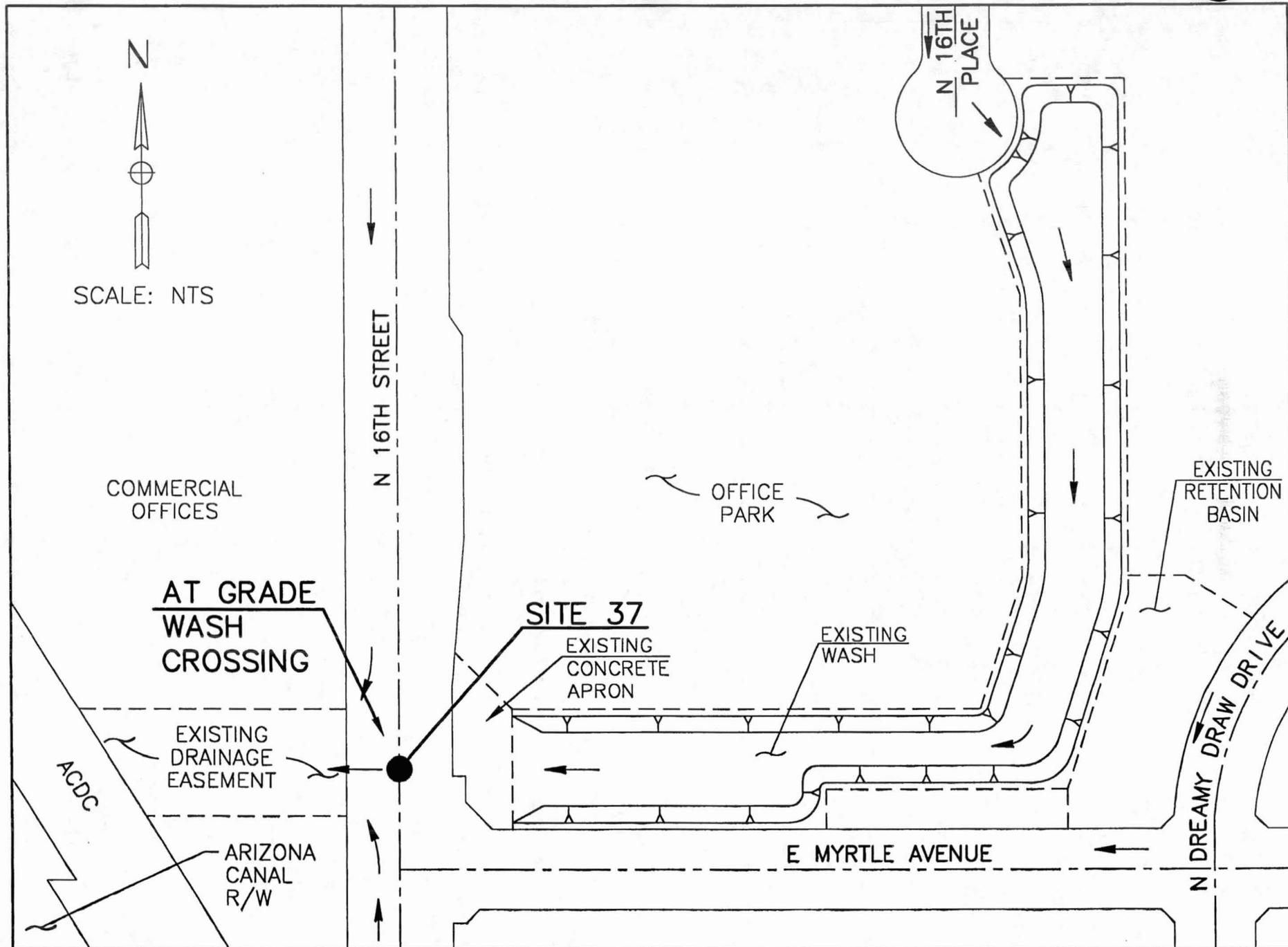
- City of Phoenix Right-of-Way Quarter Section Map Numbers: 23-30, Revised 7-27-93; 23-31, Revised 10-24-95.
- City of Phoenix Topographic Quarter Section Map Numbers: 23-30, Flown 2-26-73; 23-31, Flown 10-24-67.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 23-30, Flown 6-12-95; 23-31, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 23-30, Revised 8-3-93; 23-31, Revised 7-7-95.
- City of Phoenix Water Quarter Section Map Numbers: 23-30, Revised 12-5-94; 23-31, Revised 1-18-96.
- City of Phoenix Engineering Storm Drain Maps 18 and 19 (not dated).



SCALE: 1"=2,000'

SITE 37 - VICINTY MAP

FIGURE 1



SITE 37 - PROBLEM IDENTIFICATION

FIGURE 2

- FEMA, FIS for the City of Phoenix, Revised 9-30-95.
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 37, its upstream drainage area, and downstream flow path, Photo Revised 1982.

31.5 Hydrology

Flood waters originate east of the Squaw Peak Parkway in the mountains of the Phoenix Mountain Preserve and concentrate at this wash crossing. The following table lists the return frequency and runoff volume as computed using the City of Phoenix precipitation depths listed in the City of Phoenix Storm Drain Design Manual Subdivision Drainage Design, Dated July 1988. The total drainage area was taken from the FEMA FIS.

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>
100	1,300	187.5
50	1,000	165.7
10	600	117.4

31.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

31.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1670E. It is designated as Zone AE, which means that the base flood elevation has been determined to be 1243.6 during a 100-year storm event, and the drainage surface area is 0.87 square mile.

31.8 Alternative Solutions

As mentioned earlier, sediment deposition in 16th Street is a problem associated with this site. With a portion of the drainage area originating in the foothills and mountains northeast of this location, sediment will always be a portion of the runoff. A sedimentation analysis requires substantial investigation and assessment. A simplified approach is to assume that the sediment

carried through the flood is 2 percent by volume of the flow. The 100-year flood has a net volume of 188 acre-feet which will carry 3.8 acre-feet of sediment.

Alternative 1 - Sediment/Debris Basin

There is a concrete apron in the existing channel that extends about 120 feet upstream of the back of curb on the east side of 16th Street. The geometry of the existing channel will be maintained beginning at the east gutter line of 16th Street and continuing upstream for 20 feet. A basin will be cut down at a side slope of 4:1 for a total depth of 3 feet. This basin will be contained within the drainage easement shown on the right-of-way quarter section map. It will extend east and turn north at Dreamy Draw Drive and extend upstream to the bulb of the cul-de-sac at north 16th Place. Total volume provided within the basin is 4.8 acre-feet when the basin is filled to the top. Sediment free flow will weir out of the basin, cross 16th Street, and discharge into the ACDC.

Maintenance crews will have to remove the sediment from the basin after storms to maintain the storage capacity in the basin. One drawback to this alternative is the ponded water within the basin.

Alternative 2 - 100-Year Culvert Crossing

This alternative involves design of a 3-10'x5'x75' CBC under 16th Street to convey the 100-year flow of 1,300 cfs. The road will be raised so that the culvert extends only to 16th Street. The upstream channel will be regraded with a flatter slope and grass lined. The downstream channel will end about five feet west of the west back of curb of 16th Street.

31.9 Recommended Alternative

City maintenance crews have indicated that this location is no longer a problem. Therefore, the City has decided to take no action at this time. However, if a future problem persists at this location, a sedimentation basin as recommended by Alternative 1 will be considered (see Site 37 - Preferred Alternative, Figure 3).

Two issues need to be resolved with Alternative 1. First, the sediment/debris basin will need to drain for maintenance crews to be able to remove the deposited sediment. Second, the basin will need to be landscaped and maintained on a continuing basis.

N



SCALE: NTS

NOTE: THE RECOMMENDED ALTERNATIVE IS NO ACTION.

N 16TH PLACE

COMMERCIAL OFFICES

N 16TH STREET

OFFICE PARK

EXISTING RETENTION BASIN

SITE 37

EXISTING CONCRETE APRON

EXISTING WASH

EXISTING DRAINAGE EASEMENT

ACDC

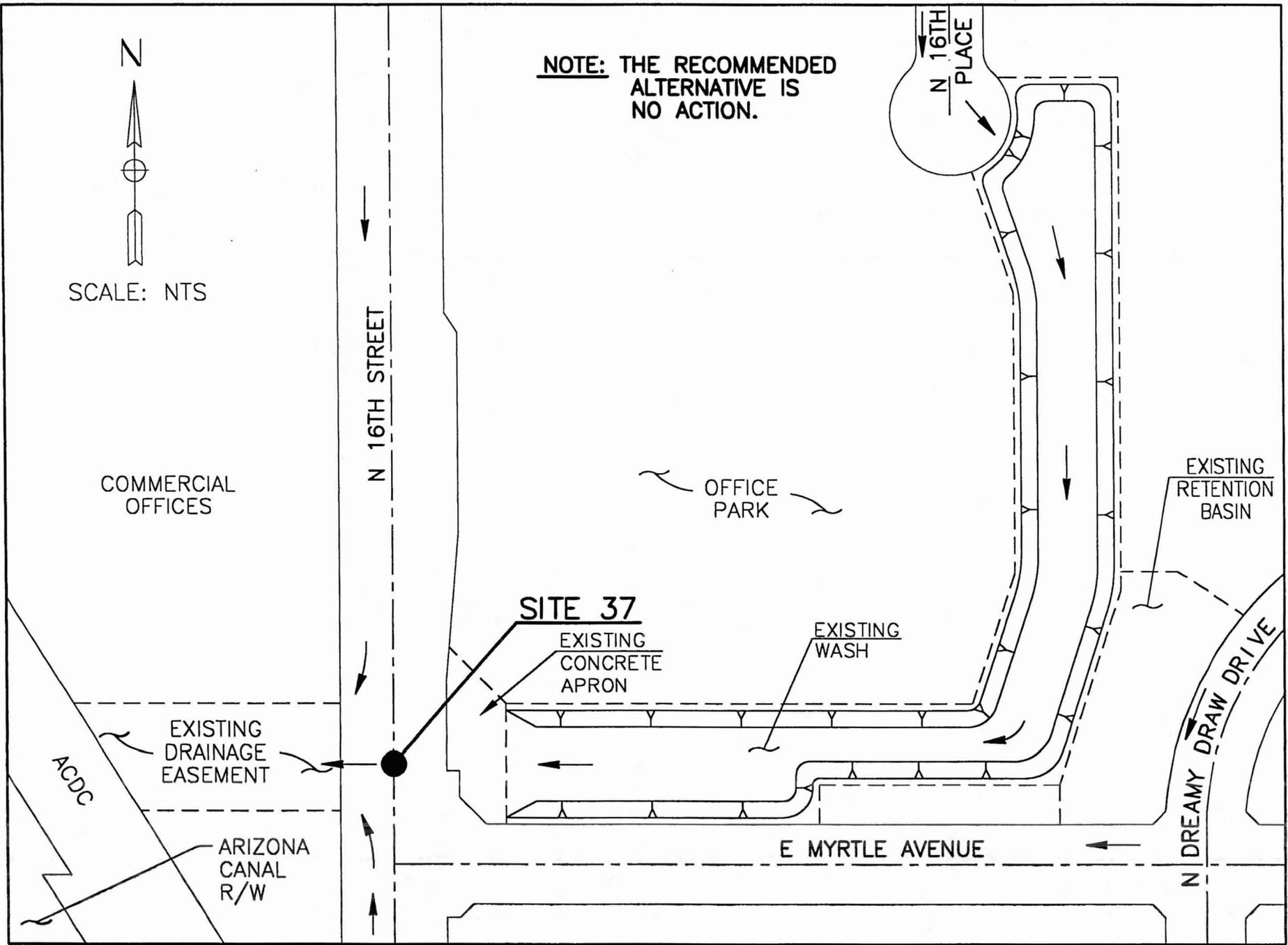
ARIZONA CANAL R/W

N DREAMY DRAW DRIVE

E MYRTLE AVENUE

SITE 37 - PREFERRED ALTERNATIVE

FIGURE 3



31.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	6,130 YD ³	\$4.00/YD ³	\$24,500
Sawcut Concrete	50 LF	\$2.00/LF	100
Landscape Basin	73,650 SF	\$1.00/SF	73,700
Demolish & Remove Concrete	Lump Sum		1,000
Subtotal			\$99,300
20% Contingency			19,900
Total			\$119,200

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Concrete	Lump Sum		\$ 1,000
Remove Asphalt*	8,900 YD ²	\$1.80/YD ²	16,000
Remove Curb & Gutter*	2,870 LF	\$2.00/LF	5,700
Remove Sidewalk	1,440 YD ²	\$1.50/YD ²	2,200
3-10'x5'x75' CBC	Lump Sum		67,500
Fill*	8,660 YD ³	\$8.00/YD ³	69,300
Install 6" Curb & Gutter (MAG 220 Type A*)	2,870 LF	\$6.00/LF	17,200
Asphalt 3" Lift*	1,480 Tons	\$60.00/Ton	88,800
ABC 6" Lift*	1,490 YD ³	\$21.00/YD ³	31,300
5' Sidewalk	1,440 SF	\$2.00/SF	2,900
Subtotal			\$301,900
20% Contingency			60,400
Total			\$362,300

*Includes Myrtle Avenue improvements.

32. Site 38 — 36th Street North of Lincoln Drive

32.1 Location And Site Description

This site includes approximately 5,400 feet of 36th Street north of Lincoln Drive to a gated fence. It is in Township 2 North, Range 3 East, Section 12 of the Gila and Salt River Base and Meridian. Lincoln Drive runs along the south base of the Phoenix Mountain Preserve. South of Lincoln Drive is the Town of Paradise Valley. 36th Street is cut into the Phoenix Mountain Preserve. 36th Street is asphalt paved except the last 400-foot segment south of the Phoenix Mountain Preserve gate (see Site 38 - Vicinity Map, Figure 1).

32.2 Problem Identification

Five problem locations exist along 36th Street as detailed below.

Location 1

This location extends 500 feet north from the intersection of Lincoln Drive to a crest point in the street. Flows and sediment wash off the mountain adjacent to 36th Street on the west side and into the intersection of Lincoln Drive and 36th Street (see Site 38, Location 1 - Problem Identification, Figure 2).

Location 2

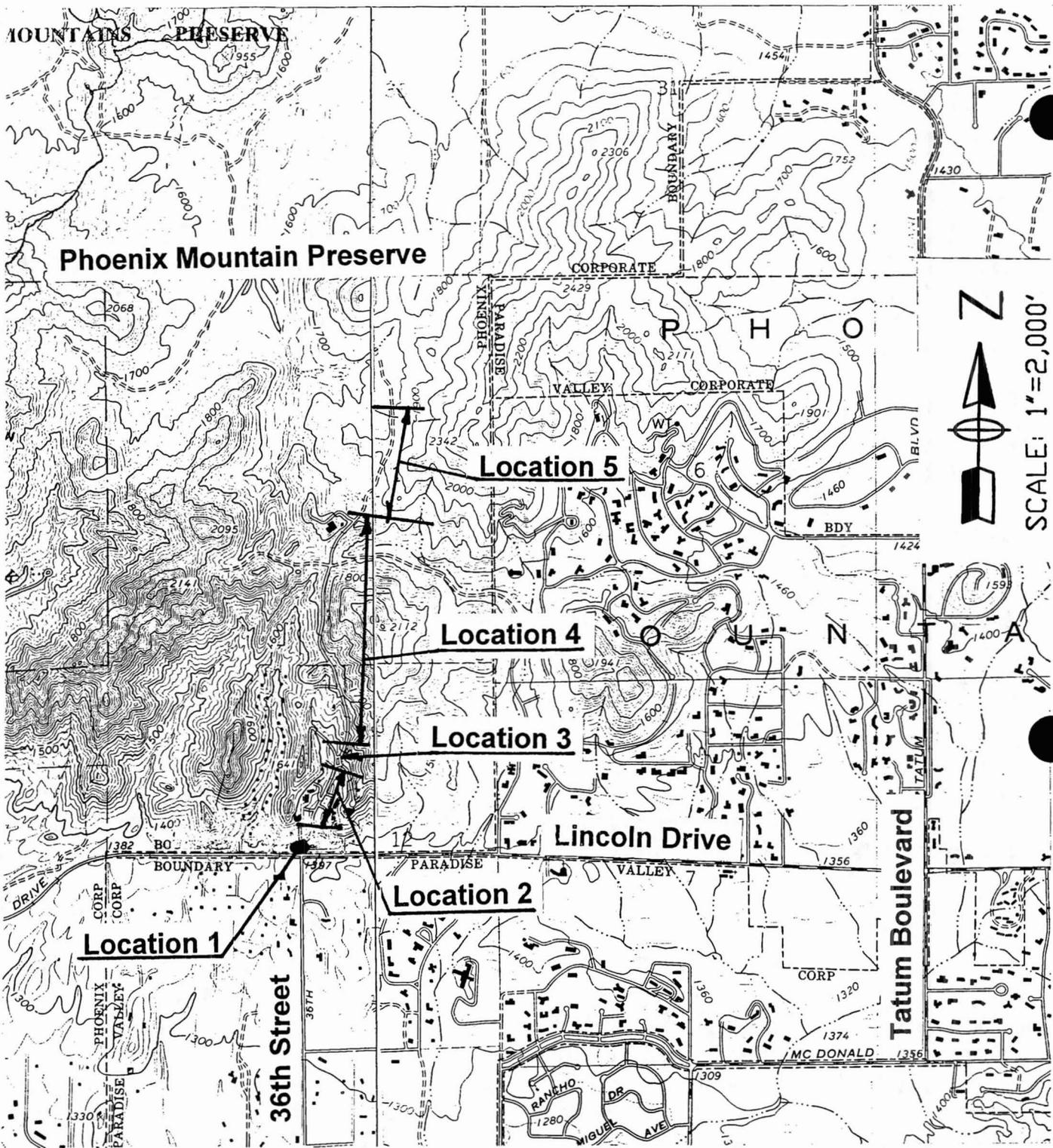
The mountain has been cut to accommodate 36th Street south of Palm Canyon Drive and on the west side of 36th Street. The mountain cut varies from 3 feet to 8 feet. The slope of the mountain on the west side 36th Street is steep and sediment washes onto the asphalt.

Location 3

From the north curb return of Palm Canyon Drive to approximately 200 feet and along the east side of 36th Street, the slope of an existing wash flattens and the banks of the wash daylight, causing flows to slow, sediment to deposit, and flows directed onto 36th Street. The curb is cut for a width of approximately 8 feet and a scupper has been constructed at the northeast curb return of Palm Canyon Drive. The scupper connects to a culvert under Palm Canyon Drive. This directs flows from 36th Street and flows remaining in the east right-of-way of 36th Street under Palm Canyon Drive and into a wash south of Palm Canyon Drive on the east side of 36th Street (see Site 38 , Location 2 - Problem Identification, Figure 3).

Location 4

The last asphalt pavement segment extends from a point 200 feet north of Palm Canyon Drive. Flows run off the mountain and into a ditch which is parallel to and on the east side of 36th Street. Curb and gutter has been constructed on the east side of the street to protect the street from erosion due to the steep slope and swiftly flowing water in the wash. However, areas of

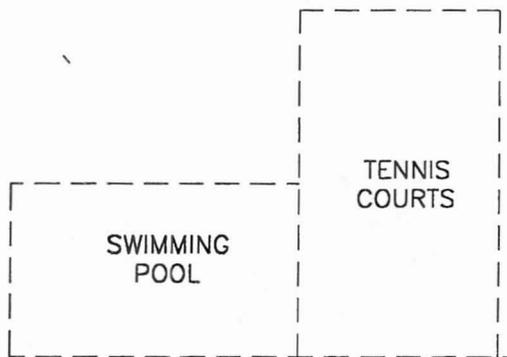
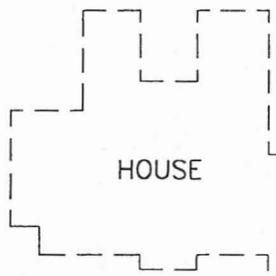


SITE 38 - VICINTY MAP

FIGURE 1



SCALE: NTS



GATED DRIVE

MOUNTIANOUS DESERT

36TH STREET

SITE 38
LOCATION 1

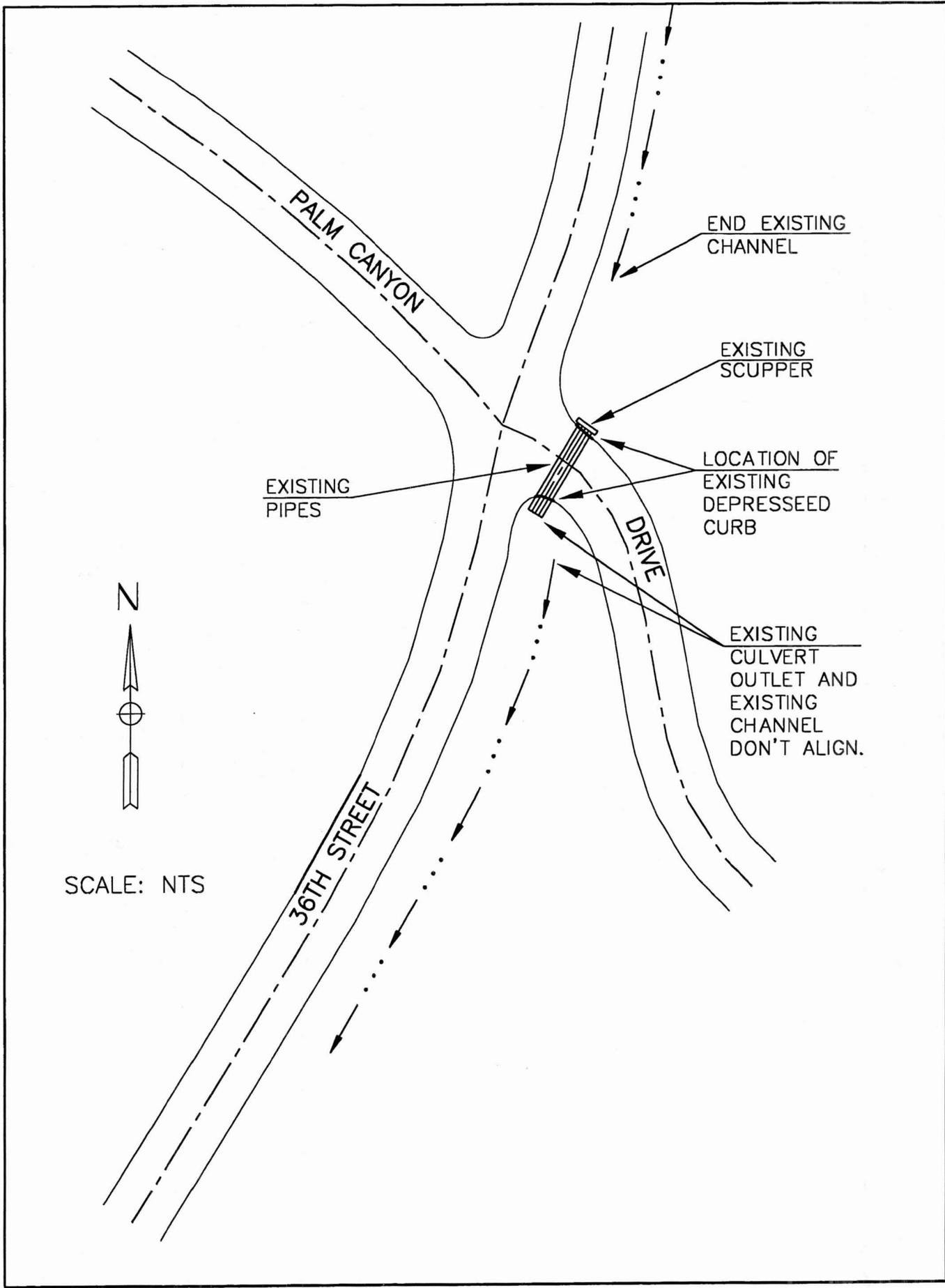
SEDIMENT DEPOSIT
DUE TO FLOW
RUNOFF FROM
MOUNTAIN

11 CFS

LINCOLN DRIVE

SITE 38 LOCATION 1 - PROBLEM IDENTIFICATION

FIGURE 2



SITE 38 LOCATION 3 PROBLEM IDENTIFICATION

FIGURE 3

head cutting have recently occurred and are readily apparent under this curb and gutter. It appears that new reaches of curb and gutter have been installed to replace some reaches which have failed in the past due to the cutting action of the swiftly flowing water (see Site 38, Location 4 - Problem Identification, Figure 4).

Location 5

Sediment washes onto the paved portion of 36th Street beginning at the gate to the mountain preserve and continuing south to the end of asphalt (see Site 38, Location 5 - Problem Identification, Figure 5).

32.3 History

No information available.

32.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 22-35, Revised 3-3-93; 22-36, Revised 9-16-90.
- City of Phoenix Topographic Quarter Section Map Numbers: 22-35, Flown 7-31-74; 22-36, Flown 7-31-74.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 22-35, Flown 6-12-95; 22-36, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 22-35, Revised 6-20-94; 22-36, Revised 7-28-94.
- City of Phoenix Water Quarter Section Map Numbers: 22-35, Revised 4-17-95; 22-36, Revised 6-21-84.
- City of Phoenix Engineering Storm Drain Map I10 (not dated).
- USGS 7.5-minute quadrangle maps for Sunnyslope Arizona (Photo Revised 1982) and Paradise Valley, Arizona which contain Site 38, its upstream drainage area, and downstream flow path.



SCALE: NTS

GRAVEL ROADWAY

EDGE OF PAVEMENT

EXISTING CHANNEL

36TH STREET

ASPHALTIC ROADWAY

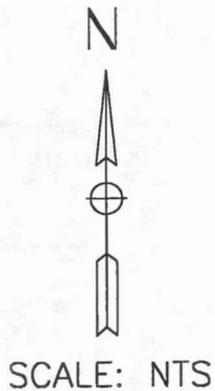
NOTE: EXISTING CHANNEL
SIDE SLOPES, LONG.
SLOPE, BOTTOM
WIDTH, AND DEPTH
VARIES ALL ALONG
THE REACH

EXISTING CHANNEL

PALM CANYON DRIVE

SITE 38 LOCATION 4 PROBLEM IDENTIFICATION

FIGURE 4



EXISTING GRADE
BREAK

1745.9

EXISTING
GATE

BEGIN EXISTING
CHANNEL

GRAVEL ROADWAY

EXISTING CHANNEL

GRAVEL ROADWAY

EDGE OF PAVEMENT

ASPHALTIC ROADWAY

NOTE: EXISTING DIRT ROAD
AND EXISTING WASH
HAVE CROSS SLOPES
AND LONGITUDINAL
SLOPES WHICH VARY.
CONSEQUENTLY, EROSION
AND SEDIMENT DEPOSITION
ARE A PROBLEM.

SITE 38 LOCATION 5 PROBLEM IDENTIFICATION

FIGURE 5

32.5 Hydrology

Locations 1 & 2

<i>Frequency</i>	<i>Discharge</i>	<i>Runoff Volume</i>	<i>Sediment Volume</i>
2	5	0.3	0.07
10	8	0.6	0.12
25	10	0.7	0.15
50	10	0.8	0.17
100	11	0.9	0.19

Locations 3 & 4

<i>Frequency</i>	<i>Discharge</i>	<i>Runoff Volume</i>	<i>Sediment Volume</i>
2	51	3.6	0.7
10	81	6.3	1.3
25	102	7.8	1.6
50	105	8.9	1.8
100	117	10.0	2.0

Location 5

<i>Frequency</i>	<i>Discharge</i>	<i>Runoff Volume</i>	<i>Sediment Volume</i>
2	9.4	0.7	0.13
10	15.2	1.2	0.24
25	19.0	1.5	0.29
50	19.6	1.7	0.33
100	21.9	1.9	0.38

32.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

32.7 Federal Emergency Management Agency

FEMA data for this area can be found on FIRM Panel Numbers 04013C1670E and 04013C1690E. It is classified as non-shaded Zone X, denoting that the area has been determined to be outside of the 500-year floodplain.

32.8 Alternative Solutions

Location 1, Alternative 1 - Sediment/Debris Basin

The 100-year discharge for Location 1 is 11 cfs. The total storm runoff volume is 0.9 acre-foot. The simplified sediment projection procedure whereby 2 percent of the total storm runoff volume will be sediment, estimates the sediment volume to be 0.2 acre-foot.

Upon reviewing the topographic, right-of-way, and aerial photographic maps from the City, it is determined that the best place to locate the sediment basin is south of the existing tennis court and swimming pool west of 36th Street. This area is referred to as Tract B on the right-of-way maps. The City may have to acquire the necessary drainage easement for this area.

It is recommended that a 5-foot buffer area be placed around the basin on the south, east, and north sides.

Inflow to the basin will be from the east. Flows which accumulate in 36th Street will be directed into the basin by reshaping 36th Street. The street should be warped to direct the flow to the west and to the basin.

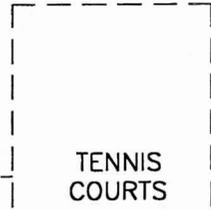
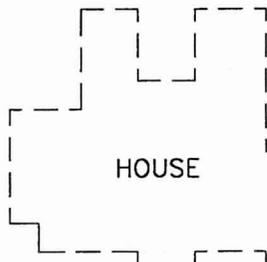
An approximate 25-foot length will be required to allow the overflow water to weir out of the basin at a depth of 0.3 foot. MAG Standard Detail 203 scuppers modified in length may be used to drain the basin through the curb face (see Site 38, Location 1 - Preferred Alternative, Figure 6).

Location 2, Alternative 1 - Crown Ditch

Construct a crown ditch similar to ADOT Standard Detail C-03.10, to be located at the top of the cut slope. Flows running off the side of the mountain will be intercepted by the crown ditch and directed to another location. With the uneven terrain at the top of the cut, it will be necessary to provide a means of draining the flow across 36th Street to the wash on the east side of the road.



SCALE: NTS



GATED DRIVE

MOUNTIANOUS DESERT

36TH STREET

SITE 38
LOCATION 1

WARP 36TH STREET TO DIRECT FLOWS TO THE WEST INTO THE PROPOSED BASIN.

CONSTRUCT AN ASPHALT BERM AT THE CURB RETURN TO HELP TURN THE FLOW WEST.

5' BUFFER ZONE

5' BUFFER ZONE

SEDIMENT BASIN

11CFS

SCUPPERS

LINCOLN DRIVE

NOTE: INITIALLY, NOTHING WILL BE BUILT AT THIS LOCATION UNTIL FUTHER FLOODING DEMONSTRATES THE NEED FOR THIS BASIN

SITE 38 LOCATION 1 - PREFERRED ALTERNATIVE

FIGURE 6

Location 3, Alternative 1 - Channel Realignment

Three issues must be resolved to improve conditions at this location. First, the upstream contributing channel must be regraded to direct the flow downstream to the weir-inlet at the northeast curb return of Palm Canyon Drive. The slope must have a steeper gradient along this reach to prevent flows from going into 36th Street and causing sediment deposition. Second, the culvert must be realigned with the downstream channel so that the flow does not have to turn immediately downstream of the culvert. Third, the culvert must be steepened to increase its sediment conveyance capacity (see Site 38, Location 3 - Preferred Alternative, Figure 7).

Location 4, Alternative 1 - Channel Improvement and Regrading

The ditch along this roadway segment has non-uniform geometry and varying slopes. To reduce the erosion in some places and sediment deposition in others, uniform slope and channel geometry must be analyzed and provided (see Site 38, Location 4 - Preferred Alternative, Figure 8).

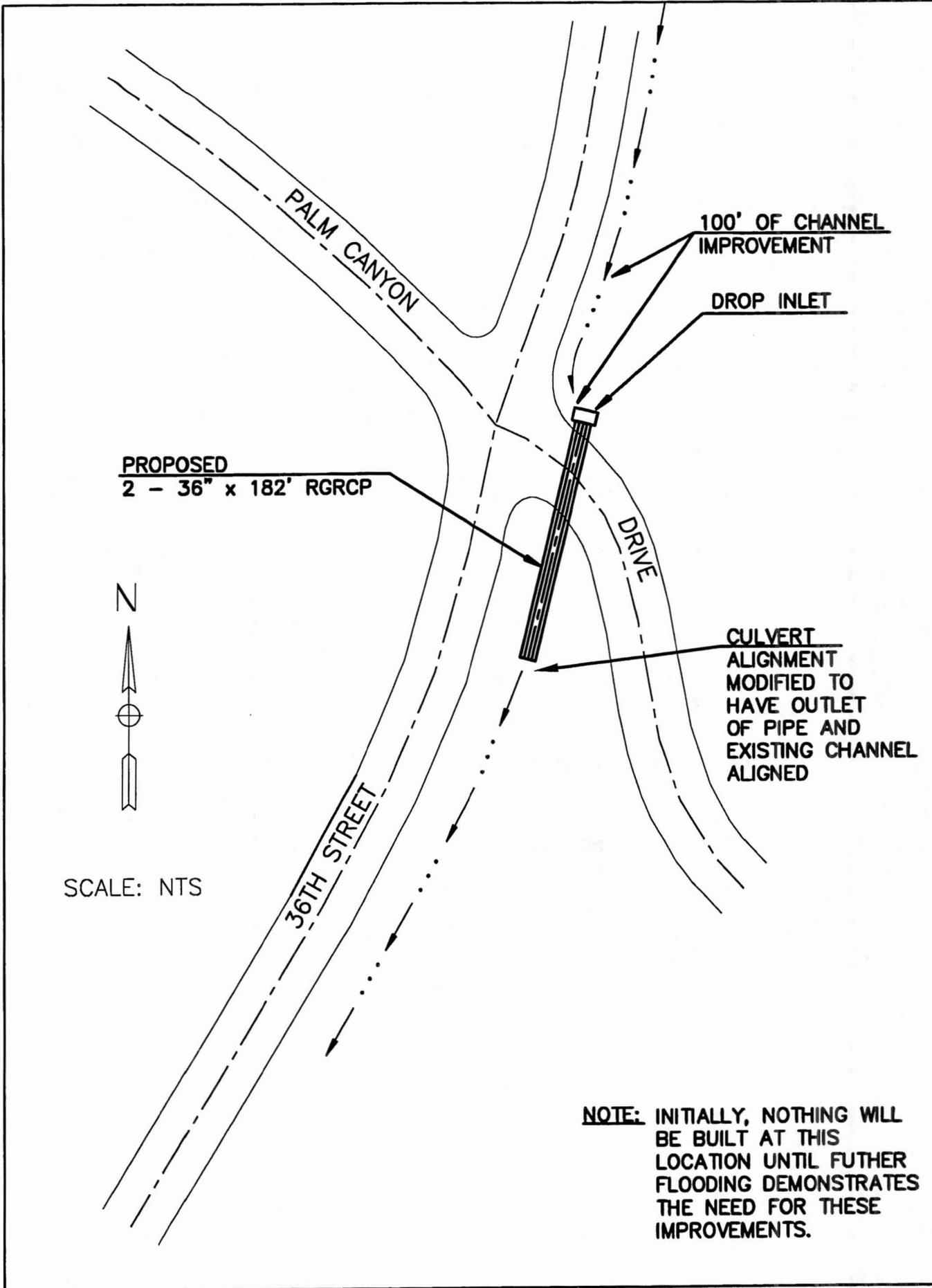
Location 5, Alternative 1 - Regrade 36th Street

The street needs to be regraded to provide a uniform slope. In addition, a high point should be created that will prevent flows from continuing south onto the asphalt section of 36th Street (see Site 38, Location 5 - Preferred Alternative, Figure 9).

The channel discussed in Location 4, Alternative 1 will be extended to this location and 36th Street warped to direct the flow east to discharge into this channel. This will reduce the sediment and rock deposits on 36th Street.

32.9 Recommended Alternative

Due to the rocky conditions and space restrictions, the solutions are beyond the scope of this project. The City of Phoenix has decided to take no action at this site at this time. Maintenance crews have indicated that the main problem area is Location 2 where rocks wash from the west onto 36th Street during heavy rains. The City indicated that they may consider constructing a retaining wall along the west side of 36th Street to Palm Canyon Drive in the future to trap sediment before it reaches 36th Street.



SITE 38 LOCATION 3 PREFERRED ALTERNATIVE

FIGURE 7

N
SCALE: NTS

GRAVEL ROADWAY

EDGE OF PAVEMENT

EXISTING CHANNEL

36TH STREET

ASPHALTIC ROADWAY

NOTE: INITIALLY, NOTHING WILL BE BUILT AT THIS LOCATION UNTIL FUTHER FLOODING DEMONSTRATES THE NEED FOR THESE IMPROVEMENTS.

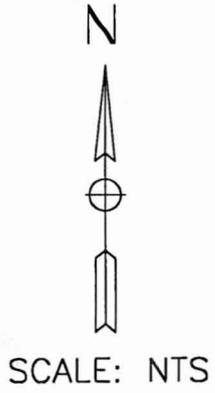
REGRADE THE EXISTING CHANNEL TO HAVE A CONSTANT SLOPE OF 12.82%, BOTTOM WIDTH=10'.

EXISTING CHANNEL

PALM CANYON DRIVE

SITE 38 LOCATION 4 PREFERRED ALTERNATIVE

FIGURE 8



EXISTING GRADE
BREAK

1745.9

EXISTING
GATE

BEGIN EXISTING
CHANNEL

2%

GRAVEL ROADWAY

2%

**REGRADE THE
EXISTING CHANNEL
TO HAVE A CONSTANT
SLOPE OF 12.82%, AND
A BOTTOM WIDTH OF 10'.**

2%

EXISTING CHANNEL

2%

GRAVEL ROADWAY

2%

2%

EDGE OF PAVEMENT

ASPHALTIC ROADWAY

NOTE: INITIALLY, NOTHING WILL
BE BUILT AT THIS
LOCATION UNTIL FUTHER
FLOODING DEMONSTRATES
THE NEED FOR THESE
IMPROVEMENTS.

SITE 38 LOCATION 5 PREFERRED ALTERNATIVE

FIGURE 9

32.10 Cost Estimate

Location 1, Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove Curb and Gutter	30 LF	\$2.00/LF	\$ 100
Reshape 36th Street	Lump Sum		3,000
Basin Excavation	710 YD ³	\$10.00/YD ³	7,100
Scuppers	10 Each	\$1,100/Each	11,000
Landscape Basin	7,500 SF	\$1.00/SF	7,500
Subtotal			\$28,700
20% Contingency			5,700
Total			\$34,500

Location 3, Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Regrade Upstream Channel	100 LF	\$100.00/LF	\$ 10,000
Remove Asphalt	200 YD ²	\$1.80/YD ²	400
Remove Curb & Gutter	40 LF	\$2.00/LF	100
Remove Existing Culvert	180 LF	\$15.00/LF	2,700
Excavate for Culvert	1,670 YD ³	\$3.00/YD ³	5,000
Fill	1,520 YD ³	\$8.00/YD ³	12,200
Asphalt 2" Lift	22 Tons	\$60.00/Ton	1,300
ABC 6" Lift	34 YD ³	\$21.00/YD ³	700
Install Curb & Gutter	40 LF	\$6.00/LF	200
Construct Concrete Drop Inlet	8 YD ³	\$300/YD ³	2,400
Reshape Channel at Culvert Outlet	190 YD ³	\$10.00/YD ³	1,900
36" RGRCP	364 LF	\$135.00/LF	49,100
Subtotal			\$ 86,000
20% Contingency			17,200
Total			\$103,200

Location 4, Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Revise Channel Geometry	890 LF	\$100.00/LF	\$89,000
<i>20% Contingency</i>			17,800
<i>Total</i>			\$106,800

Location 5, Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Revise Slope & Increase Conveyance Capacity	720 LF	\$100.00/LF	\$72,000
Reshape 36th Street	280 YD ³	\$8.00/YD ³	2,200
<i>Subtotal</i>			\$74,200
<i>20% Contingency</i>			14,800
<i>Total</i>			\$89,000

33. Site 39 — Central Avenue and Bethany Home Road

33.1 Location and Site Description

Site 39 is located at the southeast corner of Central Avenue and Bethany Home Road. The area is completely developed as moderately urbanized. It is in Township 3 North, Range 3 East, Section 33 of the Gila and Salt River Base and Meridian (see Site 39 - Vicinity Map, Figure 1).

33.2 Problem Identification

The existing 8-inch concrete pipe has insufficient conveyance capacity to drain runoff away from the residence at the corner of Central Avenue and Bethany Home Road. Consequentially, the resident has complained of property and home flooding (see Site 39 - Problem Identification, Figure 2).

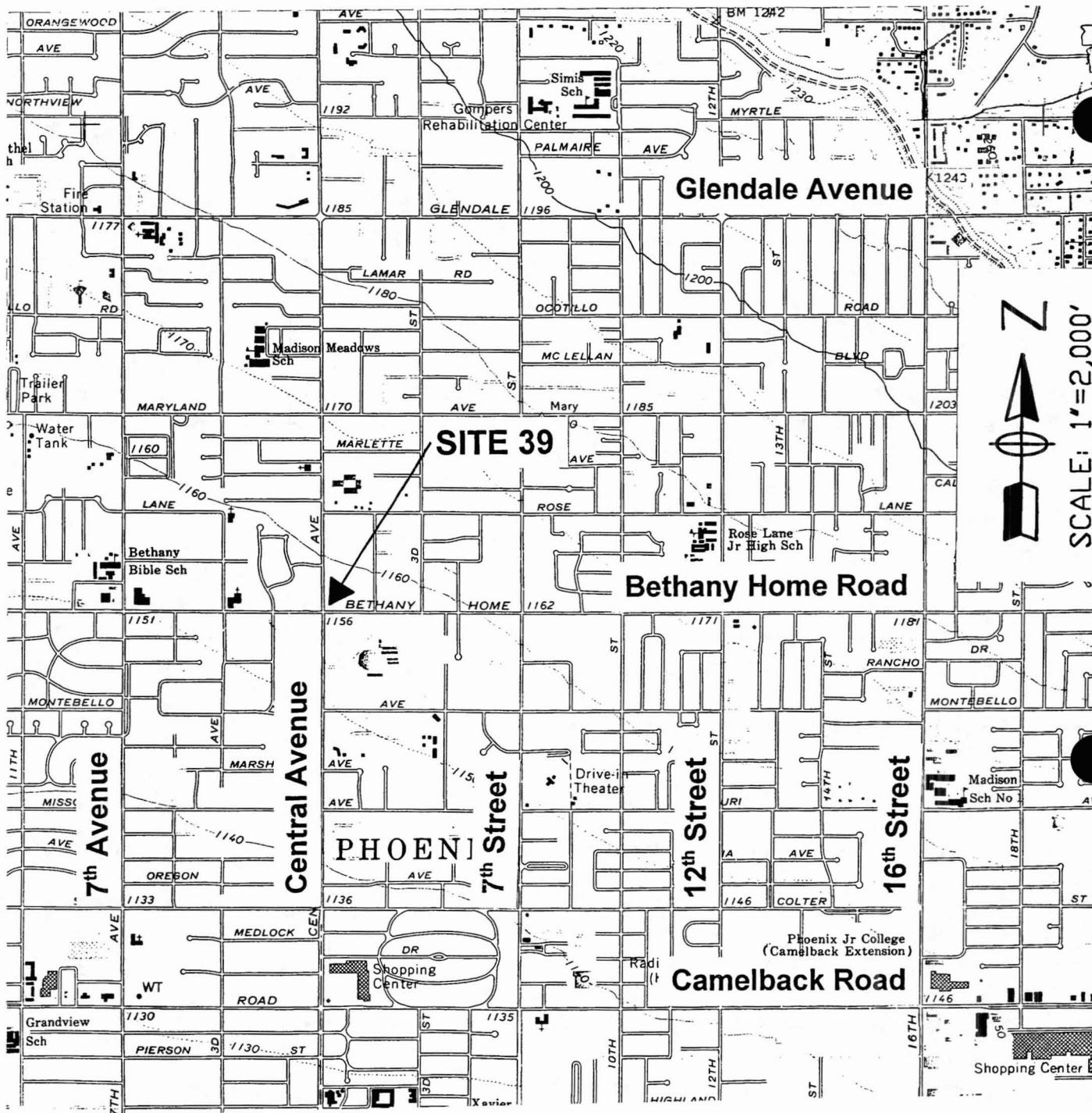
33.3 History

The headwall and its 8-inch concrete pipe collect storm water from the right-of-way swale running parallel to Central Avenue and convey it to the storm drain in Central Avenue. Also found in the right-of-way is an existing equestrian trail adjacent to the right-of-way swale.

33.4 Site Specific Data Acquisition

The following documentation was acquired from various sources for use in evaluating this site:

- City of Phoenix Right-of-Way Quarter Section Map Numbers: 20-28, Revised 8-18-93; 21-28, Revised 7-30-93.
- City of Phoenix Topographic Quarter Section Map Numbers: 20-28, Flown 5-1-82; 21-28, Flown 5-1-82.
- City of Phoenix Aerial Photo Quarter Section Map Numbers: 20-28, Flown 6-12-95; 21-28, Flown 6-12-95.
- City of Phoenix Wastewater Quarter Section Map Numbers: 20-28, Revised 4-26-95; 21-28, Revised 11-4-94.
- City of Phoenix Water Quarter Section Map Numbers: 20-28, Revised 4-26-95; 21-28, Revised 11-4-94.
- City of Phoenix Engineering Storm Drain Map I8 (not dated).
- USGS 7.5-minute quadrangle map for Sunnyslope Arizona which contains Site 39, its upstream drainage area, and downstream flow path, Photo Revised 1982.
- Paving Central Avenue, Camelback Road to Bethany Home Road, City of Phoenix P-895904, Erikson & Salmon, Inc., Record Drawing Date 3-30-92.
- Storm Sewer in Central Avenue, Camelback Road to Bethany Home Road, City of Phoenix ST-846063, Erikson & Salmon, Inc., Record Drawing Date 3-30-92.



SITES 39 - VICINITY MAP

FIGURE 1



SCALE: NTS

BERRIDGE LANE

CENTRAL AVENUE

CENTERLINE OF EXISTING SWALE

EXISTING DRIVEWAY

EXISTING 18" CULVERT

EXISTING 8" CONCRETE PIPE

EXISTING CONCRETE HEADWALL

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SITE 39

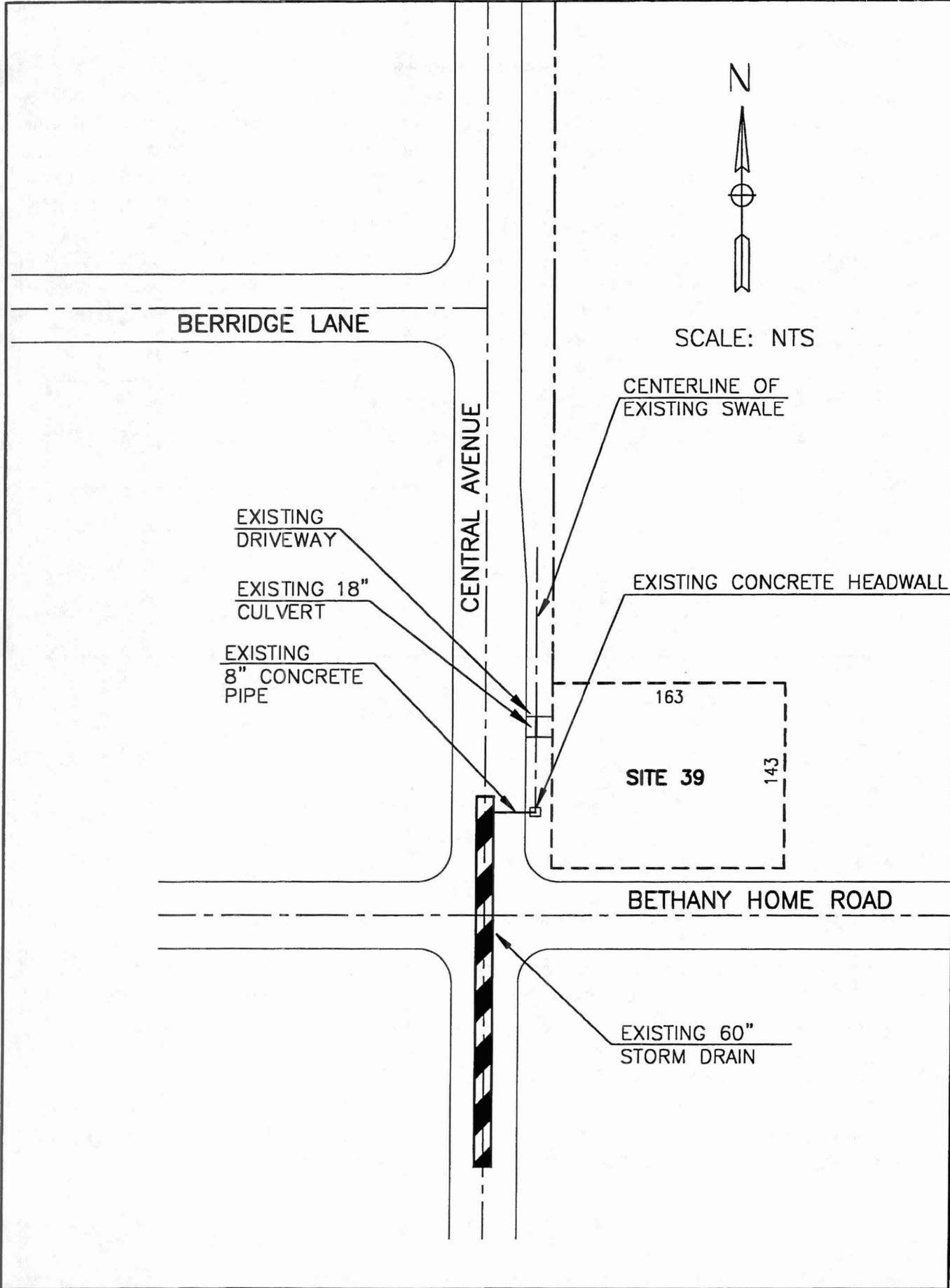
143

BETHANY HOME ROAD

EXISTING 60" STORM DRAIN

SITE 39 - PROBLEM IDENTIFICATION

FIGURE 2



33.5 Hydrology

This site is located at the residence at the southeast corner of Central Avenue and Bethany Home Road. A drainage area was delineated with the assumption that all flow in Central Avenue upstream of Marlette Avenue is intercepted or diverted. However, all flows south of Marlette Avenue were considered to impact the site for 100 percent of the runoff for all frequency storms. Flows originate from the northeast and drain in a southwesterly direction. A detailed hydrologic study will be required to determine the actual flow split which is beyond the scope of this project. The drainage area size is 59.7 acres. The runoff from this drainage area is directed to Central Avenue, then south in a right-of-way swale to a headwall for an 8-inch concrete pipe located at the southeast curb return of Central Avenue and Bethany Home Road. The following table lists the hydrologic and hydraulic values for the site:

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>	<i>Runoff Volume (ac-ft)</i>	<i>Depth of Flow in Channel (ft)</i>	<i>Flow Velocity (fps)</i>
100	105	20.1	*	*
50	94	17.8	*	*
10	67	15.5	*	*
5	56	12.6	2.02	4.64
2	32	7.2	1.43	3.94

*Exceeds top of bank (20 feet).

33.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

No freeway corridors are planned for this area in the foreseeable future.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

The City of Phoenix Street Transportation Department instituted a five-year arterial street and storm drain improvement program beginning in 1995. There are no plans to improve any of the streets, nor are there any plans to construct any storm drain systems in the area of this site.

33.7 Federal Emergency Management Agency

FEMA data for this site can be found on FIRM Panel Number 04013C1665G. The area is shown to be in a non-shaded Zone X which denotes areas beyond the 500-year floodplain.

33.8 Alternative Solutions

Alternative 1 - Create a High Point in the Resident's Driveway

The site located at the southeast corner of Central Avenue and Bethany Home Road is fenced with a block wall. Flows can only enter the property from the driveway. This alternative proposes the construction of a high point in the driveway at the fence line that is 0.5-foot higher than the edge of pavement. This will divert a portion of the flow away from the property and prevent the house from flooding.

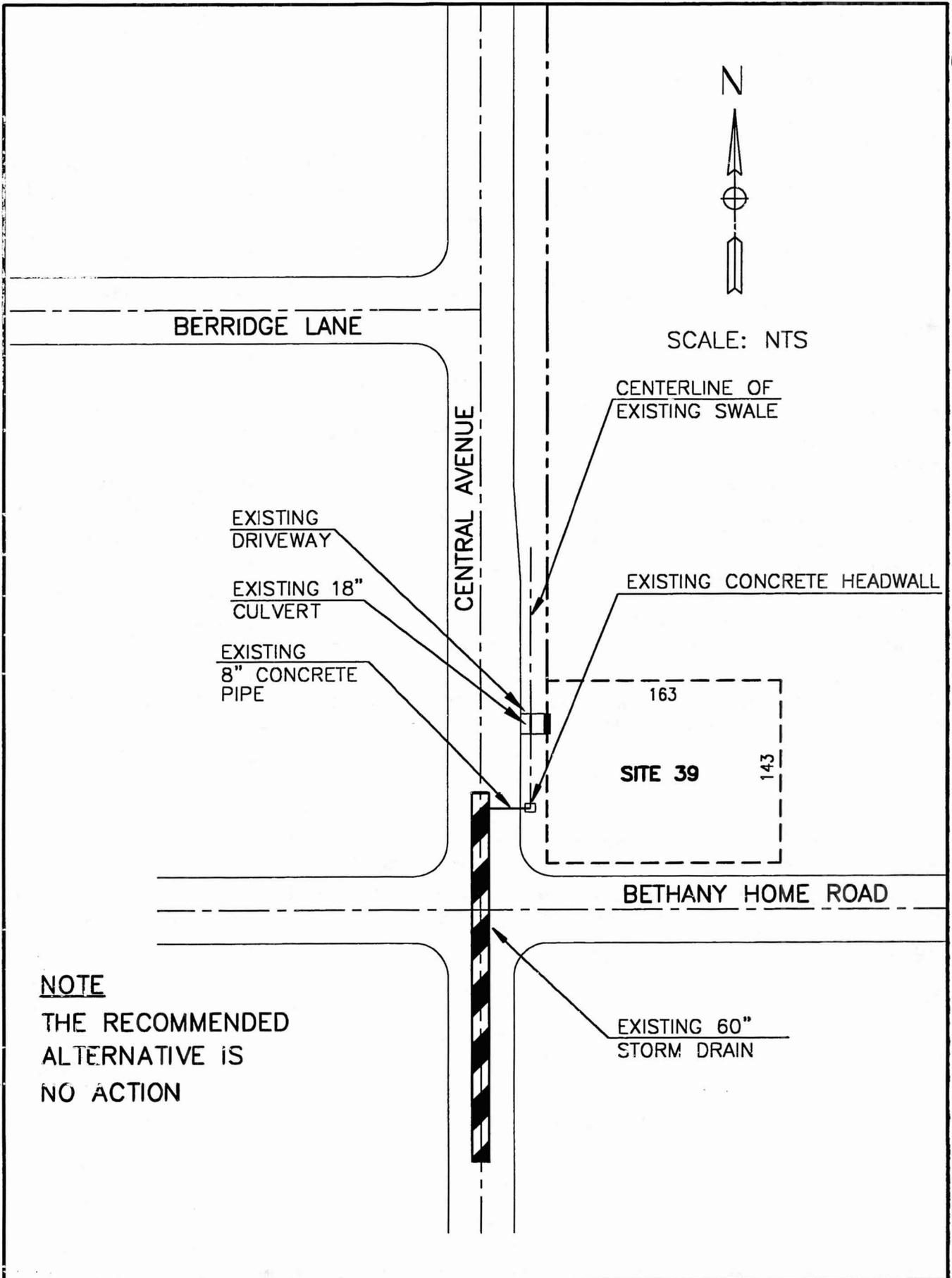
Alternative 2 - Replace Existing 8-Inch Concrete Pipe and Headwall with a Pipe Sized to Intercept the 2-Year Storm

There is an existing 60-inch storm drain in Central Avenue into which the 8-inch concrete pipe drains. The hydraulic report is not available for review. However, the storm drain plans for the storm sewer in Central Avenue shows the hydraulic grade elevation in the center of the junction structure to be 1145.9. The design frequency for the trunk line is not known. However, it was assumed that the design frequency is the 2-year storm (32 cfs). The centerline elevation in Central Avenue at the center of the junction structure is 1156.7. Assuming a 2% cross slope, the gutter elevation at the extruded curb is 1156.2. To convey the 2-year storm at an elevation of 1155.7 (0.5 foot lower than the pavement) to the existing 60-inch storm drain, a 30-inch RGRCP will be required. This alternative includes the construction of approximately 30 linear feet of 30-inch RGRCP and four City of Phoenix P-1570 Type N catch basins with four City of Phoenix P-1565 Type 2 grates in place of the existing headwall and 8-inch pipe.

The existing extruded curb will be removed to reduce the potential for flooding of the residence with less frequent storms.

33.9 Recommended Alternative

The City of Phoenix has indicated that flooding problems at this site are minimal. The City has determined that solutions to correct the problem are beyond the scope of this project due to community sensitivity associated with the bridle path. The City has decided to take no action at this time and that any future action will require community consent (see Site 39 - Preferred Alternative, Figure 3).



NOTE
 THE RECOMMENDED
 ALTERNATIVE IS
 NO ACTION

SITE 39 - PREFERRED ALTERNATIVE

FIGURE 3

33.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Sawcut Concrete Driveway	32 LF	\$3.00/LF	\$ 100
Remove Existing Concrete	15 YD ²	\$50.00/YD ²	800
Fill Material	40 YD ³	\$8.00/YD ³	300
PCC Concrete for Driveway	1.2 YD ³	\$200.00/YD ³	200
<i>Subtotal</i>			\$1,400
<i>20% Contingency</i>			300
<i>Total</i>			\$1,700

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Remove 4-Inch Extruded Curb	Lump Sum		\$ 500
Remove Asphalt	39 YD ²	\$1.80/YD ²	100
Remove Existing Pipe and Headwall	Lump Sum		1,000
Excavation	55 YD ³	\$3.00/YD ³	200
Asphalt 2-Inch Lift	0.1 Ton	\$60.00/Ton	100
Fill	47 YD ³	\$8.00/YD ³	400
ABC 6-Inch Lift	4 YD ³	\$21.00/YD ³	100
COP Standard Detail P-1570 4-Catch Basin	1 Each	\$3,000/Each	3,000
30-Inch RGRCP	30 LF	\$80.00/LF	2,400
Connect to Existing Junction Structure	Lump Sum		1,000
<i>Subtotal</i>			\$8,800
<i>20% Contingency</i>			1,800
<i>Total</i>			\$10,600

34. Site 40 — East Side of Central, Butler to Bethany Home Road

34.1 Location and Site Description

This site is an existing swale located along the eastern right-of-way of Central Avenue from Bethany Home Road to Butler Drive. An existing horse path is located adjacent to the swale within the easement (see Site 40 - Vicinity Map, Figure 1).

34.2 Problem Identification

Erosion of asphalt driveways occurs when the flow in the swale along Central Avenue overtops its banks and the driveway crossings (see Site 40 - Problem Identification, Figure 2).

34.3 History

Asphalt driveways cross the swale which conveys flow for Central Avenue. The driveway owners have complained of damage to their driveways from the flows and have requested help from the City of Phoenix.

34.4 Site Specific Data Acquisition

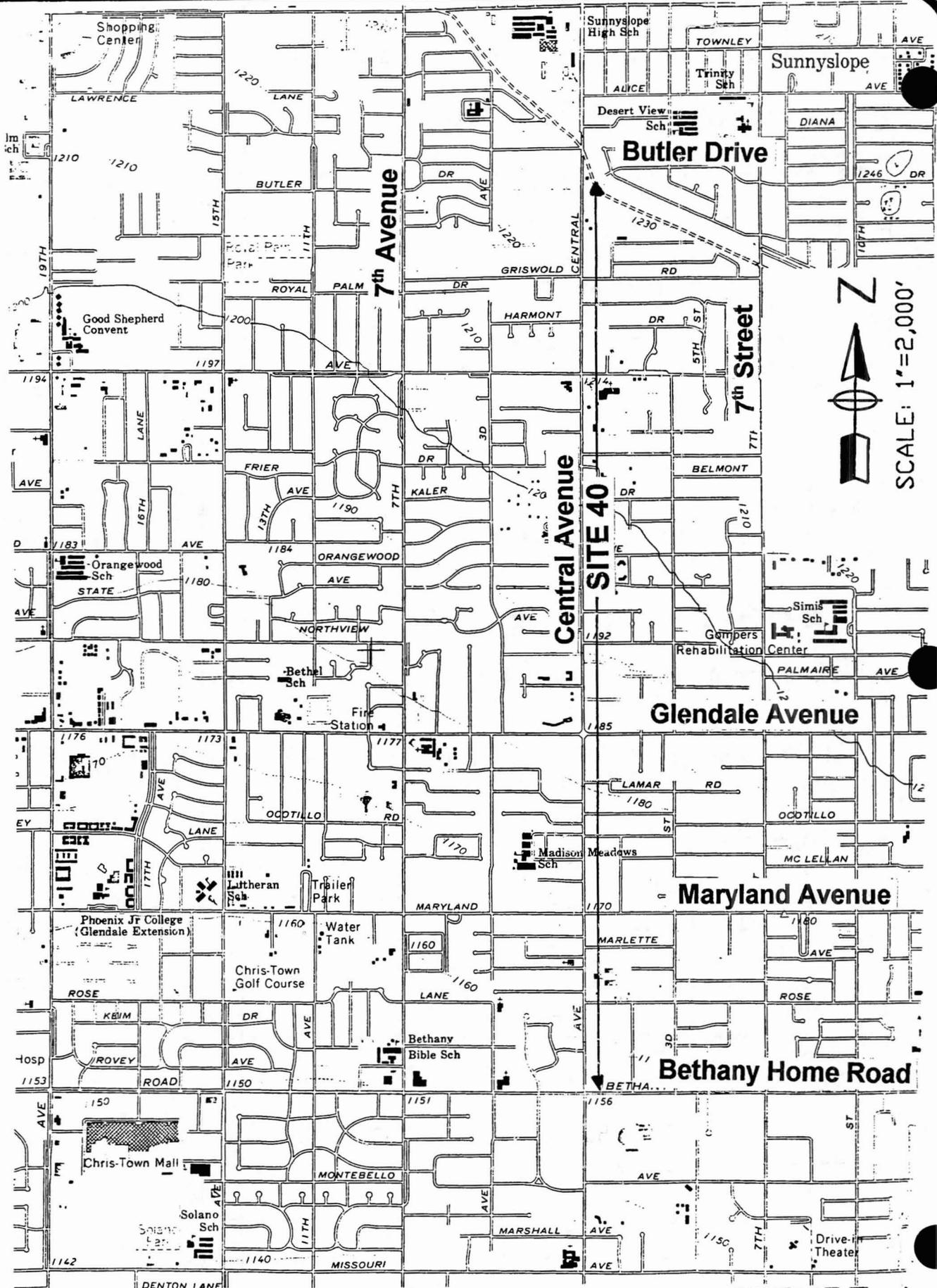
The following documentation was acquired from various sources for use in evaluating this site:

- USGS 7.5-minute quadrangle map for Sunnyslope which contains Site 40 and its upstream drainage area, Revised 1982.

34.5 Hydrology

The flows for this reach, as calculated by the Rational Method for different design frequencies, are as follows:

<i>Frequency (yr)</i>	<i>Discharge (cfs)</i>
100	105
50	94
10	67
5	56
2	32

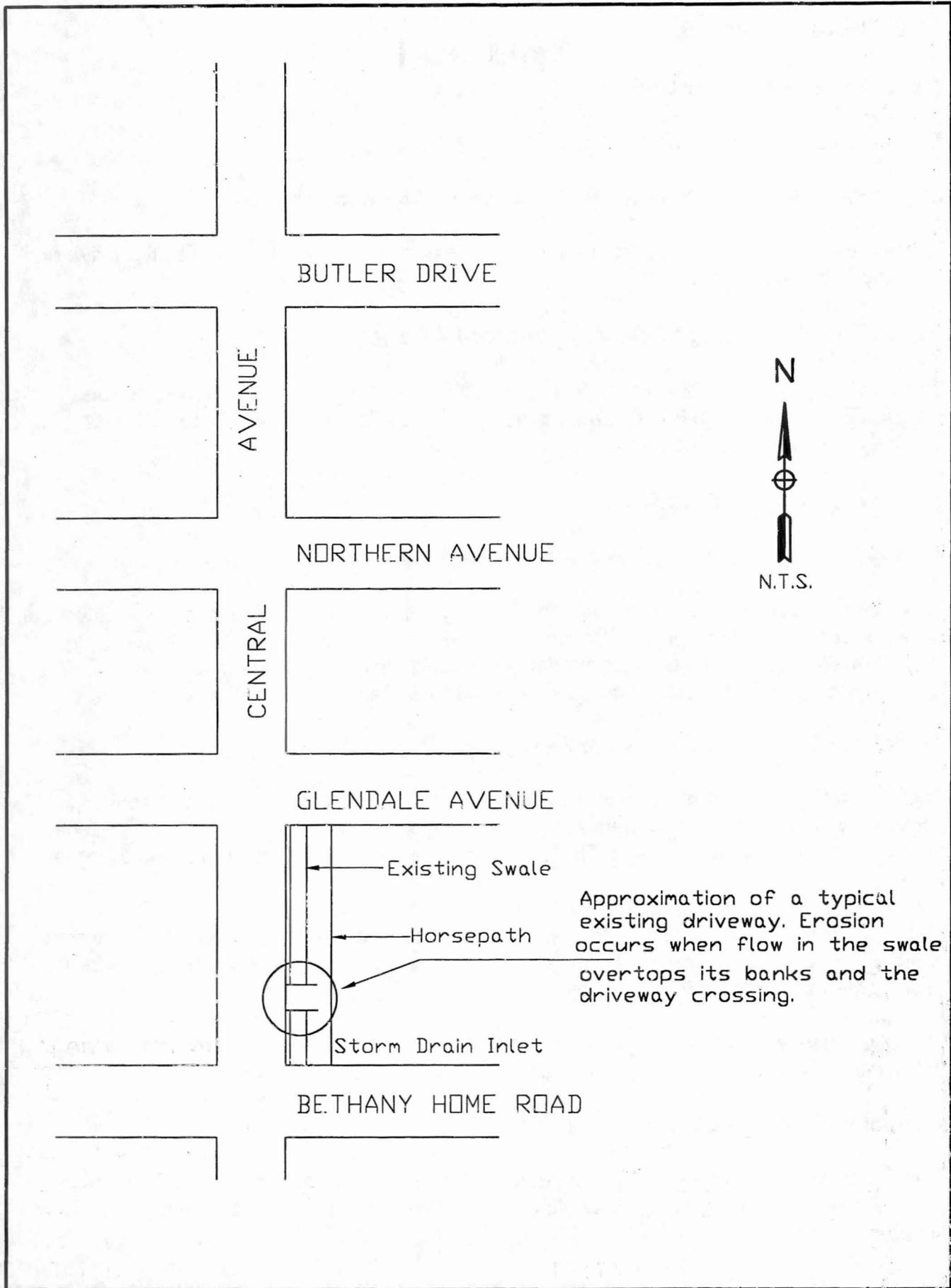


N

 SCALE: 1"=2,000'

SITE 40 - VICINITY MAP

FIGURE 1



SITE 40 - PROBLEM IDENTIFICATION

FIGURE 2

34.6 Future Projects

City of Phoenix Freeway Corridor Information Report, Summer 1993

There are no projects planned which will impact this site.

City of Phoenix Five-Year Arterial Street and Storm Drain Program

There are no plans within this program to improve Central Avenue between Butler Drive and Bethany Home Road.

34.7 Federal Emergency Management Agency

This site is located on FEMA Flood Insurance Rate Map Panel Number 04013C1665G, revised September 30, 1995. The area is designated as Zone X, which denotes areas outside of the 500-year floodplain.

34.8 Alternative Solutions

Alternative 1 - Improvement of Driveway Erosion Only

This alternative consists of Improving the driveway crossings by replacing the asphalt with a brick and mortar crossing or another more durable material such as concrete (see Figure 2.1). This alternative does not prevent flow from overtopping the banks of the swale. Driveways to be constructed in accordance with MAG Standard Detail #250.

Alternative 2 - Improvement of the Swale Capacity

This alternative involves increasing the swale capacity by increasing its depth, providing corrugated metal pipe culverts beneath the driveways, and providing for regular maintenance to remove sedimentation build-up. This would prevent the flows from overtopping the swale banks.

The depth required to convey the 2-year flow is approximately 4 feet, without freeboard, for a channel with a 2-foot bottom width and a 1:1 side slope. Corrugated metal pipes will be used to carry the flow beneath the driveways.

This alternative will increase capacity but will require the entire 10-foot easement, eliminating the horse path and possibly requiring safety fencing along the channel.

Alternative 3 - Install a 2-Year Storm Drain

This alternative requires that a 66-inch storm drain with catch basin/inlet be installed along the entire segment and tied to the existing storm drains. However, this option is beyond the scope of this project.

34.9 Recommended Alternative

The City of Phoenix has indicated that there is minimal flooding at this site. However, there is a problem with debris and erosion in the swale and driveways. The City has determined that the solutions to correct the problem (such as tiling under the length of the bridle path) are beyond the scope of what can be achieved for this project. The City has decided to take no action at this time and has indicated that any action taken in the future will require community consent.

34.10 Cost Estimate

Alternative 1

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
5" Concrete Driveway	520 SF	\$2.50/SF	\$1,300
<i>Subtotal</i>			\$1,300
<i>20% Contingency</i>			300
<i>Total</i>			\$1,600

Alternative 2

<i>Description</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Cost</i>
Excavation	100 YD ³	\$1.50/YD ³	\$ 200
26' x 9" CMP	5 Each	\$455/Each	2,300
<i>Subtotal</i>			\$2,500
<i>20% Contingency</i>			500
<i>Total</i>			\$3,000