Northern/Orangewood Storm Drain Project
LOCATION STUDY

FCD Contract 94-12

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ENG COPY

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LOCATION STUDY

FCD Contract 94-12

March 14, 1996

Prepared for:
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1.0 EXECUTIVE SUMMARY

On December 29, 1994, the District entered into an agreement with Wood, Patel & Associates, Inc. (WPA) to perform a Concept Routing Study for the Northern/Orangewood Storm Drain Project. A preliminary concept evaluation was performed prior to the Concept Routing Study. This evaluation studied additional conceptual alignments on a micro scale within the storm drain alignment corridor. The results of this evaluation are presented in this Location Study.

The study area is bounded by Butler Drive to the north, 63rd Avenue to the east, Glendale Avenue to the south, and the Agua Fria Freeway to the west. Figure 1, Location Map, depicts the Northern, Orangewood, and Glendale Avenue alignments, including the contributing watershed.

The original purpose of this Location Study was to develop and evaluate storm drain alternative routing schemes along Grand Avenue near 67th Avenue, Northern Avenue near 85th Avenue, storm drain to Peoria basin at Northern Avenue near 85th Avenue, and the outfall near 91st Avenue and Orangewood.

The Location Study is hereby presented to the District and the Cities of Glendale and Peoria with a number of options and WPA's recommended option. The recommended options are incorporated into the Concept/Routing Study (published separately). These agencies will review and select a storm drain alignment for further consideration from the Concept/Routing Study.

Although several Location Study suboptions were not recommended for further consideration by WPA; the District, City of Glendale, and City of Peoria have requested that they be included in this report to document all of the concepts that were considered. This study document is submitted to the agencies as backup information only.

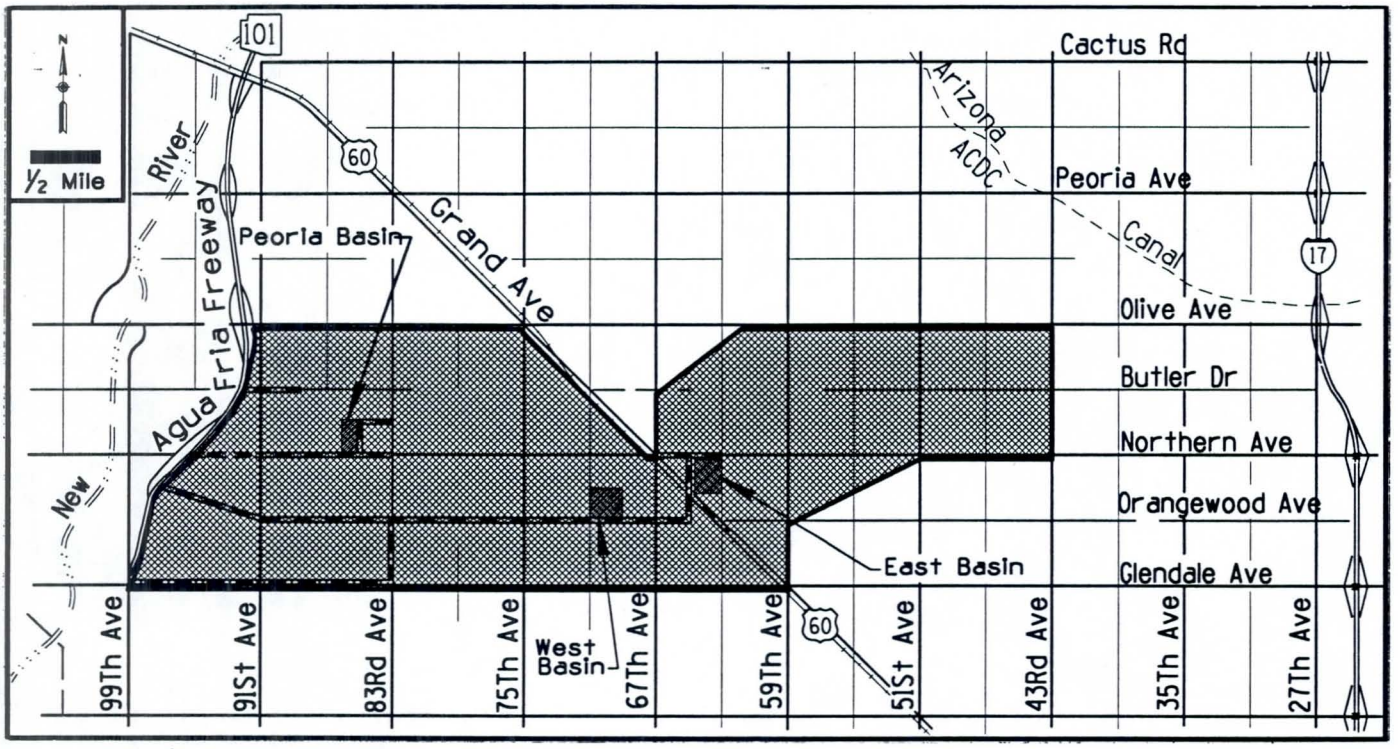


Figure 1, Location Map

Storm drain alignments evaluated in the Concept/Routing Study are depicted as dashed lines. The cross hatch shaded area represents the contributing watershed.

2.0 INTRODUCTION

The Flood Control District of Maricopa County (District) identifies regional drainage and flooding problems and develops alternative solutions to protect life and property. This program is accomplished through Area Drainage Master Studies (ADMS's) and Area Drainage Master Plans (ADMP's).

The District, in association with the Cities of Glendale and Peoria, performed such an ADMP called the *Glendale-Peoria ADMP* in May of 1987. The *ADMP* recommended several comprehensive storm drain/detention basin projects. Some of those projects are already built and others are under construction or design. One such project is the subject of this study.

On December 29, 1994, the District entered into an agreement with Wood, Patel & Associates, Inc. (WPA) to perform a Concept/Routing Study for the Northern/Orangewood alignments. A phasing plan will be prepared upon completion of the Concept/Routing Study and design plans will follow thereafter.

Based on the preliminary concept evaluation during the project proposal stage, several cost-effective alternative alignments were identified by WPA. During the study phase of the Concept/Routing Study, WPA studied additional conceptual alignments on a micro scale in the following locations within the storm drain alignment corridor, herein referred to as *Location Study*.

Location 1. Grand Avenue near 67th Avenue (Glendale west and east basins)
Location 2. Northern Avenue near 85th Avenue (Peoria north and south basins)
Location 3. Storm drain to Peoria basin at Northern Avenue near 85th avenue
Location 4. Outfall at 91st Avenue near Orangewood.

For each isolated study location, the storm drain alignment (and basin facility, if applicable) has been identified per the *Glendale-Peoria ADMP*. A cost analysis was performed for this alignment based on the unit price data from the *ADMP*. The results of this analysis were used as the basis for comparison with other possible alignment options. The unit prices from the *ADMP* were used to insure an "apples-to-apples" comparison.

3.0 HYDROLOGY

The *Location Study* alternatives presented here were developed in the initial phases of the Concept/Routing Study in an attempt to identify the optimum alignment for recommendation to the District. Therefore, these alignments were developed using the results of the preliminary hydrologic analysis from the *Glendale-Peoria ADMP*.

4.0 STORM DRAIN LOCATION STUDY

4.1 Introduction

The *Glendale-Peoria ADMP* outlines major trunk line and lateral storm drain systems within the study area. In that report, several storm drain alignments were laid out including trunk lines along major arterial streets such as Cactus Road, Olive Avenue, Northern Avenue and Orangewood Avenue.

While maintaining the general storm drain alignment concept presented in the *ADMP*, small-scale alternative alignments and pipe sizes were identified at several locations through the *Location Study*. These alternatives were developed using the results of the preliminary hydrologic analysis. Section 4.2 describes the individual alternatives and the selection of the recommended alignment.

The most desirable alignments from the *Location Study* were selected for their incorporation into two major storm drain outfall alignments in the Concept Routing Study. These alignments were:

- Northern Avenue storm drain alignment for the City of Peoria
- Orangewood Avenue or Glendale Avenue for the City of Glendale.

An in-depth cost evaluation was then carried out for these alignments. Several key components were included to further refine the alignments presented in Sections 4.2 and 4.3.

The detention basins proposed with the Concept/Routing Study will serve as a surge basin per the intent of the *Glendale/Peoria ADMP*. According to the *ADMP* concept, by significantly reducing the downstream pipe size at strategic locations, the stormwater hydraulic grade line is pushed higher within the storm drain system. By allowing a large opening area immediately upstream of the smaller diameter pipe, then facilitates the larger peak flows to enter into the detention basin.

The surge basin facility thus operates as an off-line detention basin. It offers the following advantages:

- Allows initial runoff to continue in the small diameter pipe, thereby bypassing the detention basin. This, in turn, will keep the basin free from all nuisance flows. This concept will likely divert the majority of frequent storms on an annual basis. As a result, problems associated with siltation, ponding, nuisance vegetation growth, and maintenance can be significantly reduced. Additionally, multiple use of the basin facility for recreation and play fields can increase.

- Allows much lower invert elevations for the storm drain system. As a result, keeping the storm drain pipe below the majority of existing utilities, e.g., sanitary sewer line, irrigation lines, electric/telephone/gas lines. This option reduces relocation costs associated with both dry and wet utilities.

For the purpose of hydraulic/hydrologic modeling, an off-line type of hydrograph divert subroutine was used. This concept was concurred by the District.

Cost estimates for earthwork for the detention/surge basin were based on the peak storage volume for diverted hydrographs. Several factors will influence earthwork estimates presented in this report during the final design of the detention/surge basin including:

- configuration of recreational fields, parking areas, etc.;
- terracing requirements within basins (i.e., certain areas above 1-year and 2-year peak water surface elevations);
- handling of low-flow swales within the basin and type of lining material used; and
- minimum acceptable cross slope in basin bottom.

Sections 4.2 and 4.3 describe the *ADMP* alignments as they apply to this project as well as several alternative general alignments. The alternatives resulted from discussions among the Flood Control District of Maricopa County, WPA, and the Cities of Peoria and Glendale.

In the following sections, numerous plates and tables are referenced in order to explain the various options. These plates and pertinent cost analysis tables are included in Appendix I.

4.2 Location Study

Based on the preliminary concept evaluation during the project proposal stage, several cost-effective alternative alignments were identified by WPA. During the study phase, WPA studied additional conceptual alignments on a micro scale in the following locations within the storm drain alignment corridor, herein referred to as *Location Study*.

Location 1. Grand Avenue near 67th Avenue (Glendale west and east basins)

Location 2. Northern Avenue near 85th Avenue (Peoria north and south basins)

Location 3. Storm drain to Peoria basin at Northern Avenue near 85th Avenue

Location 4. Outfall at 91st Avenue near Orangewood

For each isolated study location, the storm drain alignment (and basin facility if applicable) was identified per the *Glendale-Peoria ADMP*. A cost analysis was performed for this alignment based on the unit price data from the *ADMP*. The results of this analysis were used as the basis for comparison with other possible alignment options. Here again, the unit prices from the *ADMP* were used to insure an "apples-to-apples" comparison.

This *Location Study* was previously submitted to the District and the Cities of Glendale and Peoria for the purpose of finding the optimum storm drain alignment serving the needs of all communities involved. With the exception of one location (location 2), the recommended option for each location in the *Location Study* was used in the larger-scale Concept/Routing Study. At location 2, the City of Peoria recommended that WPA evaluate a storm drain alignment along Butler Drive. The details of the Butler Drive alignment are discussed in Section 4.2.3.

Although several Location Study suboptions were not recommended for further consideration by WPA, the District, City of Glendale, and City of Peoria have requested that they be included in this report to document all of the concepts that were considered. The options that were not recommended are provided in this report for informational purposes only.

4.2.1 Location 1:

Location one is bounded by Northern Avenue to the north, 63rd Avenue to the east, Orangewood Avenue to the south and 71st Avenue to the west (see Plate I-1 in Appendix I). This location includes improvements to the area west of Grand Avenue by the District and joint Glendale/Peoria participation. However, the area east of Grand Avenue will be either the City of Glendale, ADOT, or combined Glendale/ADOT responsibility.

The *Glendale-Peoria ADMP* concept called for a pipe in Grand Avenue south of Northern Avenue between 65th and 67th Avenues. The pipe would drain that portion of Grand Avenue, including the 67th Avenue/Northern Avenue intersection. in order to avoid traffic conflicts, a Northern Avenue storm drain alignment was chosen as an alternate way to drain the intersection. This alignment, which extends between 63rd and 67th Avenues, provides additional protection for the City of Glendale along Northern Avenue, but still serves to drain the 67th Avenue/Northern Avenue intersection. Therefore, although much of the benefit and consequent burden of cost will be the City of Glendale's, the City could negotiate with ADOT to share the cost since some flood protection/relief is still being provided along Grand Avenue.

Several options were considered in the routing study within this location.

Option 1

Option 1 includes the storm drain and detention basin as proposed in the *Glendale-Peoria ADMP*. By including the recommendations from the *ADMP*, it is easier to compare cost as well as other factors in the selection process for this particular location.

As shown on Plate I-1, a 10-foot diameter pipe is proposed within Northern Avenue between 67th Avenue and 63rd Avenue. Likewise, a 9-foot diameter pipe is proposed along Grand Avenue between 67th and 63rd Avenues. These pipes may be the responsibility of Glendale and/or ADOT. A 12-foot diameter pipe is proposed within 67th Avenue from Northern Avenue to Orangewood Avenue and the pipe continues west from 67th Avenue to 69th Avenue in the Orangewood Avenue alignment. At this point, a surge basin will intercept a large portion of the flow from the trunk line. The downstream storm drain between 69th Avenue and 71st Avenue within Orangewood Avenue will be reduced to a 6-foot diameter pipe.

Since the construction of the surge basin will be a common item to all options, for comparison purposes the basin's excavation and other associated costs have not been included in the cost analysis. However, the general advantages and disadvantages of Option 1 are discussed in the following paragraphs.

Some advantages of Option 1 include the lack of need to acquire any additional right-of-way since this alignment follows existing right-of-way in Orangewood Avenue, 67th Avenue, Northern Avenue and Grand Avenue. Furthermore, there is no need for any additional effort to acquire surge basin right-of-way because the land has already been acquired. Finally, since the entire alignment falls within major roadways, the storm drain proposed will also handle the pavement drainage as it occurs from localized areas.

One major disadvantage of Option 1 is that there is a large volume of traffic on 67th Avenue in a north-south direction. Likewise, there is significant traffic in Grand Avenue and Northern Avenue. The traffic disruption caused by the 12-foot pipe installation will be catastrophic. Due to the 6-way intersection, the Northern Avenue and 67th Avenue construction will be extremely difficult. This intersection also has many utilities. Therefore, to handle large conduits such as the proposed 12, 10, and 9-foot diameter pipes a major portion of the intersection will be required to be cut open. The associated costs will be extremely high.

In addition, the 12-foot diameter pipe has to cross a heavily traveled railroad alignment south of the intersection.

Another disadvantage of Option 1 is that 67th Avenue is a major north-south traffic carrier and there are numerous commercial developments on both sides of the roadway. Providing serviceable driveway access while installing a 12-foot-diameter storm drain will be a very costly and slow process. Additionally, there are numerous utilities which could conflict with the 12-foot diameter pipe.

Construction along Orangewood Avenue does not appear to present many difficulties, primarily because Orangewood Avenue does not experience a large traffic volume and because several detour alternatives exist. Additionally, utility conflicts appear manageable. However, this alignment will still require extensive effort in order to install a 12-foot diameter pipe as proposed.

The cost estimate for this option is shown in Table I-1 in Appendix I.

Option 2

Option 2 identifies a revised routing scheme including the storm drain as well as the surge basin. The basin is now located on the east side of Grand Avenue between 65th and 63rd Avenues immediately south of Northern Avenue. The routing scheme is shown on Plate I-2.

The District and joint city responsibility for the storm drain improvements will end at Grand Avenue. The benefit of this option's alignment is that the storm drain will cross Grand Avenue at Frier Drive alignment about ¼ mile south of Northern Avenue. This location also is a low point within Grand Avenue and therefore conveyance of drainage will be easier to handle. With this option, a significant reduction in the pipe size, traffic disturbance, and overall cost is anticipated. As shown on Plate I-2, the flow will be routed via a 10-foot diameter pipe from the Northern Avenue and 67th Avenue intersection east along Northern Avenue to 65th Avenue. Likewise, a 3-foot diameter pipe along Northern between 63rd and 65th Avenues will fall within the basin right-of-way. Since the

3-foot pipe will be located within the basin boundaries, construction will be very easy. There will be less traffic disturbance and fewer utility conflicts with this alignment. The cast-in-place pipe option may be available for this storm drain alignment which can again translate into a major cost savings. From the junction at Northern Avenue and 65th Avenue an estimated 4-foot diameter pipe will follow the westerly boundary of the basin to Grand Avenue near Frier Drive. The combined flow from the 10-foot and 3-foot diameter pipes will enter the 4-foot diameter pipe, thereby allowing excess flow into the east surge basin.

Within Grand Avenue a 9-foot pipe is proposed between 63rd Avenue and 65th Avenue. Here again, this pipe can be placed by ADOT or a joint effort between Glendale and ADOT. Initial flow from this 9-foot pipe will be discharged to the outflow storm drain system. However, excess flow will be directed to drain into the east surge basin, thereby keeping the diameter of the outflow pipe at 5 feet or smaller.

The 5-foot diameter pipe will continue along 65th Avenue south to Orangewood Avenue then west along Orangewood to 67th Avenue. Because of local flow, it is anticipated that the pipe may become 6-foot in diameter between 67th Avenue and 71st Avenue within this alignment. A portion of pipe within the 65th Avenue alignment will require new right-of-way. Additionally, the entire surge basin area will have to be purchased.

Since construction activity at the 67th Avenue and Northern Avenue intersection will be reduced significantly, the traffic disruption will be reduced as well. Additionally, by moving construction away from this major intersection, the construction period will be shorter due to fewer utility conflicts. A significant cost reduction is possible with this option as shown in Table I-2. By not constructing along 67th Avenue, the disruption of traffic and business driveways will be reduced. The fact that a major portion of the storm drain follows a rural farmland alignment, consists of cast in-place pipe, and has fewer utility conflicts will result in a significant cost reduction over Option 1.

By moving the basin to the east side, it is possible that the east basin portion of construction can be done in the early phase and the system can be working without the benefit of an outfall. It is recognized that a positive drain is not available to discharge the stored water in the basin in the interim condition, so some special provision will be required to drain the basin.

Since both east and west basins are similar in size, for the purpose of the *Location Study*, right-of-way costs were not included in the cost estimate.

4.2.2 Location 2:

This location is bounded by Northern Avenue to the north, 85th Avenue to the east, Orangewood Avenue to the south and 91st Avenue to the west. The improvements for this location will be the responsibility of the District and a joint Glendale/Peoria participation. Several options have been considered in the routing study within this location.

Option P1

Option P1, as shown on Plate I-3, is the storm drain alignment recommended in the *ADMP* and has been provided for cost comparison purposes. This alignment consists of a 4.5-foot to 5-foot diameter storm drain in Northern Avenue from 85th Avenue to 91st Avenue and a 6-foot diameter storm drain in 91st Avenue from Northern Avenue to Orangewood Avenue. Also included within this option is a detention/surge basin located at the northwest corner of 85th Avenue and Northern Avenue.

Subsequent to the selection of this alignment in the *Glendale-Peoria ADMP*, a 5-foot diameter storm drain was constructed in Northern Avenue from 91st Avenue to the ADOT outfall channel. The capacity of this storm drain was analyzed in an attempt to optimize the design in this location.

Costs associated with Option P1 are shown on Table I-3.

Option P2-North

This alignment, as shown on Plate I-4, consists of a 3.5-foot diameter storm drain from 85th Avenue to 89th Avenue, a 5-foot diameter storm drain from 89th Avenue to 91st Avenue and a 4-foot diameter storm drain in 91st Avenue from Northern Avenue to Orangewood Avenue.

This alignment takes advantage of the capacity an existing 5-foot diameter storm drain in Northern Avenue which will carry flow from 91st Avenue to the Agua Fria Freeway outfall channel. By utilizing the capacity of this storm drain, the storm drain in 91st Avenue between Northern and Orangewood can be reduced from a 6-foot diameter storm drain to a 4-foot diameter storm drain. Additionally, the storm drain from 85th Avenue to 89th Avenue can be reduced from a 4-foot to a 3.5-foot diameter pipe.

By taking advantage of the capacity of the existing storm drain, this option better optimizes the system as proposed in Option P1. However, the system can be further enhanced as described in Option P3.

Costs for Option P2-North are shown on Table I-4.

Option P2-South

This option, as shown on Plate I-5, is similar to Option P2-North except the detention basin location has been moved from the northwest corner of 85th Avenue and Northern Avenue to the southwest corner of 87th Avenue and Northern Avenue.

This option was originally investigated in an attempt to reduce the large volume of earthwork associated with the basin being located north of Northern Avenue. However, this basin location would require the installation of a 10-foot diameter storm drain instead of a 3.5-foot diameter drain from 85th Avenue to 87th Avenue. The cost increase for this storm drain is essentially equal to that of the savings in earthwork generated by locating the basin south of Northern Avenue. Since there is little economic value in this alternate basin location and the land for

Can you evaluate how much additional storage we need to provide in order to eliminate 91st Ave from Northern to Orangewood storm drain

the basin north of Northern Avenue has already been acquired, this option will not be pursued any further.

Costs for Option P2-South are shown on Table I-5.

Option P3

This option, as shown on Plate I-6, attempts to optimize the existing 5-foot diameter storm drain in Northern Avenue to the Agua Fria Freeway outfall channel by incorporating a supplemental detention basin in an electrical transmission line corridor at 87th Avenue north of Los Palmaritas Drive.

By incorporating the basin, the peak flow can be attenuated and the storm drain within 91st Avenue between Northern Avenue and Orangewood Avenue can be eliminated. This supplemental basin will also allow for a reduction in the pipe size from 5-foot to 4-foot diameter between 89th Avenue and 91st Avenue. There will, however, be an additional 2-foot diameter storm drain from the supplemental basin to Northern Avenue, a distance of approximately 1/4 mile. As shown in the summary of options in Section 5, Cost Evaluation, Table 5-1 and based on overall estimated costs, this is the recommended option for location 2.

Option P4

This option, as shown on Plate I-3, also attempts to optimize the existing 5-foot diameter storm drain in Northern Avenue to the Agua Fria Freeway outfall channel by incorporating a supplemental detention basin in an electrical transmission line corridor at 87th Avenue north of Los Palmaritas Drive.

All of the same features of Option P3 are included in this option except that a storm drain ranging from 36- to 42-inch diameter along Butler Drive from 91st Avenue west to the Agua Fria Freeway outfall channel is proposed. This pipe will carry flow originating from the residential area east of 91st Avenue and north of Butler Drive that would otherwise flow south on 91st Avenue.

It should be noted that after this Location Study was submitted to the District during the initial study phase, the City of Peoria requested an evaluation of a new alignment outside of the Scope of Work. The suggested alignment included a storm drain at Butler Drive from 89th Avenue to the Agua Fria Freeway channel. The Butler Drive alignment significantly changes the results/recommendations for Location 2. That detail is covered in Section 4.3.1.

4.2.3 Location 3:

An analysis was done of the storm drain system which ties into the Peoria detention/surge basin discussed in Location 2. This area is bounded by the transmission line corridor (Las Palmaritas Street alignment) on the north, 83rd Avenue on the east, Northern Avenue on the south, and 85th Avenue on the west. The improvements for this location will be the responsibility of Peoria. Several options have been considered in the routing study at this location.

Option 1

Option 1 (shown on Plate I-7) is the storm drain alignment recommended by the *ADMP* and has been provided for cost comparison purposes. This option consists of a 5-foot diameter pipe in 83rd Avenue from the transmission line corridor to Northern Avenue and a 10-foot diameter in Northern Avenue from 83rd Avenue to 85th Avenue.

Option 2

Option 2 (shown on Plate I-8) consists of a 5-foot storm drain in the transmission line corridor from 83rd Avenue to 85th Avenue and a 6-foot diameter pipe in Northern Avenue from 83rd Avenue to 85th Avenue. This alignment reduces the size of the storm drain in Northern Avenue from 10-foot to 6-foot diameter. The length of the 5-foot diameter storm drain remains approximately the same. An additional cost associated with this alignment will be a 2-foot diameter pipe within the basin from the transmission line corridor to Northern Avenue.

Option 3

This option (shown on Plate I-9) consists of a 5-foot diameter pipe running in a southwesterly direction from the intersection of the transmission line corridor and 83rd Avenue to 85th Avenue and Northern Avenue. New right-of-way will be required for this alignment. In addition, this option includes a 6-foot diameter pipe in Northern Avenue from 83rd Avenue to 85th Avenue. This alignment provides for the elimination of the 2-foot diameter pipe within the basin and, as in Option 2, the size of the storm drain in Northern Avenue is reduced from 10-foot to 6-foot in diameter. Table I-7 summarizes the costs for options 1, 2, and 3. The table shows that Option 2 is the cost effective option since no new right-of-way will be required and is therefore the recommended option for this location.

4.2.4 Location 4:

This location is bounded by Northern Avenue to the north, 91st Avenue to the east, the New River to the west and Orangewood Avenue to the south. The improvements within this location will be the responsibility of the District and a joint Glendale/Peoria participation. Several options have been considered in the routing study at this location.

A cost summary for location 4 is provided in Table I-8.

Option 1a

Option 1a, as shown on Plate I-10, is the storm drain alignment recommended in the *ADMP* and has been provided for cost comparison purposes. This alignment consists of a 6-foot diameter storm drain within 91st Avenue from Northern Avenue to Orangewood Avenue and a 8.5 to 9.5-foot storm drain in Orangewood Avenue from 91st Avenue to the New River. The outfall at New River is approximately 2,000 feet west of 99th Avenue. Several options were analyzed in an attempt to optimize this portion of the system.

Option 1b

By optimizing the storm drain detention basin system in 91st Avenue as described in the recommended option for location two (Plate I-6), the storm drain in 91st Avenue between Northern Avenue and Orangewood Avenue can be eliminated as shown on Plate I-11. In addition, the storm drain in Orangewood Avenue can be downsized to an 8-foot diameter pipe from 91st Avenue to the outfall at New River. This option results in significant savings over the *ADMP* alignment; however, further optimization is possible.

Option 2

As described above in Option 1b, the storm drain in 91st Avenue between Northern Avenue and Orangewood Avenue has been eliminated. However, instead of constructing an 8-foot diameter storm drain along Orangewood Avenue all the way to the New River, a revised alignment would extend from Orangewood Avenue north to Frier Drive alignment to the existing Agua Fria Freeway outfall channel as shown on Plate I-12.

This option was analyzed with two different conduits to transport the flow. The first option is a 10-foot by 8-foot box culvert and the second option is a 40-foot wide open channel.

The added benefits of this option over previous options include the elimination of approximately ½ mile of 8-foot diameter storm drain from the Agua Fria Freeway to the New River and the need to bore under the freeway at the Orangewood Avenue alignment. In addition, this alignment ties into the ADOT outfall channel which was designed to account for this flow.

Very Important *

This option also includes the cost associated with acquiring the necessary right-of-way and, in the case of the open channel, the acquisition of a 90-foot drainage easement along the entire alignment. However, even with these additional costs, the savings associated with this option are significant. Therefore, this is the recommended option for location 3.

Option 3

The City of Glendale requested WPA to analyze the possibility of tying into the future Agua Fria Freeway outfall channel at the Glendale Avenue storm drain alignment. As in options 1b and 2, the storm drain in 91st Avenue between Northern Avenue and Orangewood Avenue has been eliminated. This option would entail an 8-foot diameter storm drain in 91st Avenue from Orangewood Avenue to Glendale Avenue and an additional 8-foot diameter storm drain along Glendale Avenue from 91st Avenue to the future ADOT outfall channel immediately east of 99th Avenue as shown in Plate I-13.

The benefits of this option are that the area between 91st Avenue and 99th Avenue from Orangewood Avenue to Glendale Avenue can be included in the area which this storm drain serves. Also, by tying into the future ADOT channel, the need to bore under the freeway is eliminated. Since the entire alignment follows the existing street right-of-way, there will be no need to acquire any right-of-way for the outfall.

However, the additional costs associated with the addition of an 8-foot diameter storm drain in 91st Avenue from Orangewood Avenue to Glendale Avenue make this alignment more costly than the original *ADMP* option.

Another major concern with this alignment is that the ADOT Agua Fria Freeway drainage channel's construction schedule is some time after the year 2000. Therefore, that channel may not be available for the outfall, thus making this alignment unfeasible. Also unknown is whether ADOT will agree to accept runoff in this reach of the outfall channel since the existing ADOT outfall channel at Frier Drive alignment has already been designed and constructed to handle these flows.

This could kill this alternative *

5.0 COST EVALUATION

5.1 Location Study

For each location discussed in Section 4.2, *Location Study*, a summary of the bottom-line cost of each option is listed in Table 5-1 to aid in the comparison of options. As noted on Table 5-1, the preferred options for further consideration are underlined.

TABLE 5-1

Location Study
Option Cost Summary *

OPTION	*COST*
Location 1, Option 1	$7,452,480
Location 1, Option 2 (preferred option)	$3,613,512
Location 2, Option P1	$3,012,410
Location 2, Option P2-North	$2,531,930
Location 2, Option P2-South	$2,934,845
Location 2, Option P3 (preferred option)	$2,014,490
Location 3, Option 1	$1,127,000
Location 3, Option 2	$800,000
Location 3, Option 3 (preferred option)	$806,000
Location 4, Option 1a	$4,744,040
Location 4, Option 1b	$3,243,520
Location 4, Option 2 (box)	$2,367,400
Location 4, Option 2 (channel) (preferred opti	$1,256,850
Location 4, Option 3	$4,968,320

Notes:
* Underlined option is a preferred option for further consideration in the Concept/Routing Study.
* At Location 2, a completely new option was developed outside of the study scope area.
* These costs do not include right-of-way costs.
* These costs are included for information purposes only.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The *Glendale-Peoria ADMP* outlines major trunk line and lateral storm drain systems within the study area. In that report, several storm drain alignments were laid out including trunk lines along major arterial streets such as Cactus Road, Olive Avenue, Northern Avenue and Orangewood Avenue.

While maintaining the general storm drain alignment concept presented in the *ADMP*, small-scale alternative alignments and pipe sizes were identified at several locations through the *Location Study*. These alternatives were developed using the results of the preliminary hydrologic analysis. Section 4.2 describes the individual alternatives and the selection of the recommended alignment.

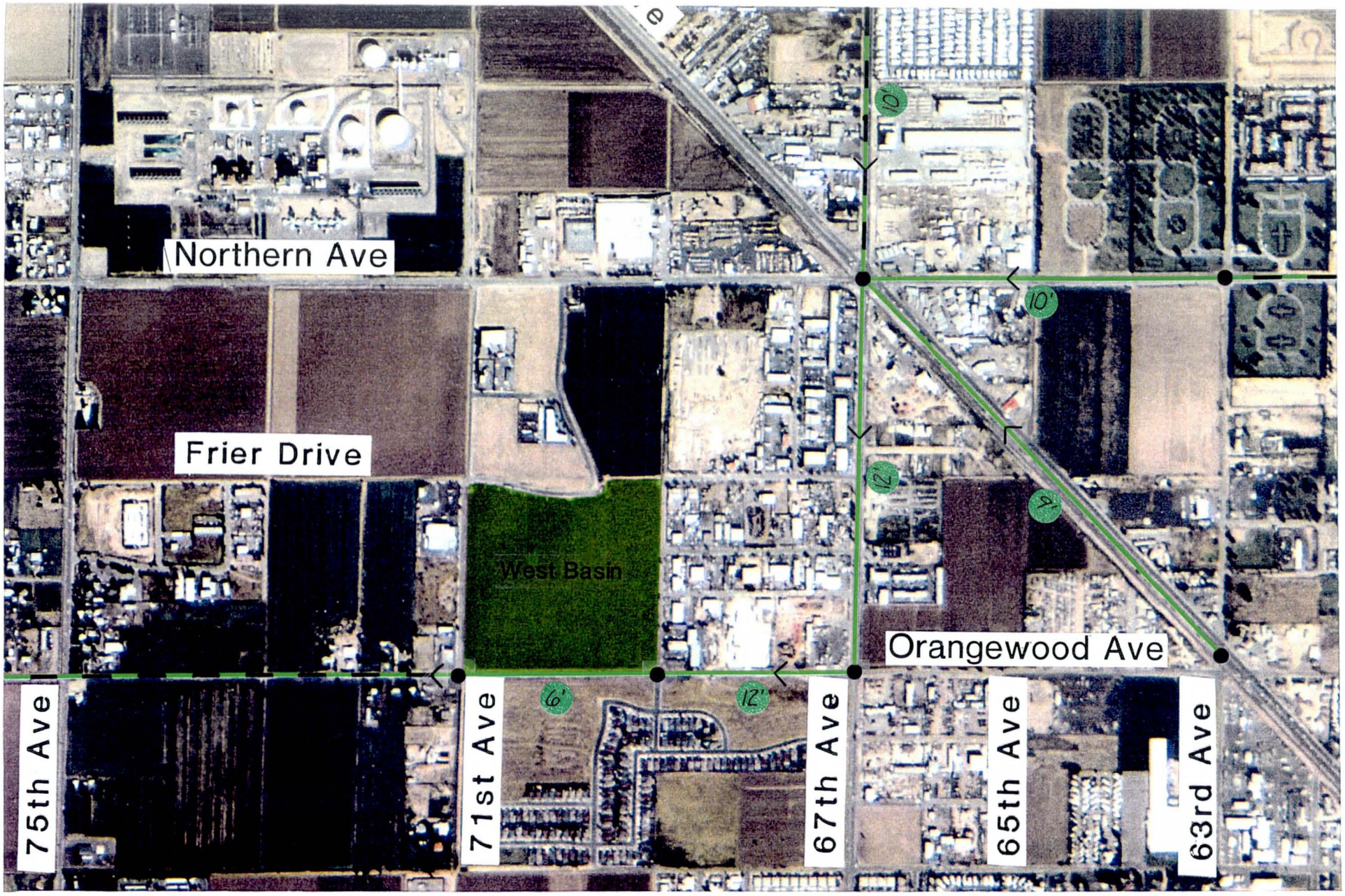
The most desirable alignments from the *Location Study* were selected for their incorporation into two major storm drain outfall alignments in the Concept Routing Study. These alignments were:

- Northern Avenue storm drain alignment for the City of Peoria
- Orangewood Avenue or Glendale Avenue for the City of Glendale.

This *Location Study* was previously submitted to the District and the Cities of Glendale and Peoria for the purpose of finding the optimum storm drain alignment serving the needs of all communities involved. With the exception of one location (location 2), the recommended option for each location in the *Location Study* was used in the larger-scale Concept/Routing Study. At location 2, the City of Peoria recommended that WPA study a storm drain alignment along Butler Drive. The details of the Butler Drive alignment are discussed in Section 4.2.3.

All selected alignments from the *Location Study* as shown in Table 5-1 were utilized for the next step in the main storm drain alignments in the *Concept/Routing Study*, e.g., Orangewood Avenue, Northern Avenue, etc. (published separately).

APPENDIX I - LOCATION STUDY ALTERNATIVES



¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 1, Option 1
Plate I-1

TABLE I-1
Location 1, Option 1

03/06/96

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

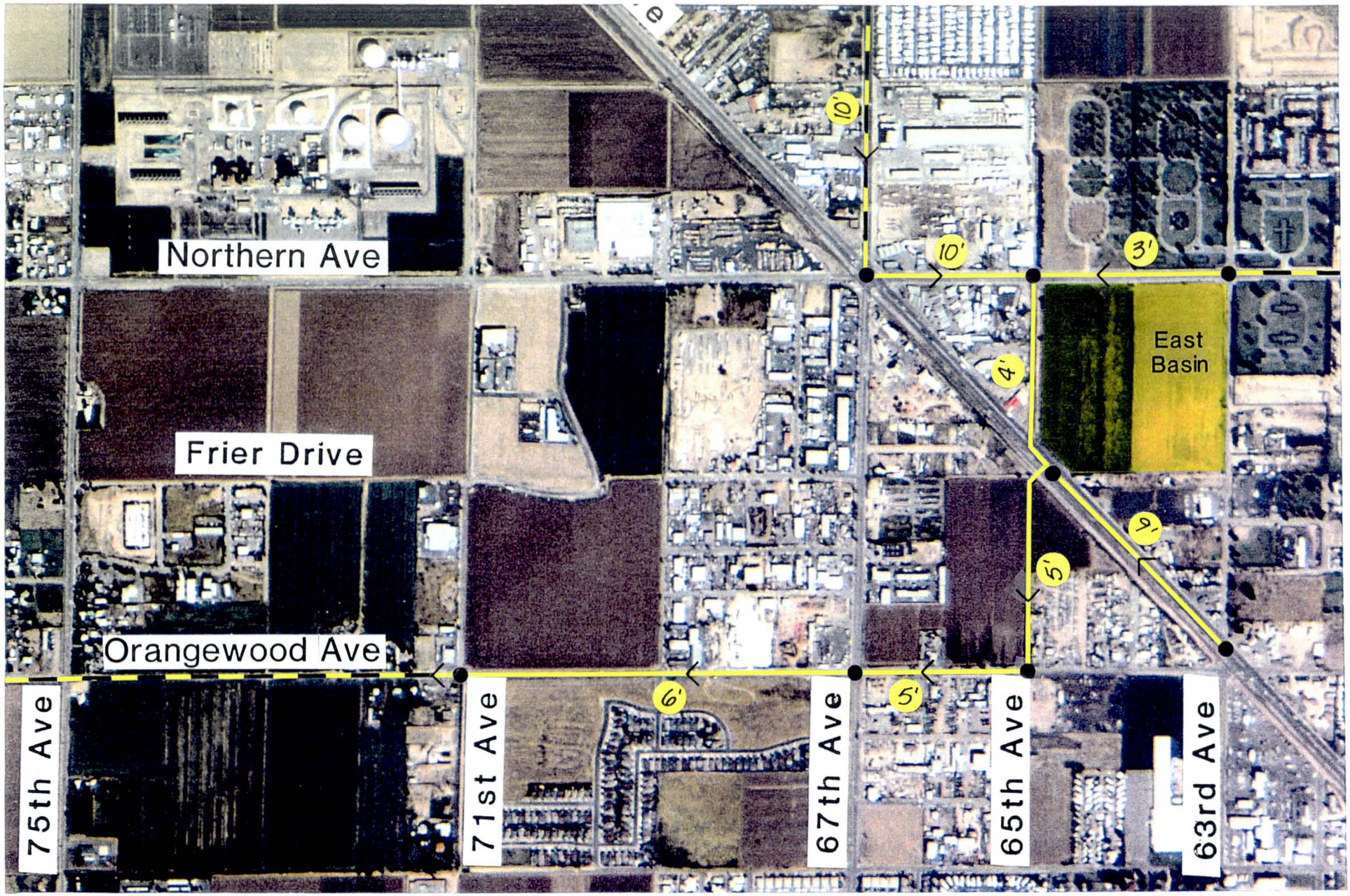
COST ANALYSIS, BASED ON ADMP FACILITY (WEST BASIN)

SEE PLATE I-1

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*	*RESPONSIBLE AGENCY FCD/GLE*	*GLENDALE*	*ADOT*
	71st Ave @ Orangewood									
196		72	1320	6	210	277,200	388,080	388,080		
	69th Ave @ Orangewood									
196		144	1320	12	600	792,000	1,108,800	1,108,800		
	67th Ave @ Orangewood									
198		144	2640	12	600	1,584,000	2,217,600	2,217,600		
	Grand @ 67th Ave									
209		120	2640	10	450	1,188,000	1,663,200		1,663,200	
	Northern @ 63rd Ave									
	Grand @ 67th Ave									
281		108	3800	9	390	1,482,000	2,074,800			2,074,800
	Grand @ Orangewood									
	TOTAL COST						***$7,452,480***	***$3,714,480***	***$1,663,200***	***$2,074,800***

NOTES: *ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)*
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS
SINCE BASIN SIZE IN THE ADMP IS SIMILAR TO THE NEW CONCEPT, BASIN COSTS ARE EXCLUDED FROM THIS COMPARISON

NO COST FOR BASIN R/W !!!



N

¼ Mile

NORTHERN/ORANGEWOOD PROJECT

Location 1, Option 2

Plate I-2

TABLE I-2

03/06/96

Location 1, Option 2

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

COST ANALYSIS BASED ON MODIFIED FACILITY (EAST BASIN)

SEE PLATE I-2

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*	*RESPONSIBLE AGENCY FCD/GLE*	*GLENDAL*	*ADOT*
	71st Ave @ Orangewood									
1		72	2640	6	210	554,400	776,160	776,160		
	67th Ave @ Orangewood									
2		60	1320	5	160	211,200	295,680	295,680		
	65th Ave @ Orangewood									
3		60	1320	5	160	211,200	295,680	295,680		
	Grand @ 65th Ave									
4		48	1320	4	120	158,400	221,760	221,760		
	Northern @ 65th Ave									
5		120	1320	10	450	594,000	831,600	831,600		
	67th Ave @ Northern									
	Grand @ 67th Ave									
6		108	1900	9	390	741,000	1,037,400			1,037,400
	Grand @ Orangewood									
	Northern @ 65th Ave									
7		36	1320	3	84	110,880	155,232		155,232	
	Northern @ 63th Ave									
	TOTAL COST						***$3,613,512***	***$2,420,880***	***$155,232***	***$1,037,400***

NOTES: *ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)*
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS
SINCE BASIN SIZE IN THE ADMP IS SIMILAR TO THE NEW CONCEPT, BASIN COSTS ARE EXCLUDED FROM THIS COMPARISON

NEED TO ADD COST FOR THE BASIN R/W!!!

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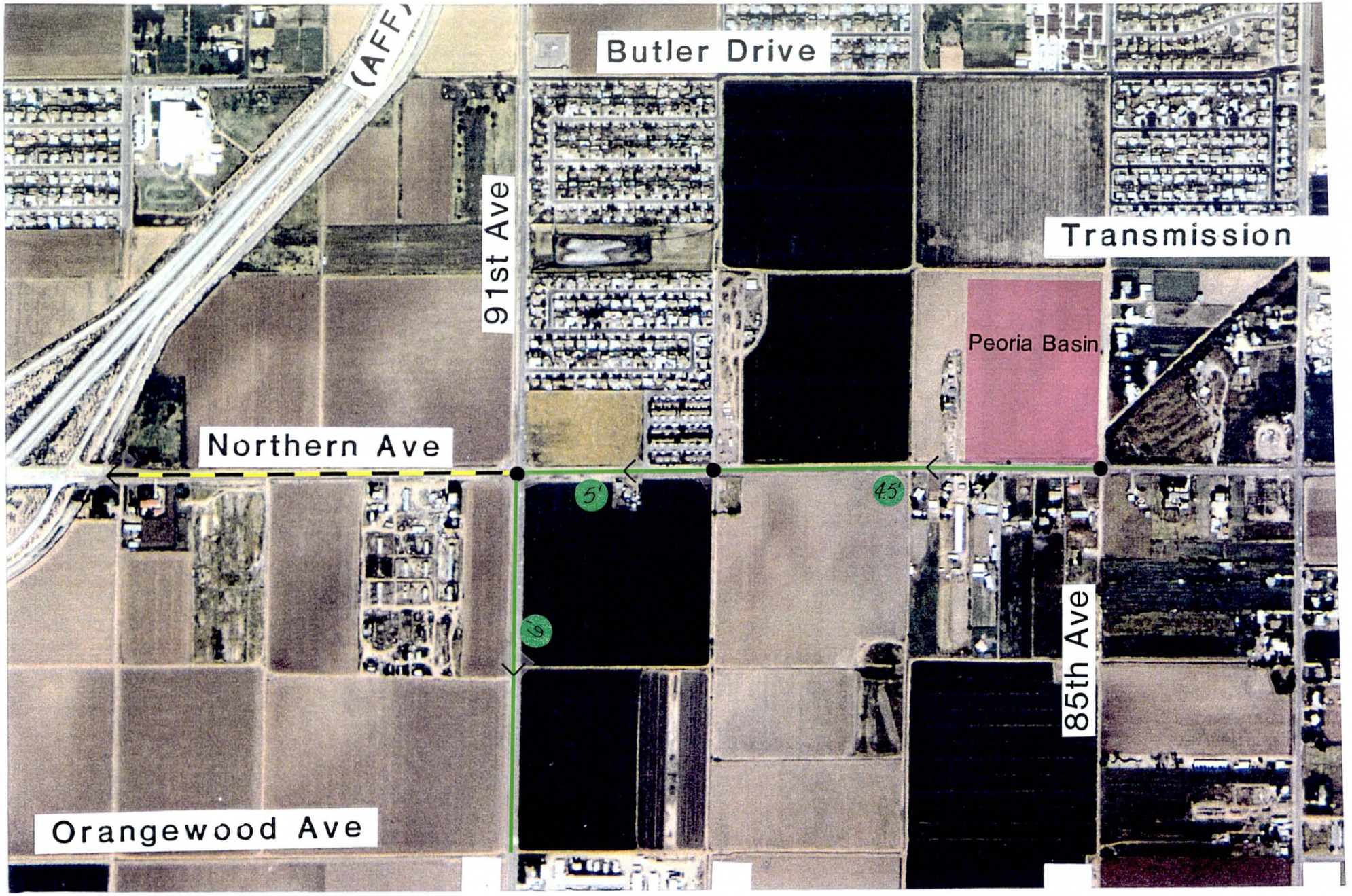


N

¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 2, Option P1
Plate I-3

TABLE I-3

LOCATION 2, OPTION P1 03/06/96

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

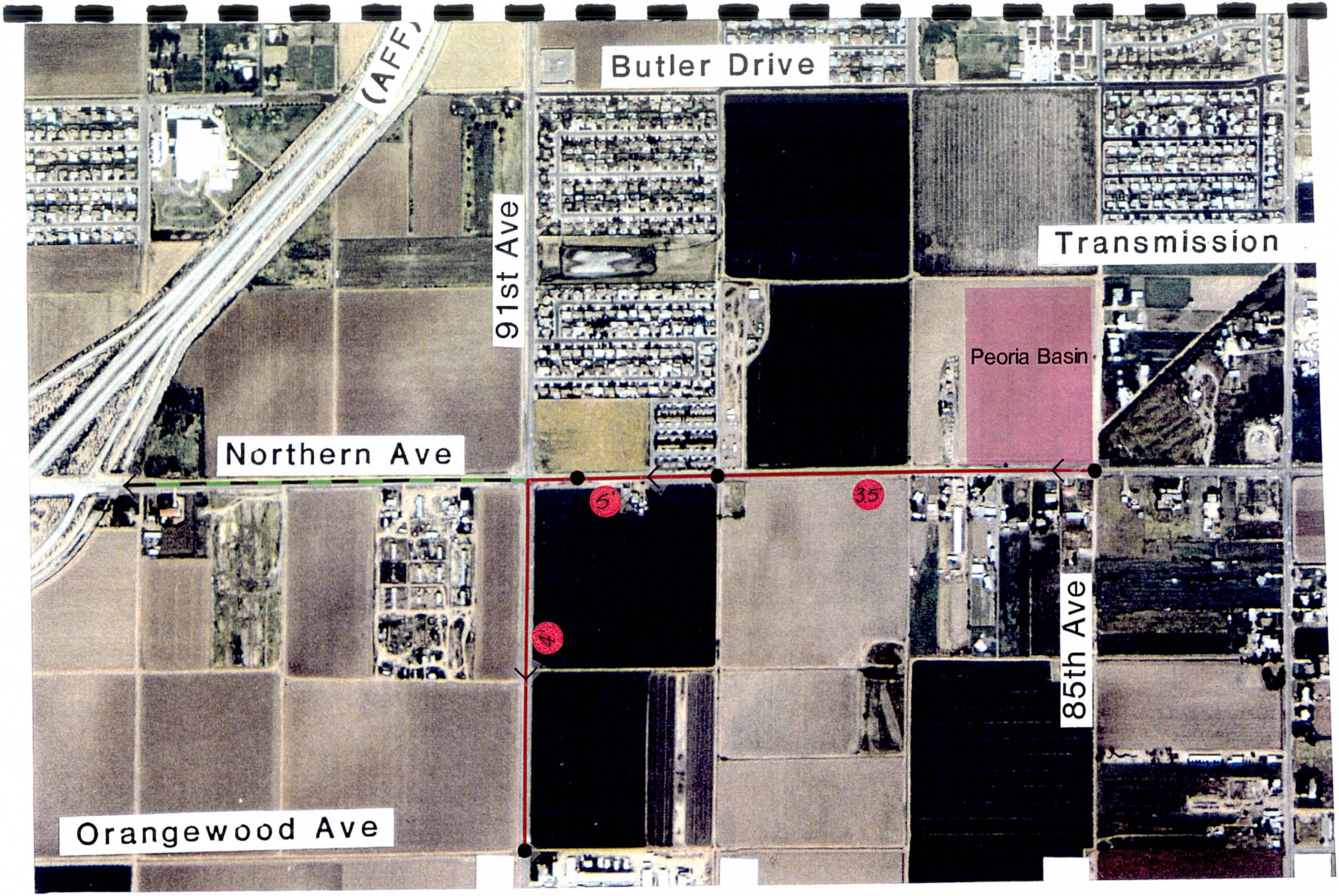
LOCATION STUDY

COST ANALYSIS, BASED ON ADMP-PEORIA FACILITIES

SEE PLATE I-3

PIPE ID	*STORM SEWER LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	LATERAL TRUNK						
	91st Ave @ Orangewood						
185		72	2640	6	210	554,400	776,160
	91st Ave @ Northern Ave						
694		60	1320	5	160	211,200	295,680
	Northern Ave @ 89th Ave						
692		54	2640	4.5	140	369,600	517,440
	Northern Ave @ 85th Ave						
	Subtotal					$1,135,200	**$1,589,280**
	REVISED COSTS OF DETENTION BASINS PER PURCHASE PRICES OF BASINS:						
	18 AC BASIN	LAND	23	23	27,437	630,502	630,502
	assume 9ac x 13' ave cut	EARTHWORK	188,721		3	566,163	792,628
	Subtotal						**$1,423,130**
	GRAND TOTAL						***$3,012,410***

NOTES: *ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)*
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS



N

¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 2, Option P2-North
Plate I-4

TABLE I-4

03/06/96

LOCATION 2, OPTION P2-NORTH

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

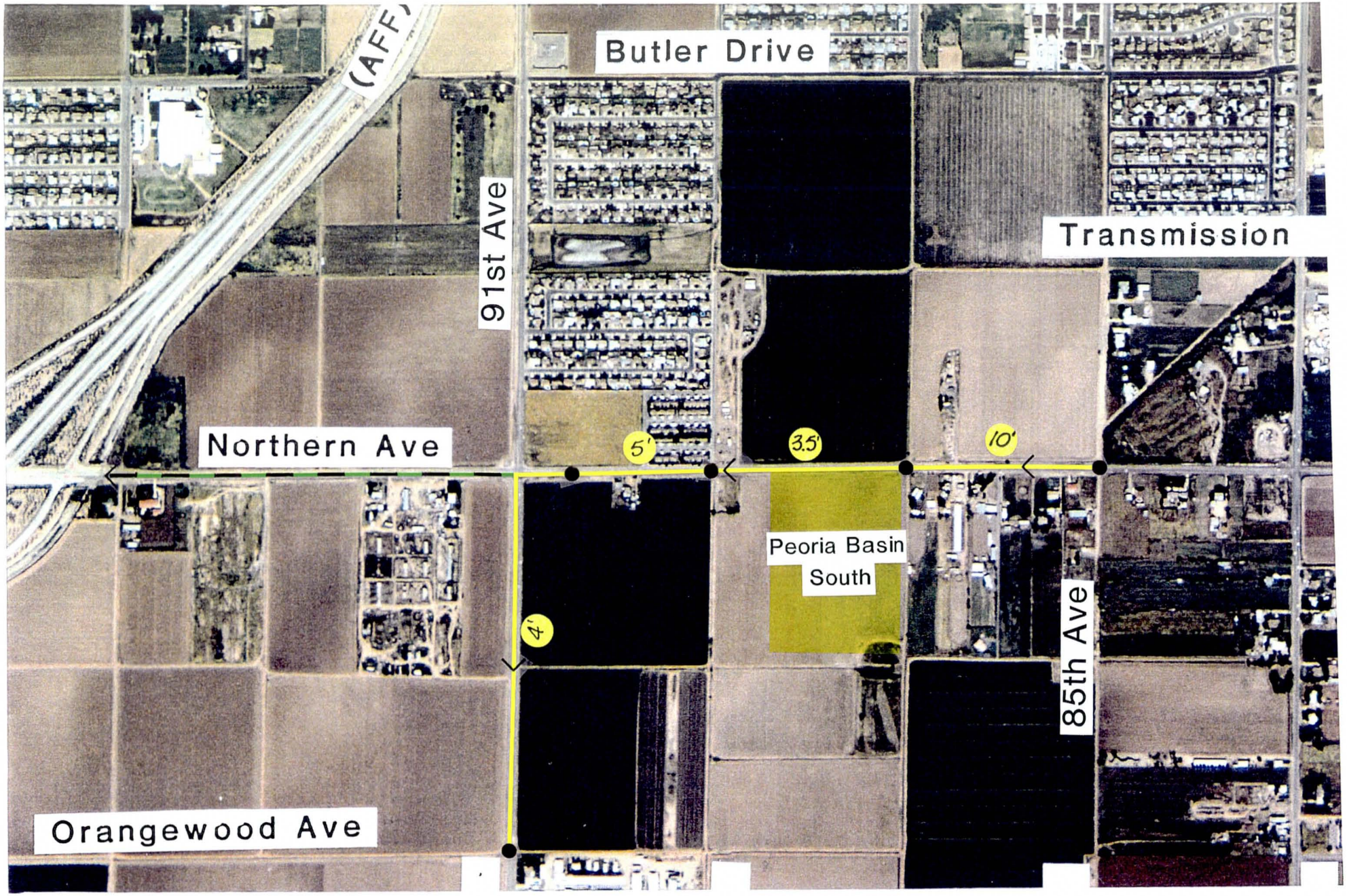
LOCATION STUDY

COST ANALYSIS, BASED ON SPLITTING THE FLOW @ 91ST/NORTHERN WITH BASIN NORTH OF NORTHERN AVENUE

SEE PLATE I-4

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	LATERAL TRUNK						
	91st Ave @ Orangewood						
185		48	2640	4	120	316,800	443,520
	91st Ave @ Northern Ave						
694		60	1320	5	160	211,200	295,680
	Northern Ave @ 89th Ave						
692		42	2640	3.5	100	264,000	369,600
	Northern Ave @ 85th Ave						
	Subtotal					$792,000	**$1,108,800**
	REVISED COSTS OF DETENTION BASINS PER PURCHASE PRICES OF BASINS:						
	18 AC BASIN	LAND	23	23	27,437	$630,502	$630,502
	assume 9 ac x 13' ave cut	EARTHWORK	188,721		3	$566,163	$792,628
	Subtotal						**$1,423,130**
	GRAND TOTAL						***$2,531,930***

NOTES: *ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)*
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS



¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 2, Option P2-South
Plate I-5

TABLE I-5

03/06/96

LOCATION 2, OPTION P2-SOUTH

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

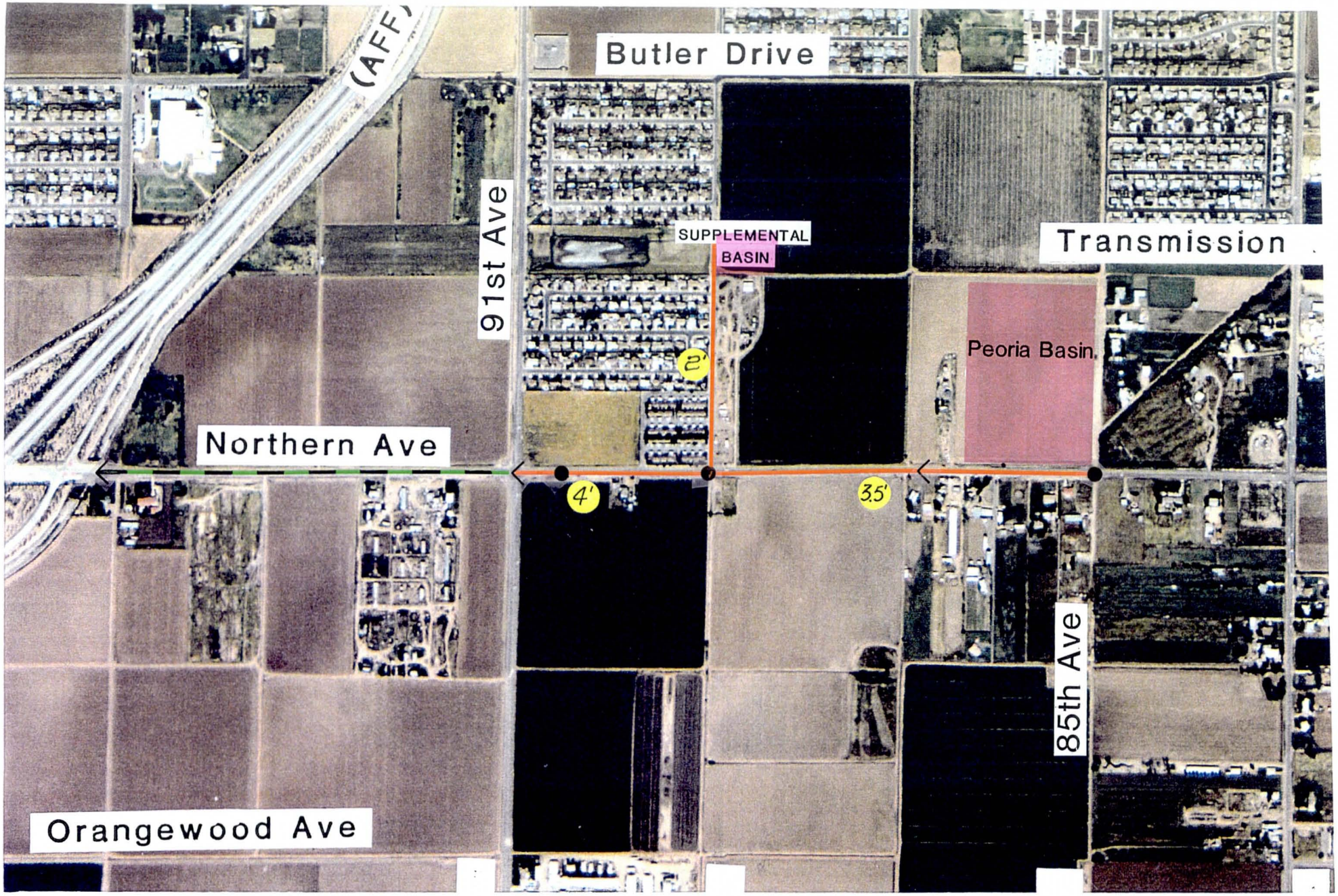
LOCATION STUDY

COST ANALYSIS, BASED ON SPLITTING THE FLOW @ 91ST/NORTHERN WITH BASIN SOUTH OF NORTHERN AVENUE

SEE PLATE I-5

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	LATERAL TRUNK						
	91st Ave @ Orangewood						
185		48	2640	4	120	316,800	443,520
	91st Ave @ Northern Ave						
694		60	1320	5	160	211,200	295,680
	Northern Ave @ 89th Ave						
692		42	1320	3.5	100	132,000	184,800
	Northern Ave @ 87th Ave						
692		120	1320	10	450	594,000	831,600
	Northern Ave @ 85th Ave						
	Subtotal					$1,254,000	**$1,755,600**
	REVISED COSTS OF DETENTION BASINS PER assumed new PURCHASE PRICES OF BASINS:						
	18 AC BASIN	LAND	23	23	27,437	$630,502	$630,502
	assume 9ac x 9' ave cut	EARTHWORK	130,653		3	$391,959	$548,743
	Subtotal						**$1,179,245**
	GRAND TOTAL						***$2,934,845***

NOTES: *ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)*
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS



¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 2, Option P3
Plate I-6

TABLE I-6

03/06/96

LOCATION 2, OPTION P3

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

COST ANALYSIS, BASED ON CONNECTING TO EXISTING STUB @ 91ST AVENUE

SUPPLEMENTAL BASIN IN PEORIA JURISDICTION TO REDUCE 89TH AVE FLOW FROM 122 TO 70 CFS

SEE PLATE I-6

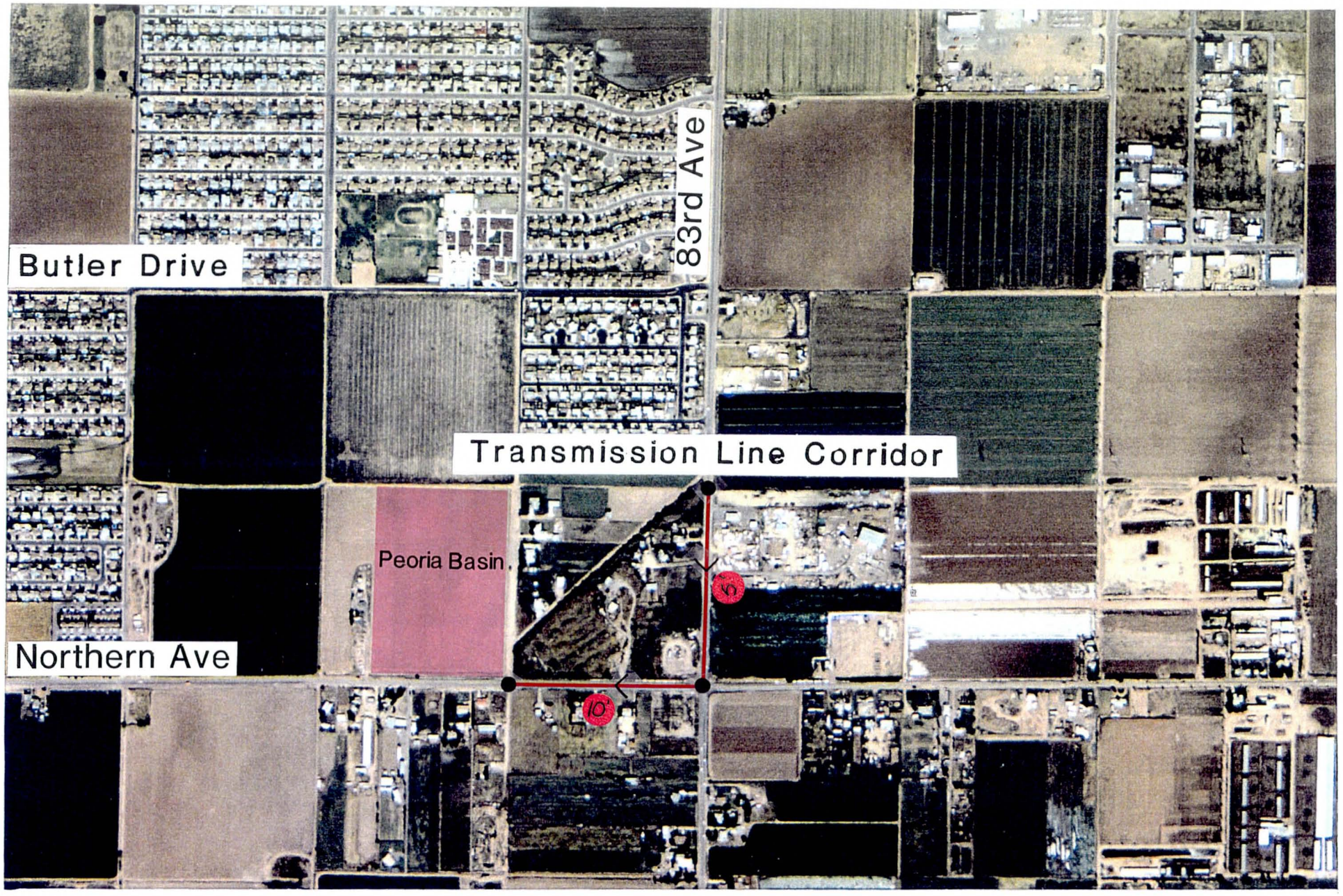
PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	LATERAL TRUNK						
	91st AVE @ Northern Ave						
694		48	1320	4	120	158,400	221,760
	Northern Ave @ 89th Ave						
692		42	2640	3.5	100	264,000	369,600
	Northern Ave @ 85th Ave						
		24	1320	2	69	91,080	127,512
	Elec Corridor to Northern Ave						
	Subtotal					$513,480	**$718,872**

REVISED COSTS OF DETENTION BASINS PER PURCHASE PRICES OF BASINS:

18 AC BASIN	LAND	23	23	27,437	$630,502	$630,502
assume 9ac x 13' ave cut	EARTHWORK	188,721		3	$566,163	$792,628
SUPPLEMENTAL BASIN						
assume 3 ac-ft of cut	EARTHWORK	130,680		3	$392,040	$548,856
Subtotal						**$1,971,986**
GRAND TOTAL						***$2,690,858***

NOTES: *ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)*
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS

Why no cost for supplemental basin?



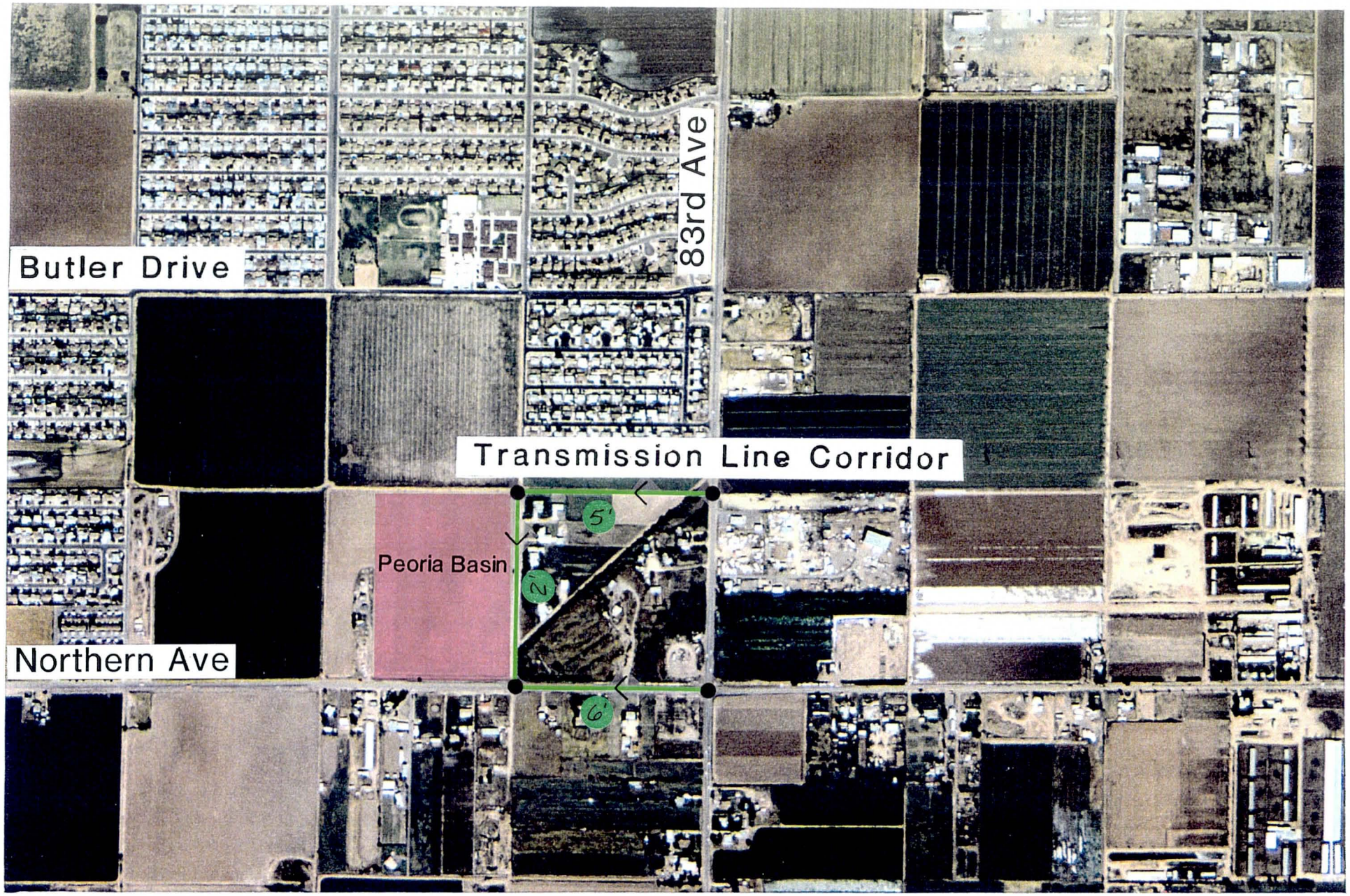
N

¼ Mile

NORTHERN/ORANGEWOOD PROJECT

Location 3, Option 1

Plate I-7



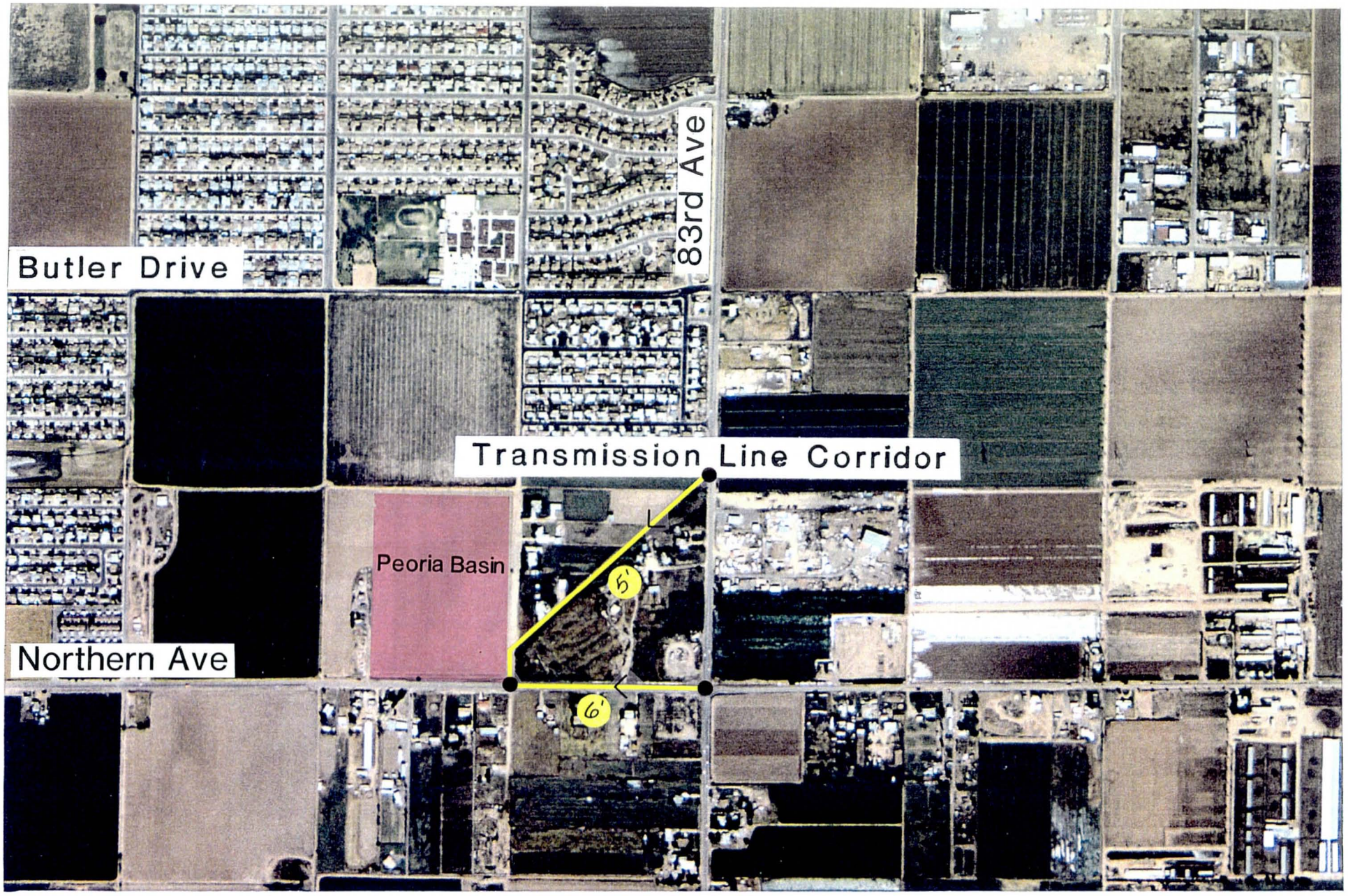
N

¼ Mile

NORTHERN/ORANGEWOOD PROJECT

Location 3, Option 2

Plate I-8



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¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 3, Option 3
Plate I-9

TABLE I-7

03/06/96

LOCATION 3, OPTIONS 1,2 AND 3

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

COST ANLYSIS FOR INFLOW TO PEORIA BASIN, IMPROVEMENTS IN PEORIA JURISDICTION AREA EAST OF PEORIA BASIN IS ANALYZED

KEEP AS-IS PER ADMP **LOCATION 3, OPTION 1**

SEE PLATE I-7

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	Transmission Corridor @ 83rd						
		60	1320	5	160	211200	295680
	83rd Ave @ Northern Ave						
993		120	1320	10	450	594000	831600
	85th Ave @ Northern Ave						
							1127280

Rounded Amount ***$1,127,000***

LOCATION 3, OPTION 2

SEE PLATE I-8

	83rd Ave @ Northern Ave						
		72	1320	6	210	277200	388080
	85th Ave @ Northern Ave						
	Transmission Corridor @ 83rd Ave						
		60	1320	5	160	211200	295680
	Transmission Corridor @ 85th Ave						
		24	1320	2	63	83160	116424
	87th Ave @ Northern Ave						
							800184

ok

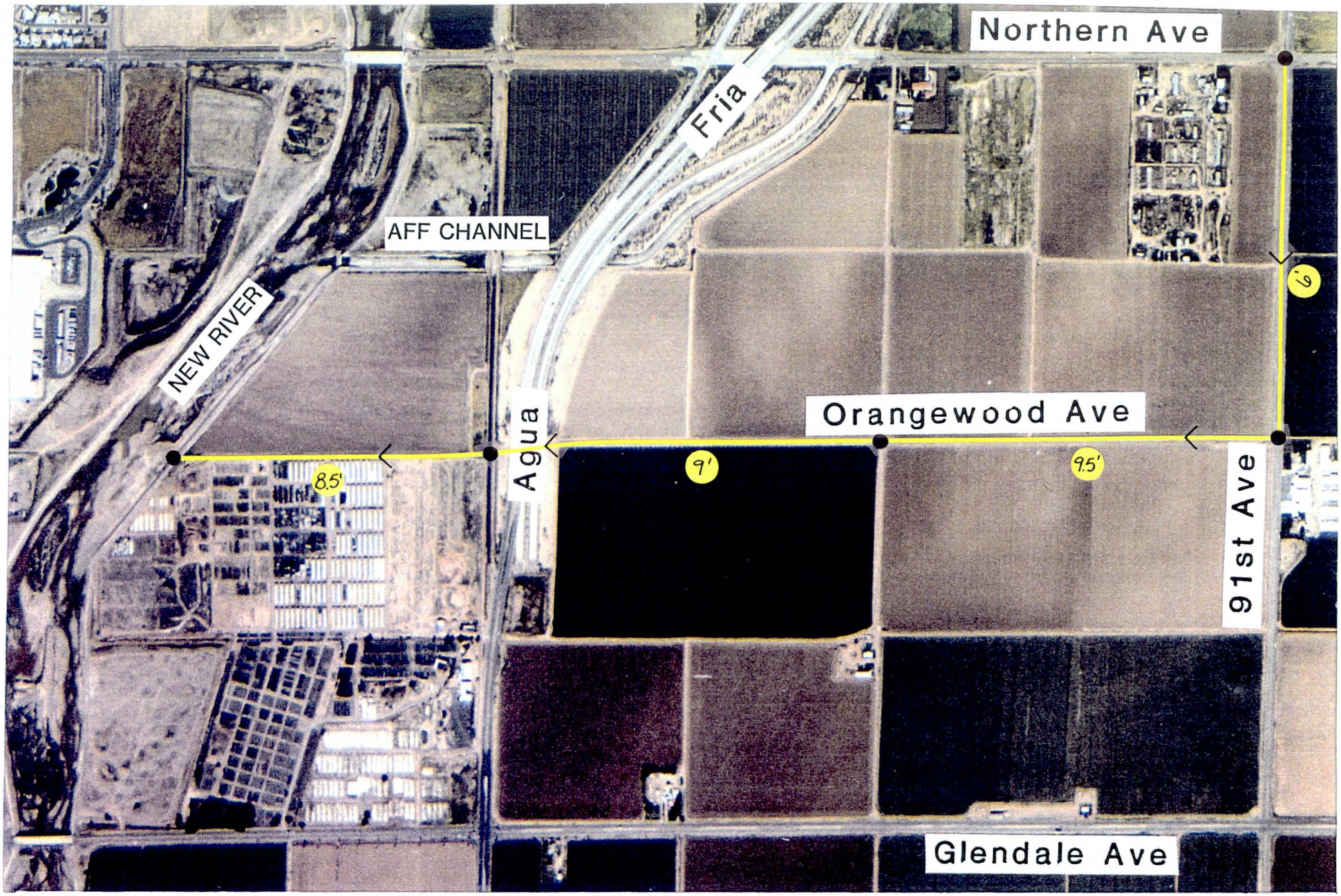
Rounded Amount ***$800,000***

LOCATION 3, OPTION 3

SEE PLATE I-9

	83rd Ave @ Northern Ave						
		72	1320	6	210	277200	388080
	85th Ave @ Northern Ave						
	Transmission Corridor @ 83rd Ave						
		60	1866	5	160	298560	417984
	85th Ave @ Northern Ave						
							806064

Rounded Amount ***$806,000***



N

¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 4, Option 1a
Plate I-10

TABLE I-8

03/06/96

(PAGE 1/3)

LOCATION 4, OPTIONS 1a, 1b,

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

LOCATION 4, OPTION 1a

COST ANLYSIS, BASED ON GLENDALE/PEORIA ADMP

SEE PLATE I-10

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	MAIN LINE						
	OUTFALL						
180		102	1960	8.5	355	695,800	974,120
	99th ave @ Orangewood						
182		108	2640	9	390	1,029,600	1,441,440
	95th ave						
184		114	2640	9.5	420	1,108,800	1,552,320
	91st ave @ Orangewood						
185		72	2640	6	210	554,400	776,160
	91st ave @ Northern						
						Subtotal	***$4,744,040***

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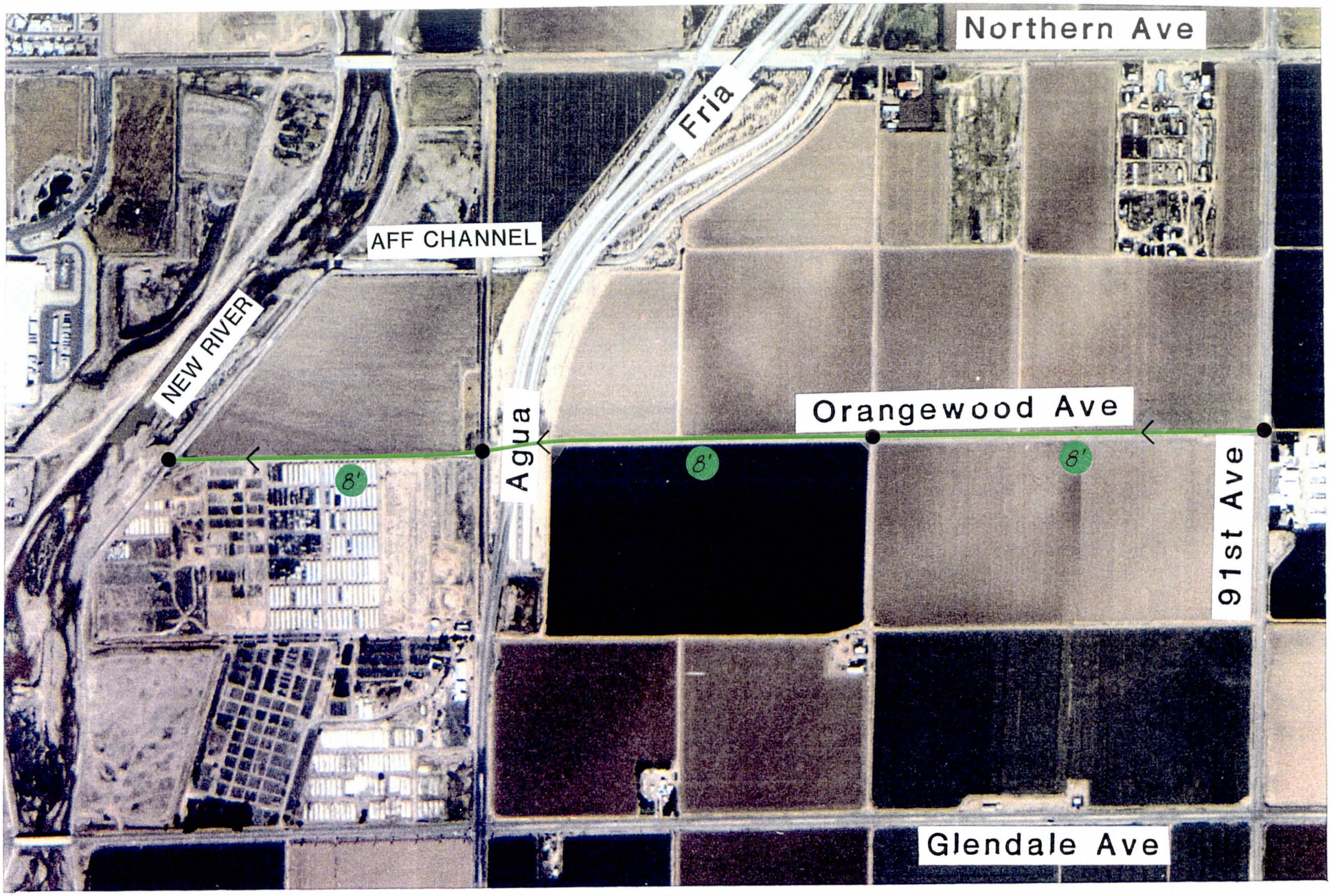

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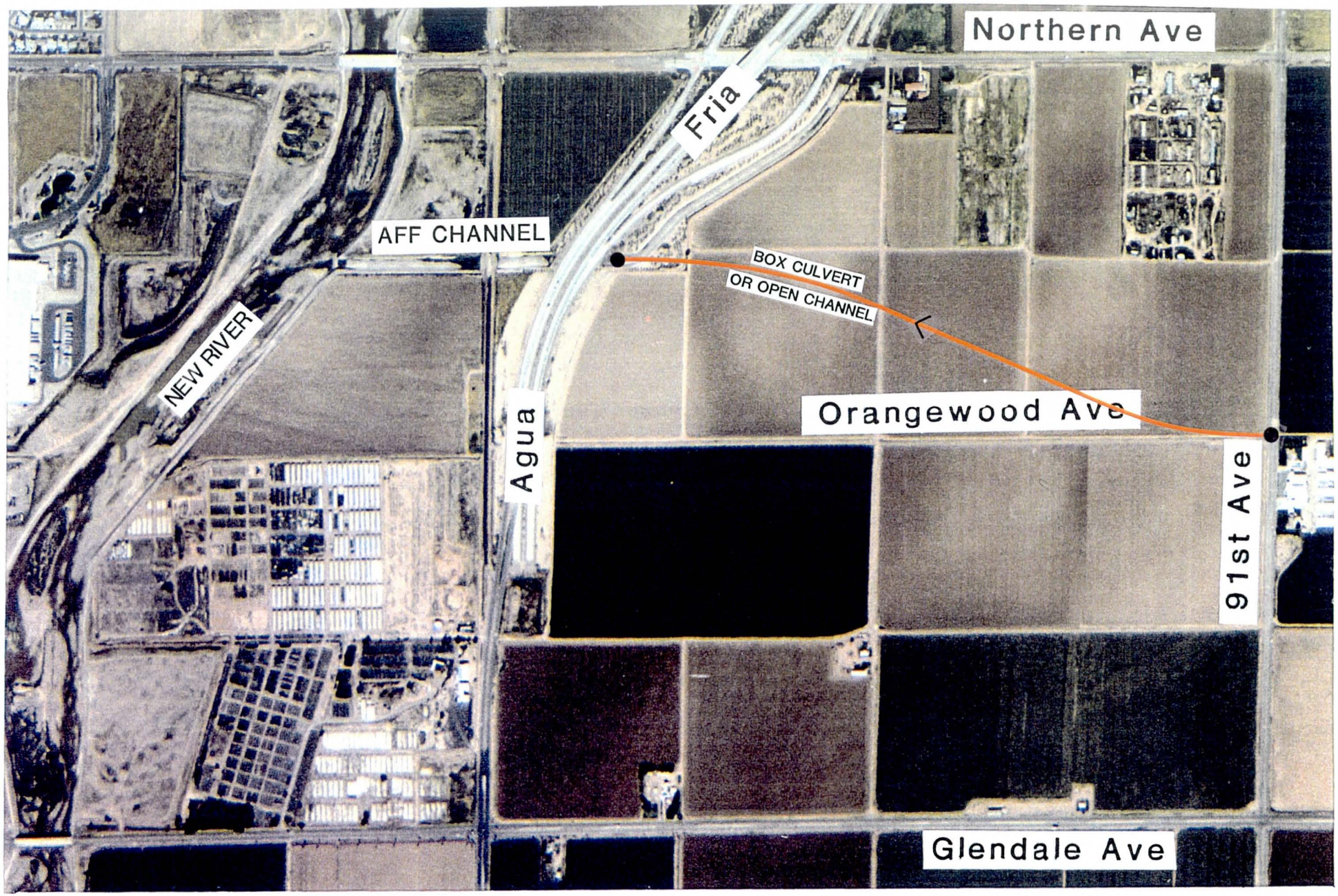
¼ Mile

NORTHERN/ORANGEWOOD PROJECT

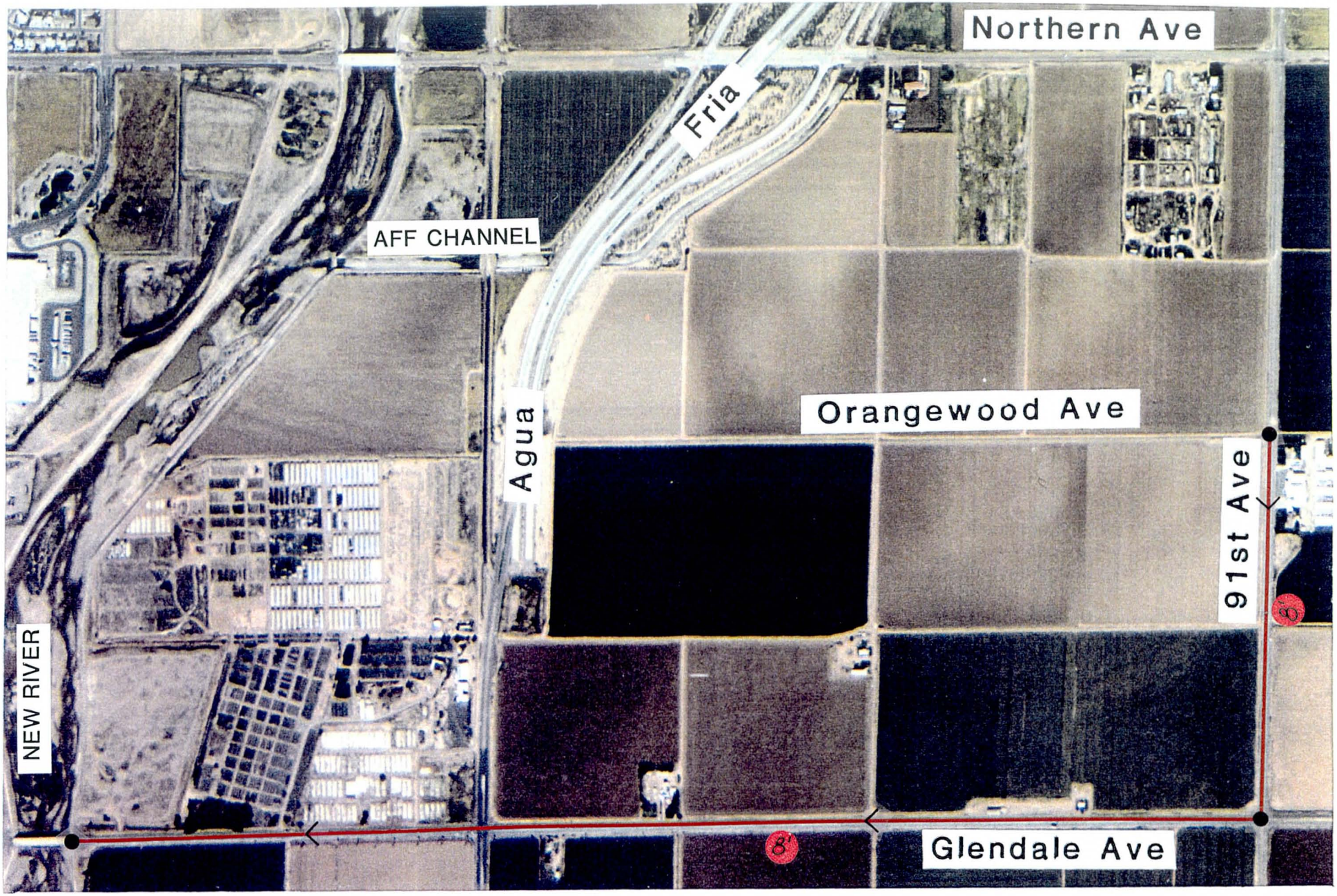
Location 4, Option 1b

Plate I-11



¼ Mile

NORTHERN/ORANGEWOOD PROJECT
Location 4, Option 2
Plate I-12



¼ Mile

NORTHERN/ORANGEWOOD PROJECT

Location 4, Option 3

Plate I-13

TABLE II-8

03/06/96

(PAGE 2/3)

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

LOCATION 4, OPTION 1b

COST ANLYSIS, BASED ON GLENDALE/PEORIA ADMP alignment but reduced flows

SEE PLATE I-11

PIPE ID	STORM DRAIN LINE AND LOCATION	PIPE DIA (in)	REACH LENGTH (ft)	PIPE DIA (ft)	UNIT COST ($)	COST	COST INCL 40% CONTINGENCY
	MAIN LINE						
	OUTFALL						
180		96	1960	8	320	627,200	878,080
	99th ave @ Orangewood						
182		96	2640	8	320	844,800	1,182,720
	95th ave						
184		96	2640	8	320	844,800	1,182,720
	91st ave						
						Subtotal	***$3,243,520***

LOCATION 4, OPTION 2 BOX

COST ANLYSIS, BASED ON AGUA FRIA FREEWAY OUTLET CHANNEL AS AN OUTFALL FOR THIS PROJECT

SEE PLATE I-12

PIPE ID	STORM DRAIN LINE AND LOCATION	BOX SIZE (ft)	REACH LENGTH (ft)	BOX SIZE (ft)	UNIT COST ($)	COST	COST INCL 40% CONTINGENCY
	AFF OUTLET CHA AS OU						
		10x8	4750	10x8	356	1,691,000	2,367,400
	91st ave						

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TABLE II-8

03/06/96

(PAGE 3/3)

NORTHERN/ORANGEWOOD STORM DRAIN PROJECT

LOCATION STUDY

LOCATION 4, OPTION 2 CHANNEL

COST ANLYSIS, BASED ON OUTFALL TO AGUA FRIA FREEWAY OUTLET CHANNEL AS AN OUTFALL FOR THIS PROJECT

SEE PLATE I-12

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*conc channel*	*REACH LENGTH (ft)*	*conc channel*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	AFF OUTLET CHA AS OU						
		90'	4750	90'	189	897,750	1,256,850
	91st ave						

LOCATION 4, OPTION 3

COST ANLYSIS, BASED ON OUTFALL TO GLENDALE AVE FROM 91ST/ORANGEWOOD

SEE PLATE I-13

PIPE ID	*STORM DRAIN LINE AND LOCATION*	*PIPE DIA (in)*	*REACH LENGTH (ft)*	*PIPE DIA (ft)*	*UNIT COST ($)*	*COST*	*COST INCL 40% CONTINGENCY*
	MAIN LINE						
	OUTFALL @ RIVER						
		96	8450	8	320	2,704,000	3,785,600
	91st ave @ Glendale Ave						
		96	2640	8	320	844,800	1,182,720
	91st ave @ Orangewood						
						Subtotal	***$4,968,320***

NOTES:

ALL UNIT PRICES ARE FROM GLENDALE/PEORIA ADMP (1987)
PIPE ALIGNMENTS ARE CONCEPTUAL
JUDGEMENTS WERE USED IN PRELIM HYDROLOGY/HYDRAULICS