AT&SF Railroad Channel and Basin Candidate Assessment Report

FCD 2007C016 Assignment 2

CANDIDATE ASSESSMENT REPORT
VOLUME 1 of 2

February 9, 2009

EXPIRES 3/31/2009

Prepared for:
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009
(602) 506-1501

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creative engineering solutions

201 West Indian School Road • Phoenix, AZ 85013 • (602)252-8384

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CAR VOLUME 2: APPENDICES (UNDER SEPARATE COVER)

EXECUTIVE SUMMARY

Hoskin•Ryan Consultants, Inc. (HRC), has been contracted by the Flood Control District of Maricopa County (FCDMC) to prepare a Candidate Assessment Report and Preliminary Design Plans for the AT&SF Railroad Channel and Basin project (Figure 1, Page 1). The AT&SF Railroad Channel and Basin is one element of the regional drainage solution proposed as part of the *Loop 303/White Tanks Area Drainage Master Plan Update* (Loop 303 ADMPU), completed in 2005 by URS for the FCDMC.

The purpose of the AT&SF Channel and Basin is to remove approximately 250 acres of existing floodplain along the west side of the Burlington Northern Sante Fe (BNSF) Railroad (formerly known as the AT&SF Railroad), protect existing infrastructure investments such as the City of Surprise Water Reclamation Facility (WRF), and provide a regional outfall. The AT&SF component of the ADMPU will work with, and optimize, the Northern Parkway, Dysart Drain, and the Loop 303 channel. This CAR investigates the alignment and design alternatives and assesses the multi-use recreational potential for the proposed channel and basin(s). The project consists of four phases:

- Data Collection and Existing Conditions Analysis
- Preliminary Alternatives Formulation and Analysis
- Proposed Alternatives Formulation and Analysis
- Recommended Alternative, Preliminary Plans, and Candidate Assessment Report

Data Collection and Existing Conditions Analysis

The study area encompasses approximately seventeen (17) square miles in the western Phoenix metropolitan area, and includes the jurisdictions of the City of Surprise, City of Glendale, City of El Mirage, and unincorporated Maricopa County. The study also borders the north boundary of Luke Air Force Base. In addition to the jurisdictional agencies in the area, the BNSF Railroad, Maricopa County Department of Transportation (MCDOT), Flood Control District of Maricopa County (FCDMC), and Arizona Bluestake were contacted during the data collection phase. Details regarding the data collection phase are documented in the *AT&SF Railroad Channel and Basin Candidate Assessment Report, Data Collection Summary*, dated July 11, 2008 (Ref. 34).

Preliminary Alternatives Formulation and Analysis

Nine (9) Preliminary Alternatives were identified during the study (See Figure 3A, Page 11). The purpose of the Preliminary Alternatives phase was to establish a wide range of alignments in order to garner initial feedback from the stakeholders. Seven (7) of the Preliminary Alternatives are documented in the *AT&SF Railroad Channel and Basin Candidate Assessment Report, Preliminary Alternatives* report, dated August 28, 2008 (Ref. 35).

Five typical cross-sections for the channelization were proposed in the Preliminary Alternatives analysis portion of the study. These are defined as Section A-Unlined Channel, Section B-Lined Trapezoidal Channel, Section C-Lined Rectangular Channel, Section D-Box Culverts, and Section E-Pipe Culverts (See Figures 3B through 3F, Pages 14-18). Preliminary sizing and hydraulics for the typical sections was performed for a range of slopes and flowrates to aid in the initial layout. HEC-1 hydrologic models were not prepared as part of the Preliminary Alternatives phase.

The first seven alternatives were presented at a stakeholders meeting held on August 28, 2008. Based on the stakeholder input and feedback, two additional Preliminary Alternatives were created. From the nine total Preliminary Alternatives that were created, two were chosen as Proposed Alternatives for further hydrologic, hydraulic, and alignment analysis.

Proposed Alternatives Formulation and Analysis

Two (2) Proposed Alternatives were analyzed in the Proposed Alternatives Formulation and Analysis phase, as documented in detail in the *AT&SF Channel and Basin Candidate Assessment Report, Alternatives Evaluation Report,* dated November 12, 2008 (Ref. 33).

- Proposed Alternative 1 (Figures 4A, 4B, and 4C, after Page 20, and Figure 4D, Page 22) utilizes the design concept from Preliminary Alternative 1 with changes to the basin location and extent of the channel. This alternative is similar to the alignment proposed as part of the Loop 303 ADMPU.
- Proposed Alternative 2 (Figures 5A, 5B, and 5C, after Page 23, and Figure 5D, Page 26) includes two channels, one along the 135th Avenue alignment from Sweetwater Avenue to the Dysart Drain, and one along the 143rd Avenue alignment from Olive Avenue to the Dysart Drain. Alternative 2 also includes two detention basins, one north of the railroad and one north of Northern Parkway.

A HEC-1 hydrologic model was created for each of the Proposed Alternatives, and the hydraulics were refined to better define the appropriate channel sizes. Right-of-way requirements and comparative cost estimates were created for each Proposed Alternative.

The two Preliminary Alternatives were presented at a Stakeholders Meeting on December 4, 2008. All stakeholders in attendance at the meeting, as well as the major private landholders impacted by the plan, supported Proposed Alternative 2 with minor modifications.

Recommended Alternative, Preliminary Plans, and Candidate Assessment Report

The Recommended Alternative (Figures 6A, 6B, and 6C, after Page 31) was created from Proposed Alternative 2 with minor modifications. It includes two channels, the Primary Channel along the 135th Avenue alignment between Sweetwater Avenue and Dysart Drain, and the Secondary Channel along the 143rd Avenue alignment between Olive Avenue and Dysart Drain. Two on-line detention basins are also included;"Cheryl Basin," located north of the railroad, and "Royal Palm Basin," located north of Northern Parkway.

At the upstream end, the Primary Channel ties into a new channel that has been graded around the west and south sides of the Surprise Point commercial development. The unlined channel commences at Sweetwater Avenue and follows along the west side of the railroad. South of Cactus Road, it transitions to a lined trapezoidal channel within the existing City of Surprise WRF. Through portions of the WRF, the channel has a lined rectangular section. Between the WRF and Peoria Avenue, the open channel is replaced by underground concrete box culverts.

A multi-use detention basin, referred to as Cheryl Basin, is located north of the railroad and south of Peoria Avenue (Figure 5D, Page 26). Outflow from this on-line basin is controlled by one (1) 36" pipe and (1) 12' x 8' concrete box culvert conveying the basin outflow under the railroad to the south. The 36" pipe is set at the basin bottom elevation. Flow starts to overtop the weir into the box culvert at approximately the 5-year storm event. The 12' x 8' box culvert also serves as pedestrian access for the trail continuation to the south.

South of Cheryl Basin, the channel is unlined and follows along the west side of the 135th Avenue alignment. North of Northern Parkway, the channel enters a second on-line basin, referred to as Royal Palm Basin. Outflow from this basin is controlled by one (1) 10' x 6' concrete box culvert, which conveys flow under Northern Parkway. South of Northern Parkway, a lined trapezoidal channel continues south to the Dysart Drain along the ¼-mile alignment west of Dysart Road.

A Secondary Channel captures flow west of the railroad (143rd Avenue alignment). The channel begins north of the railroad bend, on the north side of Olive Avenue, and passes under the railroad through two (2) 48-inch pipes. South of the railroad, the channel has a lined rectangular section until it reaches Northern Parkway,

where it passes under the Parkway through two (2) 8' x 6' concrete box culverts. South of Northern Parkway to the Dysart Drain, the channel has a lined trapezoidal section.

Northern Parkway

The AT&SF channel will be a key drainage component for the Northern Parkway (Figure 2, Page 7) between Reems Road and El Mirage Road. The channel will provide an outfall for on-site and off-site drainage systems to be designed with the Northern Parkway. Hydrologic analyses presented herein have been developed for this four-mile segment of the Parkway. Detention basins will help to attenuate the peak discharge for this drainage network.

Construction Phasing

The AT&SF Channel and Basins are a key element of the drainage facilities for the Northern Parkway. Between Reems Road and El Mirage Road, the channel provides necessary flood mitigation and a regional outfall for the Northern Parkway. Since the construction of the Northern Parkway may precede full improvements to the AT&SF Channel and Basin project, a project phasing plan has been developed as shown in Figure 7 (After Page 38). Phase 1A are those minimum improvements necessary to provide an outfall for the Northern Parkway. Right-of-way acquisition for the Cheryl Basin might also be considered if the Northern Parkway requires a borrow site for fill material.

Cost Estimates and Evaluation

The Recommended Alternative has an estimated cost of $41,042,543, including construction and right-of-way acquisition (Table 19, Page 39). If the excavation of the Royal Palm Basin and the Cheryl Basin is completed in construction with the Northern Parkway project, and the resulting material is used for embankment fill, the adjusted cost is $32,564,494 (Table 20, Page 39). After applying a credit for overlapping drainage structures, a total of $23,577,098 is reached (Table 20, Page 39).

MCDOT Evaluation

MCDOT reviewed the Recommended Alternative and made recommendations regarding the phasing and alignment of the project with regard to the proposed Northern Parkway. The issues and how they were addressed are discussed in Section 7.7 (Page 34) of this report.

1 INTRODUCTION

Hoskin•Ryan Consultants, Inc. (HRC), has been contracted by the Flood Control District of Maricopa County (FCDMC) to prepare a Candidate Assessment Report (CAR) and Preliminary Design Plans for the AT&SF Railroad Channel and Basin project (Figure 1). The AT&SF Railroad Channel and Basin is one element of the regional drainage solution proposed as part of the *Loop 303/White Tanks Area Drainage Master Plan Update* (Loop 303 ADMPU) (Ref. 57), completed in 2005 by URS for the FCDMC.

The Atchison Topeka and Santa Fe Railroad (AT&SF), noted as the Burlington-Northern Santa Fe (BNSF) Railroad on current *Right of Way and Track Maps* (Refs. 3 and 4), is an existing freight line extending from Grand Avenue and Waddell Road south to Luke Air Force Base (AFB). The rail line is elevated in relation to the surrounding agricultural fields, causing flows from the west to pond in the fields along the embankment. Approximately 250 acres of land along the railroad are located within Federal Emergency Management Agency (FEMA) 100-year Zone A floodplains.

The solution proposed in the Loop 303 ADMPU includes a channel along the west side of the railroad. A detention basin is intended to reduce peak flows before the channel discharges into the Dysart Drain. The purpose of the AT&SF Channel and Basin is to reduce the existing floodplain along the west side of the railroad, protect existing infrastructure investments such as the City of Surprise Water Reclamation Facility, and provide a regional outfall.

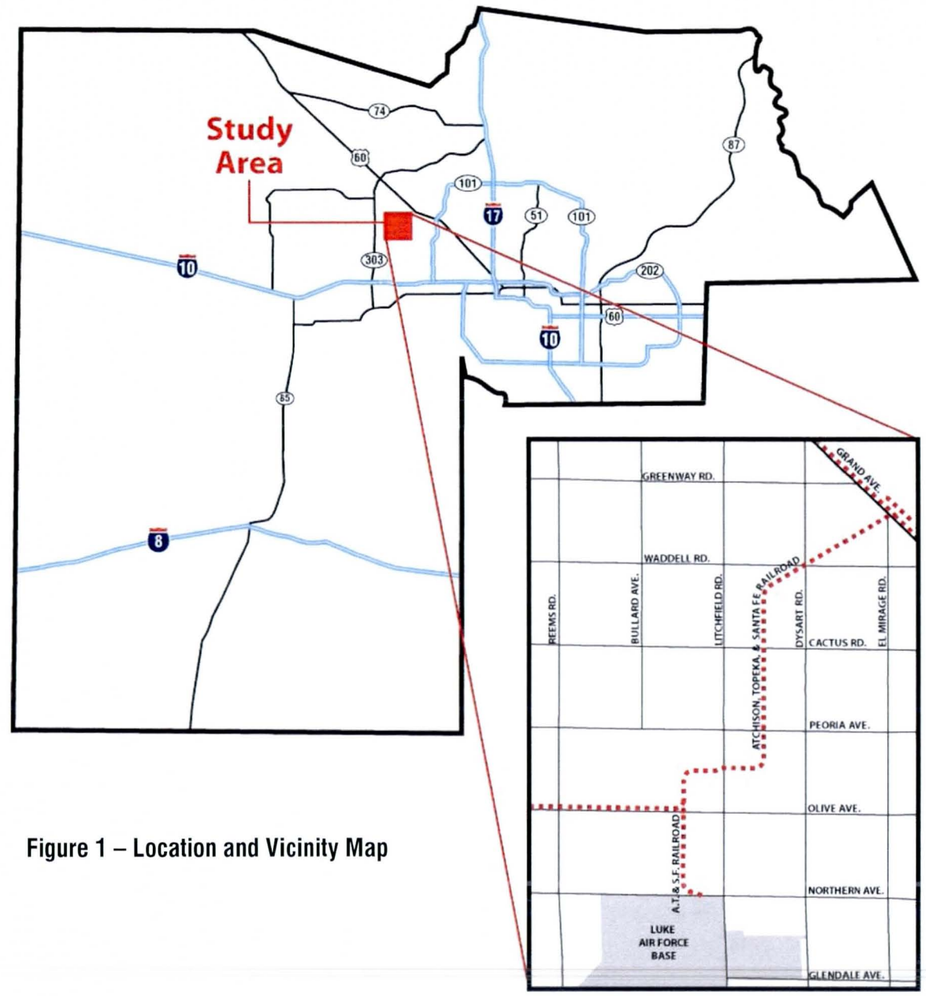


Figure 1 – Location and Vicinity Map

1.1 Stakeholders

On-going projects and interested stakeholders include the Dysart Drain through Luke AFB, the White Tanks/Loop 303 ADMP Hydrology Update, which is a joint undertaking of the FCDMC and the Arizona Department of Transportation (ADOT), the Northern Parkway project led by the City Glendale and Maricopa County Department of Transportation (MCDOT), the Loop 303 and associated regional channel system by ADOT, private development interests such as Woolf, TDR, and BNSF, along with the cities of Surprise and El Mirage.

1.2 Purpose

The purpose of the Candidate Assessment Report (CAR) and Preliminary Design Plans is to develop a preferred regional drainage collector channel alternative for the AT&SF component of the ADMPU that works with, and optimizes, the regional flood protection and drainage structures including the Northern Parkway, Dysart Drain,

and the Loop 303 channel, while satisfying stakeholder objectives/constraints. This CAR investigates the alignment and design alternatives and assesses the multi-use recreational potential for the proposed channel and basin. The project consists of four phases as follows:

- Data Collection and Existing Conditions Analysis
- Preliminary Alternatives Formulation and Analysis
- Proposed Alternatives Formulation and Analysis
- Recommended Alternative, Preliminary Plans, and Candidate Assessment Report

1.3 Recommended Alternative Phase

Presented in this report are the Recommended Alternative and Preliminary Plans, and summaries of the previous phases of the study. Previous phases are documented in detail in the *Data Collection Summary* (Ref. 34), *Preliminary Alternatives Report* (Ref. 35), and *Alternatives Evaluation Report* (Ref. 33), prepared by Hoskin-Ryan Consultants, Inc.

The Recommended Alternative was chosen based upon stakeholder input obtained from a presentation of the two Proposed Alternatives. Right-of-Way requirements, cost estimate, detailed hydrology and hydraulics, and Preliminary Plans were prepared.

1.4 Authority for Study

The Flood Control District of Maricopa County's contract number is FCD 2007C016, Assignment Number 2. The official Notice to Proceed date is May 13, 2008. The FCDMC Project Manager is Burke Lokey, P.E., CFM.

1.5 Location of Study

The study area encompasses approximately seventeen (17) square miles in the western Phoenix metropolitan area, bounded by Waddell Road to the north, the Dysart Drain to the south, Reems Road to the west, and El Mirage Road to the east. The study area includes the jurisdictions of the City of Surprise, City of Glendale, City of El Mirage, and unincorporated Maricopa County. The study boundary borders the north boundary of Luke Air Force Base.

1.6 Implementation

Upon completion and final acceptance of the CAR results by the stakeholders, the FCDMC, along with any identified partners, will proceed with project development and implementation of the preferred alternative. The final outcome of the CAR will be the recommendation of a preferred alternative, proposed IGA terms, cost share partners and percentages, and a Capital Improvement Program (CIP) proposal. In the specific case of the AT&SF Channel CAR, this project could be incorporated into a combined project with the Northern Parkway.

2 DATA COLLECTION

Details regarding the agencies contacted and the data obtained are documented in the *AT&SF Railroad Channel and Basin Candidate Assessment Report, Data Collection Summary*, prepared by Hoskin-Ryan Consultants, Inc., on July 11, 2008 (Ref. 34). Agencies contacted during the data collection process included the City of Surprise, City of Glendale, City of El Mirage, the Burlington Northern Santa Fe Railway (BNSF), Maricopa County Department of Transportation (MCDOT), Flood Control District of Maricopa County (FCDMC), and Arizona Bluestake.

Reference materials gathered from the various agencies include:

- previous and existing hydrologic studies
- landscape character and scenic resource data
- multi-use recreation data
- aerial photography and topographic mapping
- utilities locations
- right-of-way information
- proposed development projects
- proposed infrastructure projects
- GIS layer data and computer models

Site visits were conducted on May 22nd, 26th, and 28th, 2008, by the key team members. The purpose of the field visits was to provide the team with an understanding of the existing drainage structures and overall landscape characteristics of the study area, as well as to identify any major obstacles to the channel and basin layout alternatives. Selected photographs from the site visits are included in the *Data Collection Summary* (Ref. 34).

3 NORTHERN PARKWAY

3.1 Introduction

The Northern Parkway commences at Sarival Avenue, on the Butler Road alignment, and continues east to Litchfield Road before it swings south to join the Northern Avenue alignment near Dysart Road. This proposed "super street" will have grade-separated interchanges (GSI) at each of the major mile arterial roads which cross it. Eventually, the Northern Parkway will connect with ADOT's Loop 303 freeway. The *Northern Parkway Draft Design Concept Report, Volume I* (Ref. 62), and *Northern Parkway Draft Design Report, Volume II – Concept Plans* (Ref. 63), document the purpose, need, and planned concept for this major highway project, which will extend for a distance of approximately 12.5 miles.

The proposed Northern Parkway poses a barrier to natural drainage patterns in the area, which are generally from northwest to southeast. Therefore, the planning of the Northern Parkway ties critically with any proposed solutions for the AT&SF Channel. The *Design Concept Report* (Ref. 62) identifies the project's specific alignment and design constraints. The proposed drainage improvements are illustrated on Figures 5-1 and 5-2 of that report (Ref. 62). The *Concept Plans* (Ref. 63) provide specific sizes and costs of proposed storm drainage systems, channels and culverts. A drainage collection channel is proposed along the north side of the parkway with various points of outfall as follows:

- Old Sarival Road to Reems Road with outfall to the Falcon Dunes through the Reems Road Inlet Channel (Sheet D2 to D7).
- Reems Road to 151st Avenue with outfall to Falcon Dunes North Inlet Channel (Sheet D7-D9).
- 151st Avenue to AT&SF with outfall to existing channel (Sheet D10-D15).
- AT&SF to retention basin west of Litchfield Road, and storm drain south along Litchfield Road (Sheet D15-D17).
- Litchfield Road to 135th Avenue and Northern with outfall to south parkway channel (Sheet D17-D21).
- Northern and 135th Avenue to Dysart Road outfall channel (Sheet D21-D24)
- Dysart to 127th Avenue, no channel (D24-D26)
- 127th Avenue to Sta 335+00 +/- with outfall to the southeast (Sheet D26-D28)

3.2 Loop 303

The Loop 303 will involve a regional flood control channel along the west side of the freeway. This channel will continue south from the Northern Parkway interchange to the Gila River. Off-line detention basins near its interchanges with Cactus Road and Northern Avenue will help to attenuate the 100-year peak flows. In its current configuration, no flows will cross the Loop 303 from west to east. Therefore, per the current plan, no flows from west of the planned Loop 303 impact the AT&SF Channel and Basin design.

3.3 Proposed Northern Parkway Drainage System

The *Design Concept Report* (Ref. 62) documents the proposed roadway alignment and design concepts. Chapter 5.6 provides guidelines as to the design criteria and concepts established for the drainage system. From a drainage perspective, the relevant area of interest to the AT&SF CAR is defined as the "West Watershed," which extends from the White Tank Mountains to the Agua Fria River. The existing drainage features noted within this area are:

- Olive Avenue and BNSF Railroad
- Falcon Dunes Detention Basin (and Golf Course) including North Inlet Channel, East Inlet Channel and Reems Road Inlet Channel
- Reems Road drainage ditch (east of Reems Road, south of Butler Drive)
- Dysart Drain (outfall for Falcon Dunes – North and East Inlet Channels

- BNSF Railroad Spur, drainage ditch, and tailwater ditch (at 143rd Avenue, west of railroad embankment)
- A wash that crosses Northern Avenue between Dysart Road and El Mirage Road

3.4 Hydrology

Hydrology developed for the Northern Parkway was based upon the Loop 303/White Tanks ADMPU for the following conditions:

- Existing Case Model
- Projects-in-Place Model
- Projects-in-Place with Northern Parkway
- Project-in-Place with Northern Parkway and BNSF channel and basin.

In the latter case, the intent was to ensure that there would be zero increase in the 100-year flow at the confluence of the AT&SF Channel (BNSF) with the Dysart Drain.

3.5 Inventory of Proposed Drainage Systems

The major drainage facilities proposed for the Northern Parkway are represented on Figure 2 and are summarized as follows:

- Northern Parkway Drainage Channel (along north side of new roadway)
- Reems Road South Channel and concrete box culvert with outlet to Falcon Dunes Reems Road Inlet Channel
- Extended concrete box culvert at Falcon Dunes East Inlet Channel
- New concrete box culvert at the AT&SF Channel (west of BNSF Railroad Spur and 143rd Avenue) and channel south to a new off-line detention basin
- New off-line detention basin located immediately west of the AT&SF Channel, within the Luke AFB APZ zone
- New retention basin near Bullard Road (south of Northern Parkway)
- New detention basin to the northwest of Litchfield Road grade-separated interchange (GSI)
- New storm drain network at depressed Litchfield Road crossing and storm drain trunk outlet to the Dysart Drain
- New concrete box culvert 0.5 mile west of Dysart Road GSI
- New Dysart Road Channel (from Northern Parkway to Dysart Drain)
- New or extended pipe culverts across the Parkway (0.5 mile east of Dysart Road)

All of the on-site and off-site drainage which reaches the Northern Parkway will be diverted to the Dysart Drain at the following locations:

- Outlet from the Falcon Dunes golf course
- Outlet from new detention basin west of BNSF railroad
- Storm drain outfall along Litchfield Road
- Dysart Road Channel
- Natural wash between Dysart Road and El Mirage Road

3.6 Drainage System Cost Estimate

The Northern Parkway *Design Concept Report* (Ref. 62) provides an estimate of costs for all elements of the Parkway. The cost of both onsite and off-site drainage improvements are included. Using the Concept Plans (Ref. 63) as a guide, the off-site drainage costs for the "West Watershed" area (Old Sarival Road to 2,000 feet west of El Mirage Road) were identified and are summarized in Table 1. All contingency factors are included in the estimate. Right-of-way areas and costs are provided only for channel and basin areas which coincide with the AT&SF Channel design elements.

Table 1: Summary of Off-Site Drainage Costs for Northern Parkway
Old Sarival Road East to 2,000 feet West of El Mirage Road

Description	From	Sta	To	Sta	Unit Cost	Total
Drainage Structures	Old Sarival Road	8326	West of 48" Outfall	10770	$391,880	$391,880
	West of 48" Outfall	10770	Falcon Dunes Inlet Channel	16000	$667,895	$667,895
	Falcon Dunes Inlet Channel	16000	AT&SF Channel	21250	$1,383,450	$1,383,450
	AT&SF Channel	21250	West of 10' x 4' CBC Crossing	27520	$757,840	$757,840
	West of 10' x 4' CBC Crossing	27520	West of (2) 48" RCP	32500	$1,067,210	$1,067,210
	West of (2) 48" RCP	32500	Drainage Outfall	33300	$130,380	$130,380
Sub-Total Structures					$4,398,655	$4,398,655
Traffic Control					5 %	$219,933
Mobilization					5 %	$219,933
Misc. Items (Survey, QC)					5 %	$219,933
Sub-Total						$5,058,453
Unidentified Items					25 %	$1,264,613
Sub-Total						$6,323,067
Construction Administration / Contingencies					14 %	$885,229
Total Construction Cost						$7,208,296
Engineering and Design					8 %	$576,664
Total Construction, Engineering, and Design Cost						**$7,784,960**

	Acres	Unit Cost	Total
AT&SF Channel	7.3	$250,000	$1,830,808
AT&SF Basin	9.9	$250,000	$2,485,491
Dysart Road Channel	1.4	$250,000	$355,831
Total Right-of-Way Cost			**$4,672,130**
TOTAL PROJECT COST			**$12,457,090**

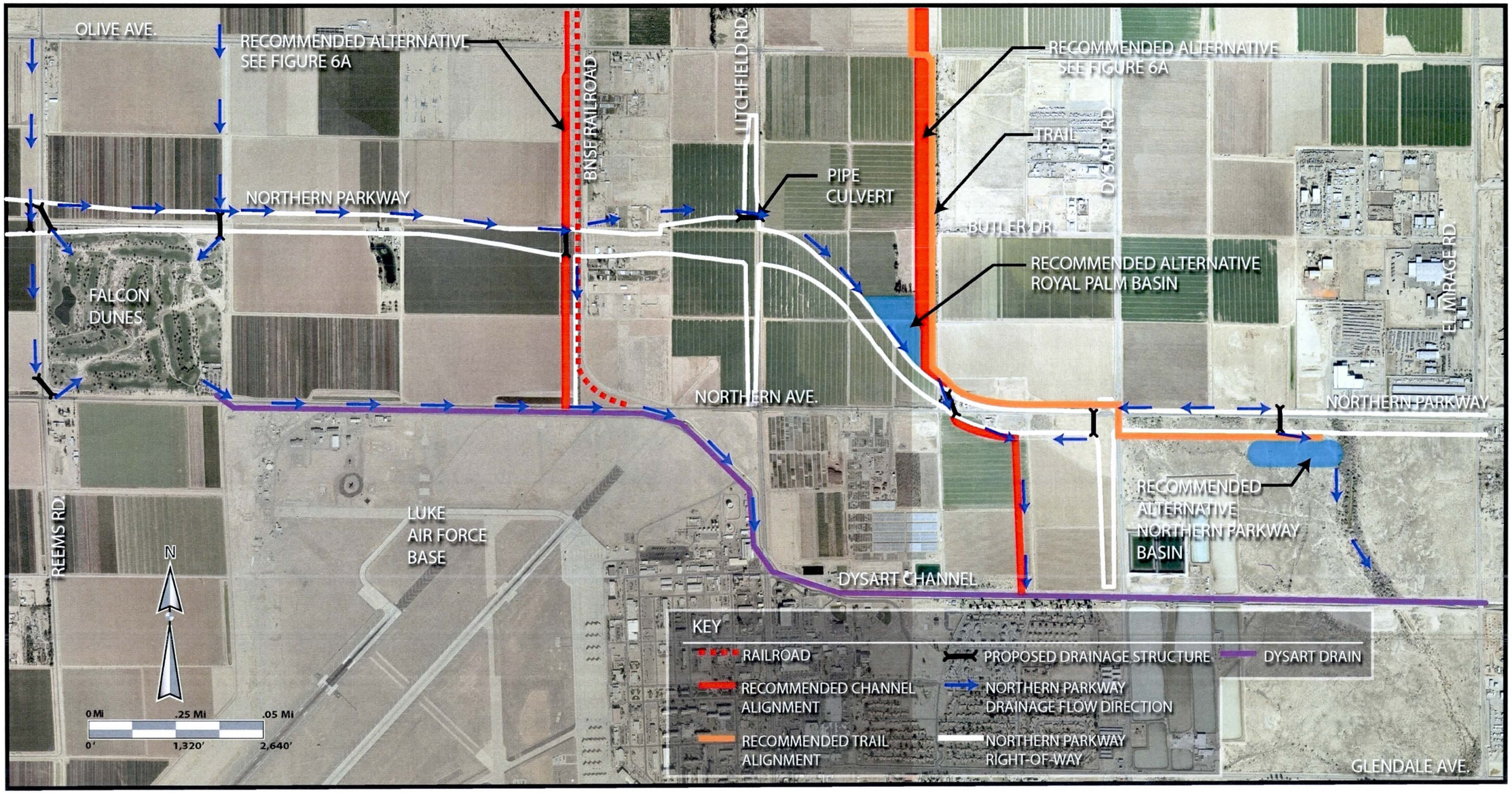


Figure 2 – Northern Parkway Drainage Concept with Recommended Alternative

4 HYDROLOGY

The study area is located within the White Tanks watershed. Extensive HEC-1 hydrologic analysis for the White Tanks watershed was initially completed in 1994 as part of the *White Tanks/Agua Fria Area Drainage Master Study* (Ref. 68). The White Tanks study was updated for existing and future conditions as part of the *Loop 303/White Tanks Area Drainage Master Plan Update* (Loop 303 ADMPU) (Ref. 57). The Loop 303 study was completed in 2005, and provided design alternatives for regional flood mitigation solutions within the watershed. Hydrology for the Loop 303 study is currently being updated for existing and future conditions by HDR Engineering under contract with the FCDMC.

Additionally, Aspen Consulting Engineers evaluated alternatives for a channel and basins at the Camelback Road and Loop 303 intersection as part of the *Camelback Basins Candidate Assessment Report* (Ref. 2). The updated HEC-1 hydrologic models for the watershed include development retention diversions for each basin and the new Suncor Channel south of Camelback Road. The result of these changes significantly decreased the peak discharges within the AT&SF Channel and Basin study.

The HEC-1 existing and proposed conditions from the Camelback CAR model were modified by HRC, first to reflect recent changes within the watershed area, second to model the Proposed Alternatives conditions, and third to model the Recommended Alternative. The HEC-1 models prepared for the Northern Parkway (Ref. 62) were also integrated into the Recommended Alternative model. Details of the hydrologic modeling and the HEC-1 output can be found in Appendices A through E in Volume 2 of the *Candidate Assessment Report*. The HEC-1 schematic maps are shown in Figures 8 through 11.

4.1 Existing Conditions

The Camelback CAR *"existing conditions with projects in place"* model reflects the existing conditions for the watershed area, and includes the assumption that construction of the Loop 303 and Reems Road Channel and Basin has been completed.

Modifications made to the Camelback CAR *"existing conditions with projects in place"* model include:

- Update of the sub-basin parameters per the Surprise Pointe commercial development
- Update of the sub-basin parameters per the Surprise Wastewater Reclamation Facility.
- Removal of the proposed routing along the AT&SF railroad, and recovery of flows overtopping the railroad towards the southeast.

This baseline was used as a point of comparison with the Proposed Alternatives. Output from the Existing Conditions HEC-1 model and a schematic diagram are included in Appendix B of Volume 2 of the AT&SF CAR. The schematic diagram is also shown in Figure 8 (Page 43).

Since completion of the Proposed Alternatives phase, a Revised Existing Conditions Model has been created, which incorporates the HEC-1 hydrology presented in the *Surprise Pointe LOMR* (Ref. 14), with additional corrections to the Surprise Pointe hydrology requested by the FCDMC. This model was used as the baseline for comparison with the Recommended Alternative. Output from the Revised Existing Conditions HEC-1 model is included in Appendix E of Volume 2 of the AT&SF CAR. Modifications due to the Northern Parkway drainage systems are not included in the Revised Existing Conditions model.

Table 2: Proposed Alternative 1 Peak Discharges

Concentration Point	Existing Conditions Model		Proposed Alternative 1 Model	
	HEC-1 I.D.	100-Yr Q (cfs)	HEC-1 I.D.	100-Yr Q (cfs)
Railroad at Sweetwater Ave	CP153	143	!RR2	143
Railroad at Cactus Rd	CP152	231	!RR3	231
Railroad at WRF	CP168A	471	!RRW	497
Railroad at Peoria Ave	CP168B	381	!RR4	436
Railroad South of Peoria Ave, Basin Inflow	CP183	303	!RR5	613
Detention Basin Outflow	N/A	N/A	SRRR5	248
Railroad at Olive Ave	CP181	239	!RR7	256
Dysart Drain at Railroad	!!C195	755	!!C195	732
Litchfield Rd at Northern Ave	!!C196	909	!!C196	883
Dysart Drain at Dysart Rd	!!C202	1104	!!C202	1077
Dysart Drain at 127th Ave	CP204	1612	CP204	1586

4.2 Proposed Alternative 1

The Proposed Conditions HEC-1 model schematic diagram for Alternative 1 is shown on Figure 9 (Page 44). The output is included in Appendix C, located in Volume 2 of the CAR. Concentration points shown in Table 2 are highlighted in red on the schematic diagram.

The following modifications were made to create the HEC-1 model for Proposed Alternative 1:

- The off-line detention basin at SRRR5 was replaced with an on-line detention basin to attenuate peak discharge and to more effectively reduce any impacts on the Dysart Drain.
- The basin was relocated to a site approximately 1,000 feet south of Peoria Avenue and 1,000 feet east of Litchfield Road.
- The routing of Sub-Basin 181A was changed to reflect the diversion of flow into the detention basin.
- The routing of flow out of the detention basin was modified to tie to concentration point !RR7.

Table 3: Proposed Alternative 2 Peak Discharges

Concentration Point	Existing Conditions Model		Proposed Alternative 2 Model	
	HEC-1 I.D.	100-Yr Q (cfs)	HEC-1 I.D.	100-Yr Q (cfs)
Railroad at Sweetwater Ave	CP153	143	!RR2	143
Railroad at Cactus Rd	CP152	231	!RR3	231
Railroad at WRF	CP168A	471	!RRW	497
Railroad at Peoria Ave	CP168B	381	!RR4	436
Railroad South of Peoria Ave, Basin Inflow	CP183	303	!RR5	622
Detention Basin Outflow	N/A	N/A	SRRR5	439
Railroad at Olive Ave	CP181	239	CP181	239
Dysart Drain at Railroad	!!C195	755	!!C195	728
Litchfield Rd at Northern Ave	!!C196	909	!!C196	880
Dysart Drain at Dysart Rd	!!C202	1104	!C202B	1156
Dysart Drain at 127th Ave	CP204	1612	CP204	1574

4.3 Proposed Alternative 2

The Proposed Conditions HEC-1 model schematic diagram for Alternative 2 is shown on Figure 10 (Page 45). The output is included in Appendix D, located in Volume 2 of the CAR. Concentration points shown in Table 3 are highlighted in red on the schematic diagram.

The following modifications were made to create the HEC-1 model for Proposed Alternative 2:

- Sub-Basins 184, 197, and 202 were divided to represent the separation of the proposed channel. MCHUP2 was used to generate unit hydrographs for the new sub-basins based on the Phoenix Valley S-graph.
- An on-line detention basin was located approximately 1,000 feet south of Peoria Avenue and 1,000 feet east of Litchfield Road. A second off-line detention basin was placed at the northeast corner of the intersection of the AT&SF channel and the planned Northern Parkway.
- The TAREA parameters of the HC cards were adjusted at every concentration point along the channel alignments for area-depth adjustment.

Table 4: Recommended Alternative Peak Discharges

Concentration Point	Revised Existing Conditions Model (1)		Recommended Alternative Model	
	HEC-1 I.D.	100-Yr Q (cfs)	HEC-1 I.D.	100-Yr Q (cfs)
Railroad at Sweetwater Ave	CP153	441	!RR2	441
Railroad at Cactus Rd	CP152	339	!RR3	388
Railroad at WRF	CP168A	471	!RRW	414
Railroad at Peoria Ave	CP168B	417	!RR4	583
Railroad South of Peoria Ave, Basin Inflow	CP183	327	!RR5	806
Detention Basin Outflow	N/A	N/A	SRRR5	544
Railroad at Olive Ave	CP181	239	CP181	239
Dysart Drain at Railroad	!!C195	755	CP195C	849
Litchfield Rd at Northern Ave	!!C196	909	!C196C	946
Dysart Drain at Dysart Rd	!!C202	1104	!C202B	1565
Dysart Drain at 127th Ave	CP204	1612	!!C204	1890
Dysart Drain at 127th Ave with Additional 5-Acre Basin South of Northern Pkwy	CP204	1612	!!C204	1579

(1) The Revised Existing Conditions Model incorporates the HEC-1 hydrology presented in the *Surprise Pointe LOMR* (Ref. 14), with additional corrections to the Surprise Pointe hydrology requested by the FCDMC.

4.4 Recommended Alternative

The Proposed Conditions HEC-1 model schematic diagram for the Recommended Alternative is shown on Figure 11 (Page 46) and are included in Appendix F, located in Volume 2 of the CAR. Concentration points shown in Table 4 are highlighted in red on the schematic diagram.

The following modifications were made to create the HEC-1 model for the Recommended Alternative:

- Northern Parkway was incorporated into the HEC-1 model. Drainage basins, channel routings, and storage routings in the URS HEC-1 model for Northern Parkway were collected and incorporated into the Recommended Alternative HEC-1 model.
- The proposed basin at the northwest corner of the AT&SF Railroad and Northern Avenue was removed.
- The detention basin northwest of Northern Parkway and Litchfield Road, proposed as part of the Northern Parkway improvements, was removed. Flow north of Northern Parkway was redirected east to Royal Palm Basin.
- The channel and storage routings in the HEC-1 model were updated per the Recommended Alternative.
- An additional 5-acre detention basin is recommended to be constructed in conjunction with the Northern Parkway improvements. This basin would be located south of Northern Parkway between Dysart Road and El Mirage Road.

5 PRELIMINARY ALTERNATIVES

5.1 Overview

Nine (9) Preliminary Alternatives were identified during the study. Seven (7) of the alternatives are documented in the *Preliminary Alternatives* report dated August 28, 2008 (Ref. 35), and were presented at a stakeholders meeting held on August 28, 2008. The first seven alternatives are shown on Figure 3A. Based on input received during the Stakeholders Meeting, two additional preliminary alternatives were created, following versions or combinations of the alignments in Figure 3A.

Choices for alignments north of the bend in the railroad, at the Mountain View Road alignment, are limited due to existing and planned residential and commercial development. In this area, the preliminary alternatives follow Litchfield Road, or alignments along the west or east sides of the railroad. South of Peoria Avenue, more choices were available for alignment. This is due to large City of Phoenix and private land holdings with no current plans for development, and zoning restrictions placed on the area due to the proximity of Luke Air Force Base.

5.2 Alternatives Evaluation

Each of the preliminary alternatives was evaluated based on several factors. Following are the factors and a description of how they influenced the choice of the two Proposed Alternatives.

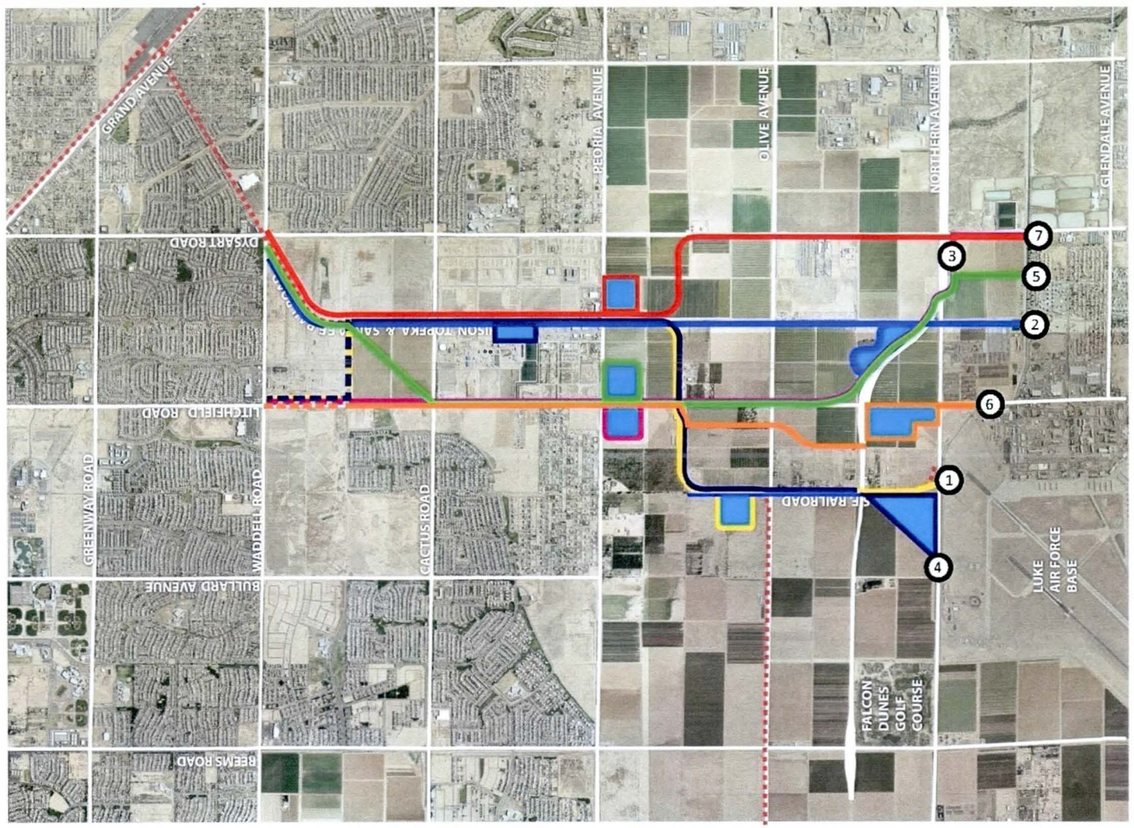


Figure 3A – Preliminary Alternatives Overview

Floodplain Mitigation

A key purpose of the AT&SF Channel and Basin improvements is to remove approximately 250 acres of existing floodplain along the west side of the railroad. The Proposed Alternatives should remove the floodplain, and not significantly increase the peak flow entering the Dysart Drain.

Regional Outfall

The channel and basin system should provide a regional drainage outfall for future infrastructure improvements in the area, including the construction of the Northern Parkway. Downstream impacts to the Dysart Drain should be minimized.

Construction Cost

The cost estimates for the majority of the Preliminary Alternatives, including right-of-way acquisition ranged from 31 to 35 million dollars. At the early stage of Preliminary Alternatives development, the costs did not affect the selection of alternatives.

Right of Way Availability

Right-of-way acquisition is a large cost item for the project. Whenever possible, it is preferable to keep the proposed channel on public land and away from private lands which have existing planned developments. Locating the channel and basin on public land is also preferable in order to maintain current open space compatibilty with the City of Phoenix planned land use and the Luke Air Force Base clear zones. Current development on property greatly influenced the conceptualization of alternatives. In particular, the Surprise Pointe development and the City of Surprise WRF have an impact on the alternatives.

Land Use Impacts

The Proposed Alternatives should not break up parcels in such a way as to make them unmarketable for future development. The footprint required for the channel and trail should be minimized where possible.

Multi-Use Opportunity

Wherever possible, the Proposed Alternatives should allow for multi-use opportunities within the channel and basins, and should interconnect with existing or planned trail networks. Basins should preferably be located outside of the Luke AFB 75db noise contour limits so that they can be used as public gathering places.

Appearance / Aesthetics

The Proposed Alternatives channel and trail alignments should benefit the surrounding existing and planned developments by improving or adding a pleasant aesthetic.

5.3 Stakeholder Input

The Preliminary Alternatives Stakeholder Meeting was held at the City of Glendale on August 28th, 2008. Representatives from the Cities of Glendale, Surprise, and El Mirage, the FCDMC, and MCDOT attended the meeting. Additional meetings with the City of Glendale and the FCDMC were held at a later date. Following is a summary of comments from the meetings:

- The FCDMC believes a trail along the Northern Parkway is desirable.
- The FCDMC will not be a cost share partner for a trail which is separate from the channel improvements.
- The FCDMC prefers to place improvements on public lands, since this is the most cost-effective.
- The City of Glendale proposes a multi-use basin south of Peoria Avenue and east of Litchfield Road.
- The City of Surprise suggested that a culvert should be installed under the railroad at Waddell and Dysart Roads to eliminate ponding on the north side of the railroad.
- The City of Surprise suggested that a companion channel on the west side of Dysart Road from Waddell Road to the El Mirage Tributary should be part of a preferred solution.
- The City of Surprise Water Services department showed preference for Preliminary Alternatives 5 and 7, both of which bypass the Water Reclamation Facility.
- The City of Surprise Water Services department noted that the retention basins on the WRF site were designed for on-site flows only, and that the remainder of the site is currently being designed for a recharge well field. Therefore, the City will not allow the flood control design to include the retention areas within the WRF. However, the City supports the use of available space, excluding the recharge field and the current retention basins, for the FCDMC plans.
- City of Surprise indicated that security issues may arise from placing the trail along the railroad, or through or along the WRF.

- The City of El Mirage will not allow any additional flow or channels into their city limits. They will only accept drainage in the same manner as it currently approaches the city limits.
- The City of El Mirage proposed an alignment that follows along the southern side of the Northern Parkway, tying to the Dysart Drain between Dysart and El Mirage Roads.
- MCDOT suggested that basins should not be located within the Luke AFB flight paths, due to the possibility of attracting birds which could interfere with air traffic.
- MCDOT shows a preference for a minimum box culvert height of six (6) feet, and single barrel instead of multiple-barrel culverts, due to ease of maintenance.
- All agencies agreed that the new channel being constructed as part of the Surprise Pointe development should be utilized if possible.
- All agencies agreed that the diagonal channel placement in Preliminary Alternative 5 was not practical for future land use opportunities. Additionally, it was agreed that channel improvements should be kept within ¼ mile of the major road alignments in order to create marketable parcels for industrial development.

5.4 Typical Cross-Sections

Five typical cross-sections were proposed in the Preliminary Alternatives analysis portion of the study. The unlined trapezoidal channel (Section A, Figure 3B), lined trapezoidal channel (Section B, Figure 3C), rectangular box culvert (Section D, Figure 3E), and pipe culvert (Section E, Figure 3F) cross-sections were selected for use in the two Proposed Alternatives. Additionally, Section B also includes a lined trapezoidal channel without trail landscaping, for cases where the trail diverges from the channel. The typical cross-section sketches follow this section.

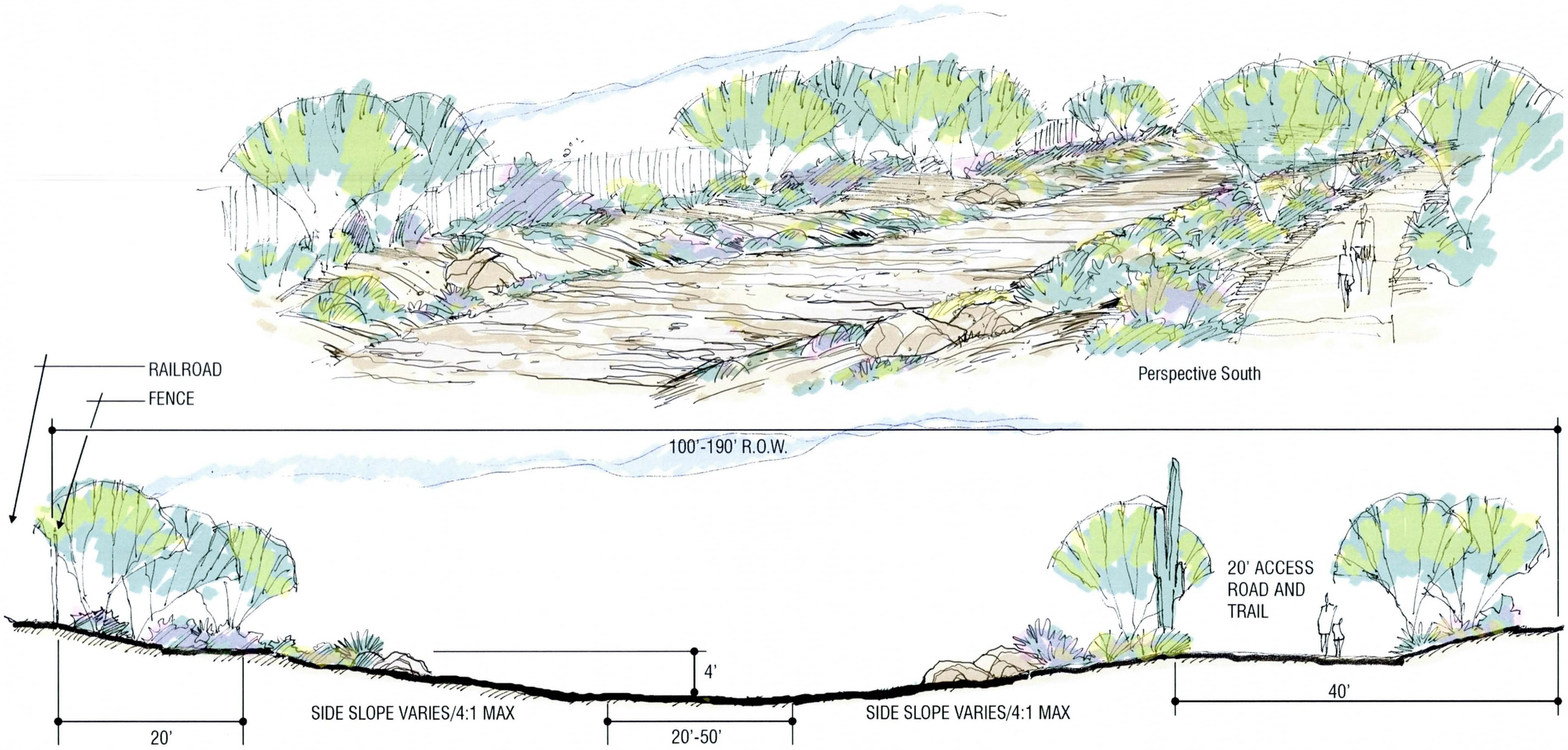
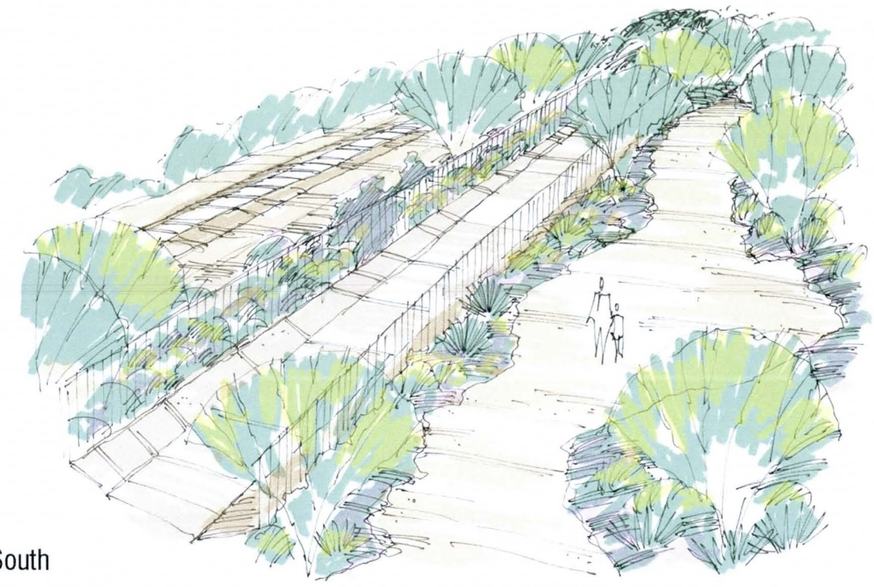


Figure 3B – Section A, Unlined Channel



Perspective South

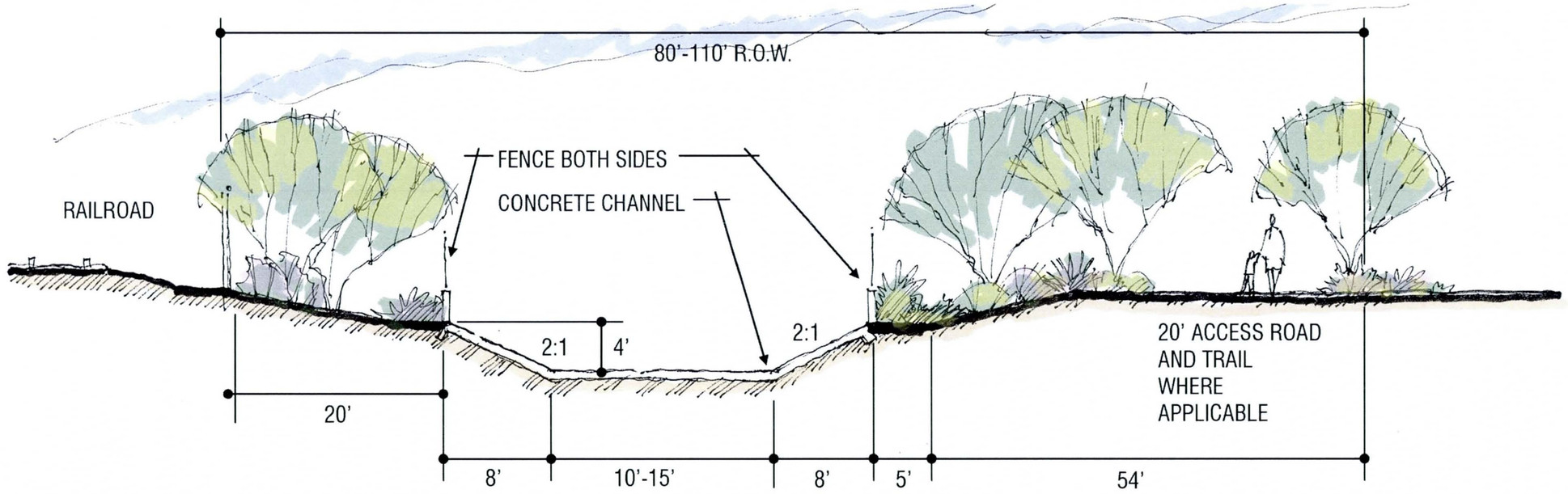
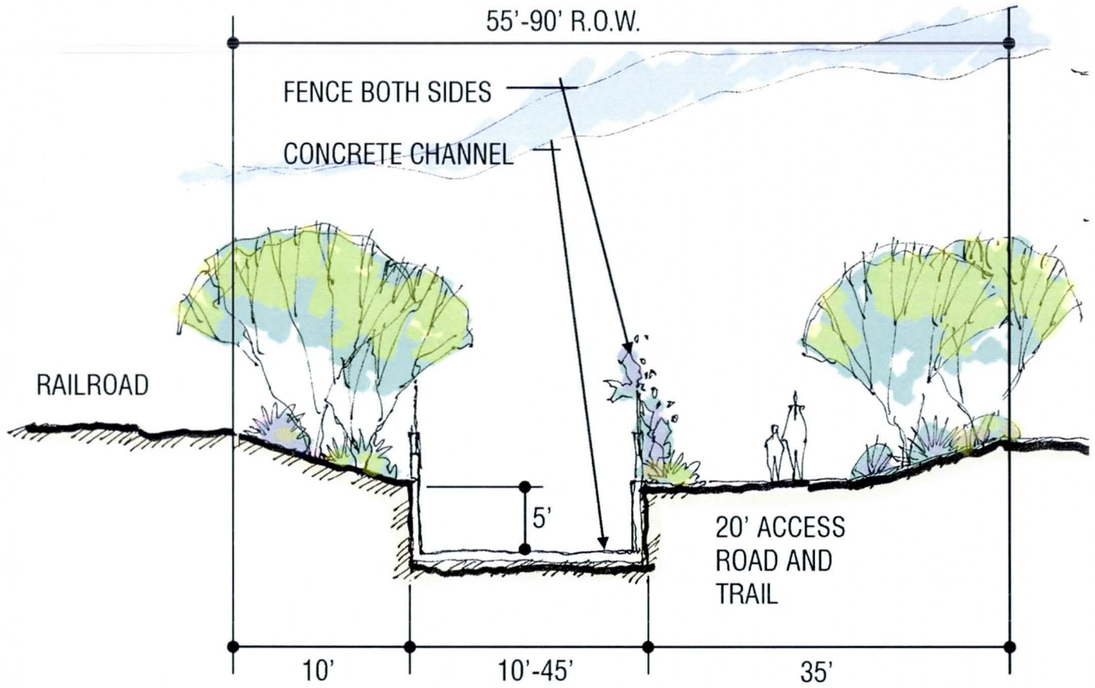
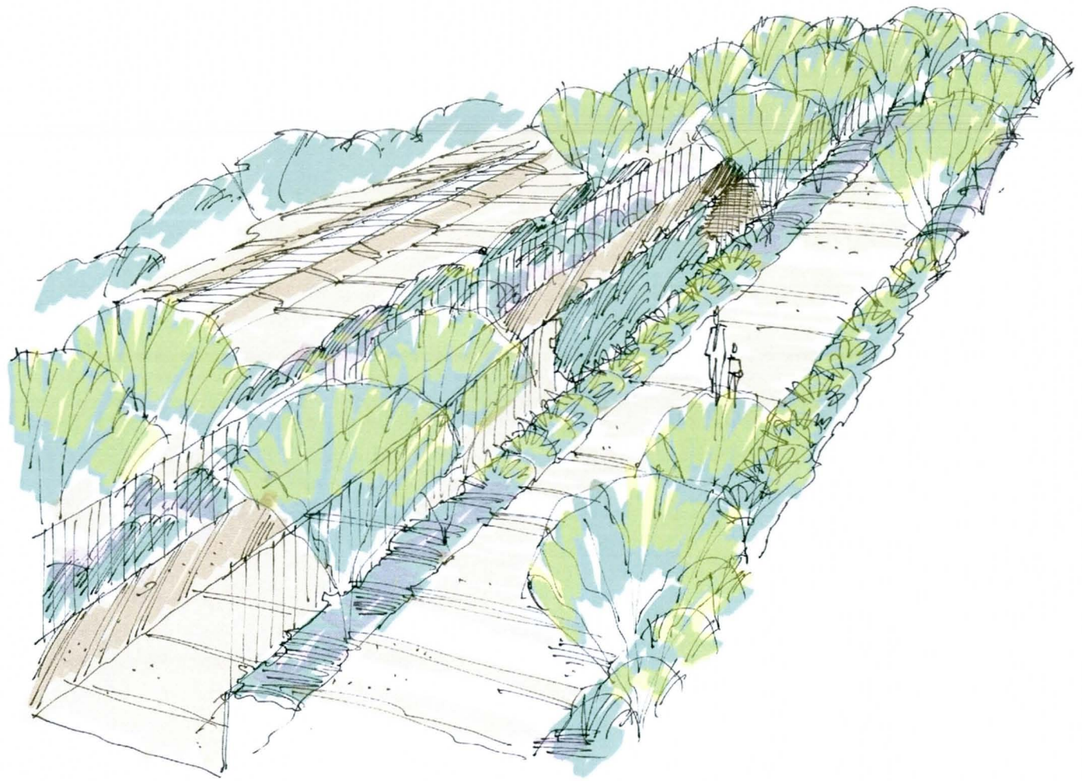


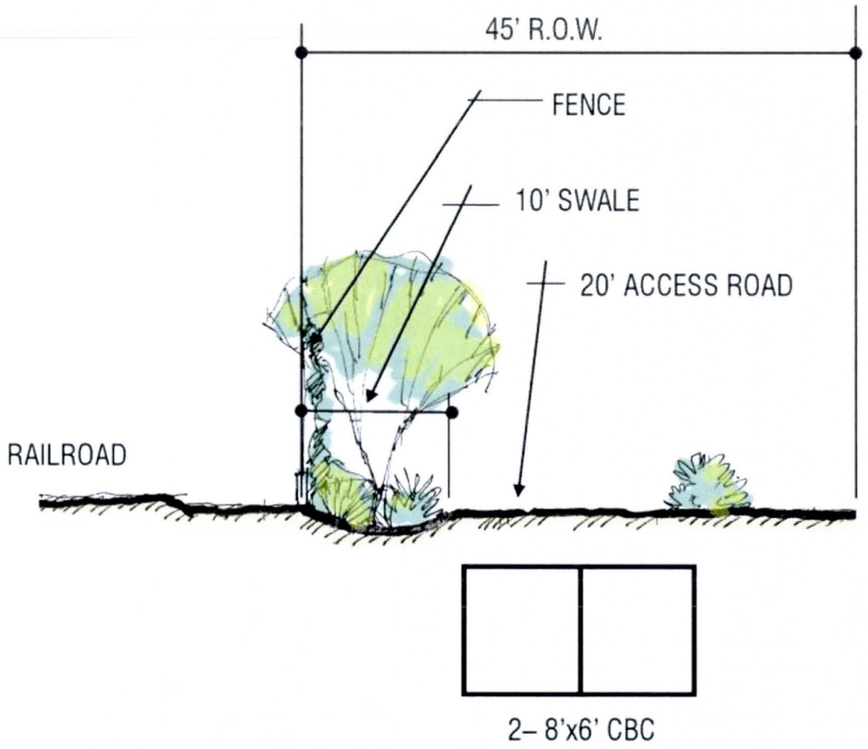
Figure 3C – Section B, Lined Trapezoidal Channel





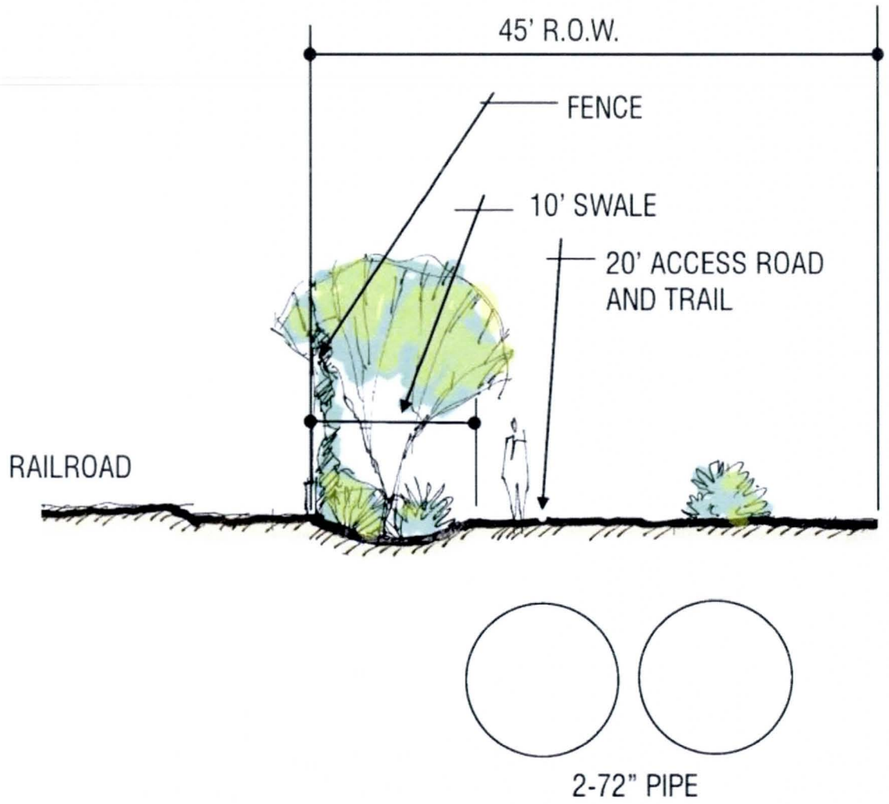
Perspective South

Figure 3D – Section C, Lined Rectangular Channel



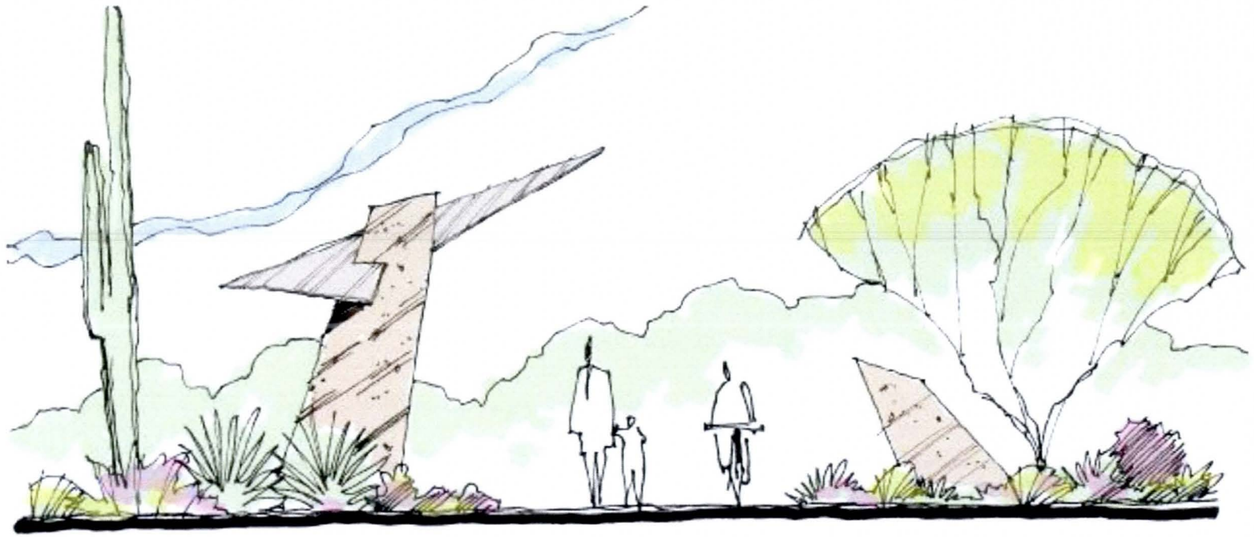
Perspective South

Figure 3E – Section D, Box Culverts

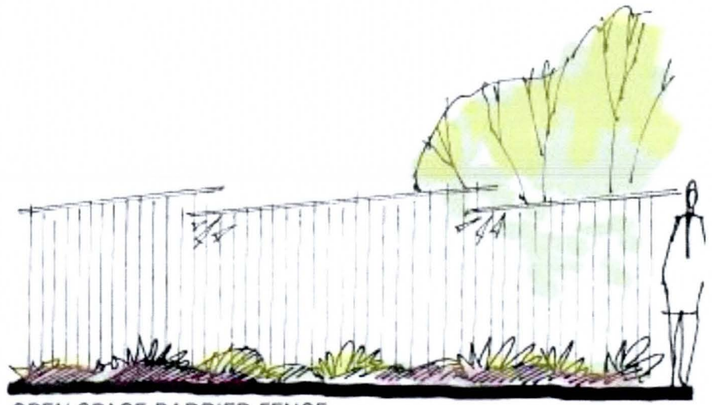


Perspective South

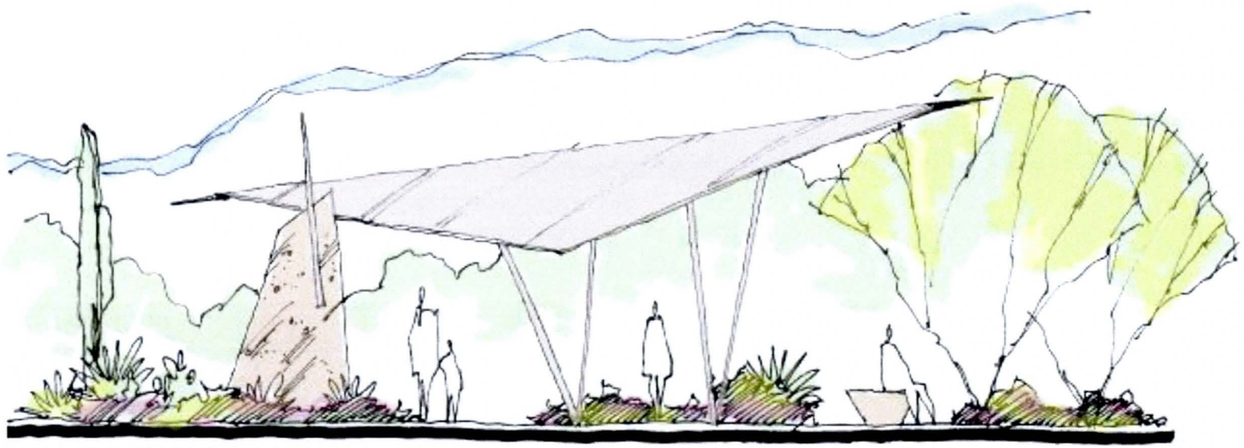
Figure 3F – Section E, Pipe Culverts



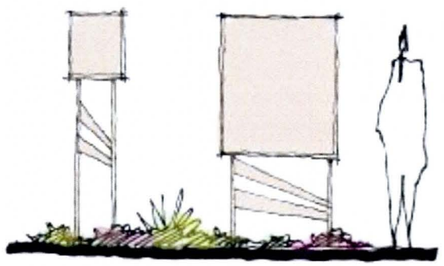
TRAIL GATEWAY



OPEN SPACE BARRIER FENCE



TRAIL REST STOP & RAMADA



TRAIL SIGNAGE

Figure 3G – Multi-Use Element Sketches

6 PROPOSED ALTERNATIVES

Presented in this section are the two (2) Proposed Alternatives that were chosen based on stakeholder feedback regarding the Preliminary Alternatives. The Proposed Alternatives are documented in detail in the *Alternatives Evaluation Report* dated November 12, 2008 (Ref. 33). Stakeholder input was obtained from a presentation of the Proposed Alternatives, held on December 4, 2008. Based upon this input, the Recommended Alternative was chosen for Preliminary Plan preparation and further analysis.

6.1 PROPOSED ALTERNATIVE 1

6.1.1 Description

Proposed Alternative 1 utilizes the design concept from Preliminary Alternative 1 with changes to the basin location and extent of the channel. The proposed channel alignment and section types are indicated on Figure 4A. Land ownership along the proposed alignment is shown on Figure 4C.

At the upstream end, the channel ties into a new channel that has been graded around the west and south sides of the Surprise Pointe commercial development. The engineer for Surprise Pointe has obtained a LOMR which removes the floodplain area west of the railroad, and re-configures the floodplain downstream of the intersection of Waddell Road and Dysart Road. As a result of lower discharges and on-site retention provided by Surprise Pointe, it is proposed to eliminate the construction of a channel through Surprise Pointe.

South of Cactus Road, the City of Surprise WRF is under construction. The proposed channel design transitions to a concrete-lined channel section located within an existing right-of-way owned by the City of Surprise WRF, and then to an underground concrete box culvert system through the most restricted areas of the WRF campus.

An on-line detention basin is located south of Peoria Avenue, referred to in this report as the Cheryl Basin. A collection channel along the railroad tracks intercepts surface flow and conveys it east into the detention basin. The outflow from the basin, which is to the west, is controlled by two six-foot diameter pipes, which convey the outflow to the west and then south along the railroad to an outfall channel south of Olive Avenue. The pipes outlet to a wide, unlined channel section which continues south and ties into the Dysart Drain. The channel crosses the Northern Parkway in a location included in the *Design Concept Report* (Ref. 62). At the confluence with the Dysart Channel, the channel crosses Northern Avenue through skew angled box culverts and then makes a turn to the east to meet the Dysart Drain through a transition structure. Due to right-of-way limitations, the trail crosses the channel on the north side of Northern Avenue and then continues east toward Litchfield Road.

6.1.2 Hydrology and Hydraulics

Revisions were made to the HEC-1 model to create a proposed conditions model for Alternative 1, as described in Section 4.2. The on-line detention basin stores 150 acre-feet of floodwater during the 100-year, 24-hour event peak flow. This reduces the peak flow in the channel from 613 cfs upstream of the basin, to 248 cfs at the downstream outlet. The peak flow entering the Dysart Drain at 143rd Avenue is reduced from 755 cfs to 732 cfs, and the peak flow in the Dysart Drain at Dysart Road is reduced from 1104 cfs to 1077 cfs. Table 5 summarizes the different channel segments, the cross-section types applied, and the hydraulics. Hydraulic calculations for Proposed Alternative 1 are included in Appendix G, located in Volume 2 of the CAR.

To prevent potential erosion, a slope of 0.15% is used to keep velocities in the unlined channel (Structure Type A – Unlined Channel) close to 3 feet per second. Since the natural slope is 0.33%, two-foot drop structures are required for every quarter-mile of channel. Proposed Alternative 1 requires a total

KEY:

Floodplain

Drainage Structures

Railroad

Proposed Channel Alignment

SECTION TOP WIDTH
A180
SECTION TYPE

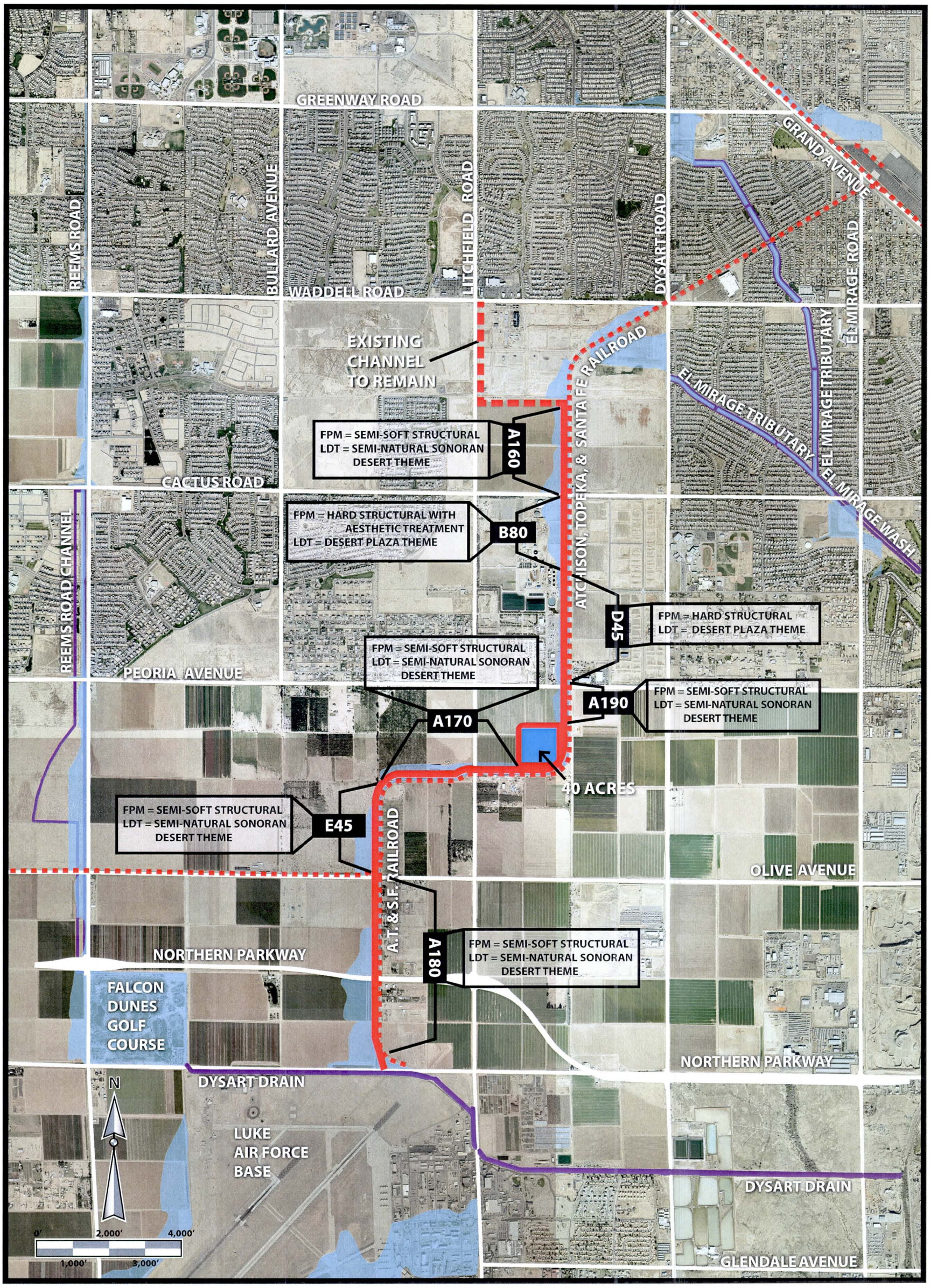


FIGURE 4A: PROPOSED ALTERNATIVE 1 - HYDROLOGY AND HYDRAULICS

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Key

- Railroad
- Proposed Trail
  *Stabilized Decomposed granite trail 20' clear width along entire length.
  *Certain lengths of the trail will serve as maintenance access.
- Proposed Channel Alignment
- Existing/Planned Trail

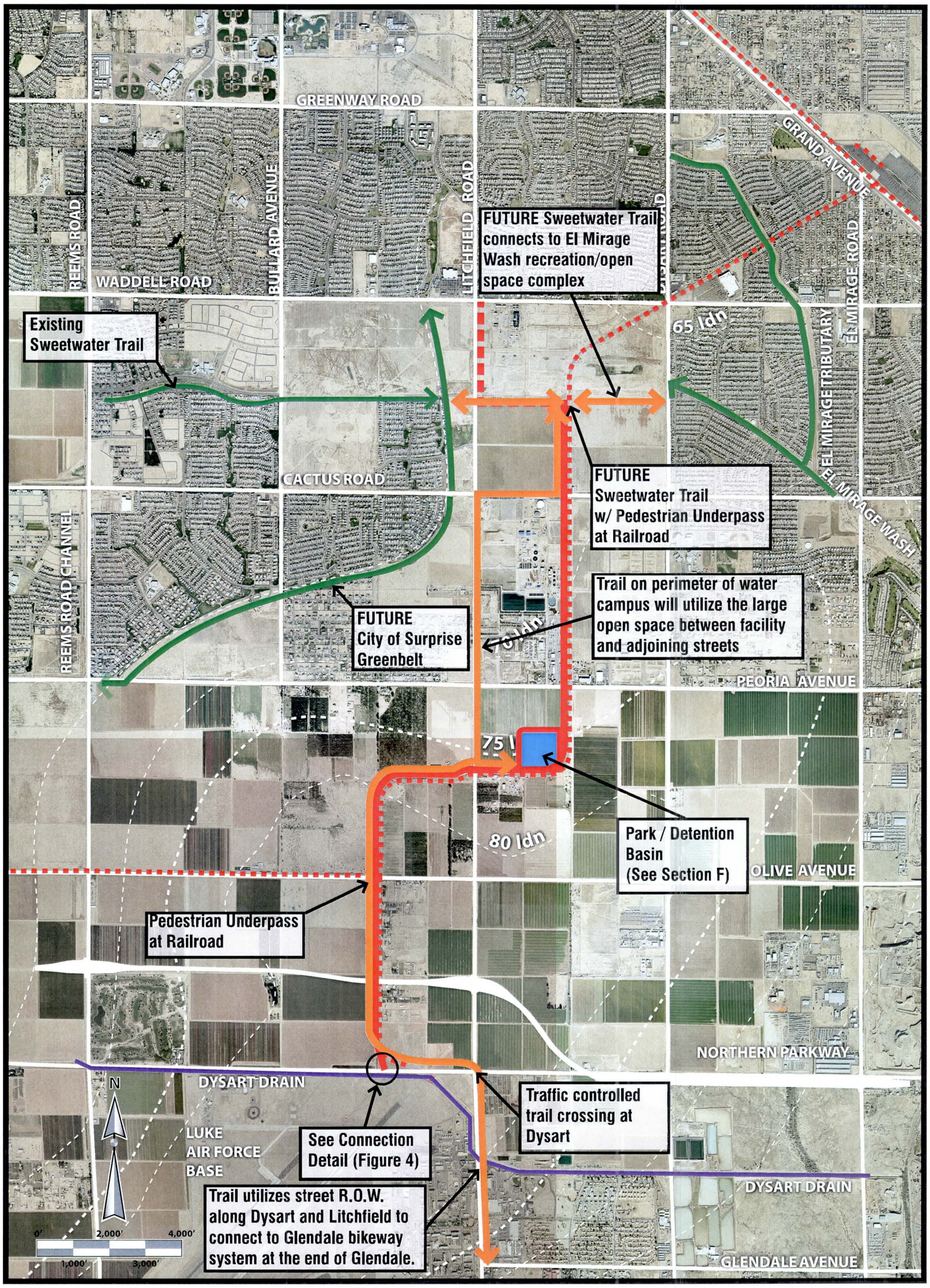

FIGURE 4B: PROPOSED ALTERNATIVE 1 - MULTI-USE MAP

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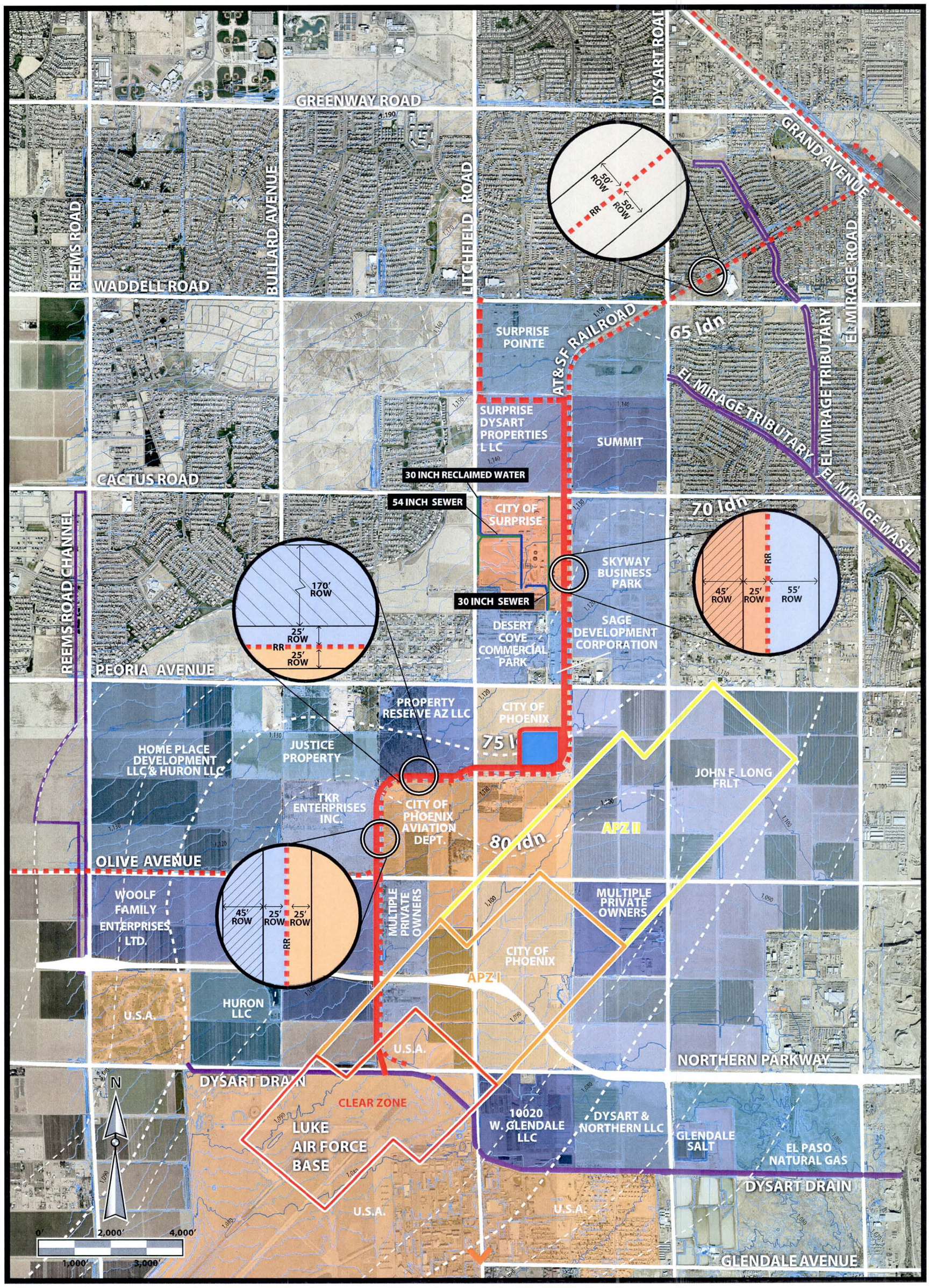

FIGURE 4C: PROPOSED ALTERNATIVE 1 - RIGHT-OF-WAY MAP

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of eleven drop structures. For the lined trapezoidal channel segments (Structure Type B – Lined Trapezoidal Channel), a slope of 0.13% was used to keep subcritical flow condition in the channel. This aids in a smooth transition from the unlined channel section.

Table 5: Proposed Alternative 1 Hydraulics

Location	Structure Type	Design Flow (cfs)	Bottom Width / Size (ft)	Sideslopes (H:V)	Slope (ft/ft)	Flow Depth (ft)	Total Right-of-Way Width (ft)
Sweetwater Ave – Cactus Rd	A – Unlined Channel	231	20	4:1	0.0015	3	160
Cactus Rd – Varney Rd	B – Lined Trapezoidal Channel with No Trail	497	15	2:1	0.0013	3	80
Varney Rd – Peoria Ave	D – Concrete Box Culverts	497	(2) 8' x 6' CBC	n/a	0.0033	n/a	45
Peoria Ave - Basin	A – Unlined Channel	497	50	4:1	0.0015	3	190
Basin South of Peoria Ave	F – Basin with Amenities	643 In 248 Out	150 AF	Varies	n/a	5	40 Ac
N. of RR Between Basin and 143rd Ave	A – Unlined Channel; flows east to Basin	363	30	4:1	0.0015	3	170
W. of RR Between Mountain View and Olive Ave	E – Pipe Culverts	248	(2) 72" RCP	n/a	0.0015	n/a	45
Olive Ave – Dysart Drain	A – Unlined Channel	441	40	4:1	0.0015	3	180

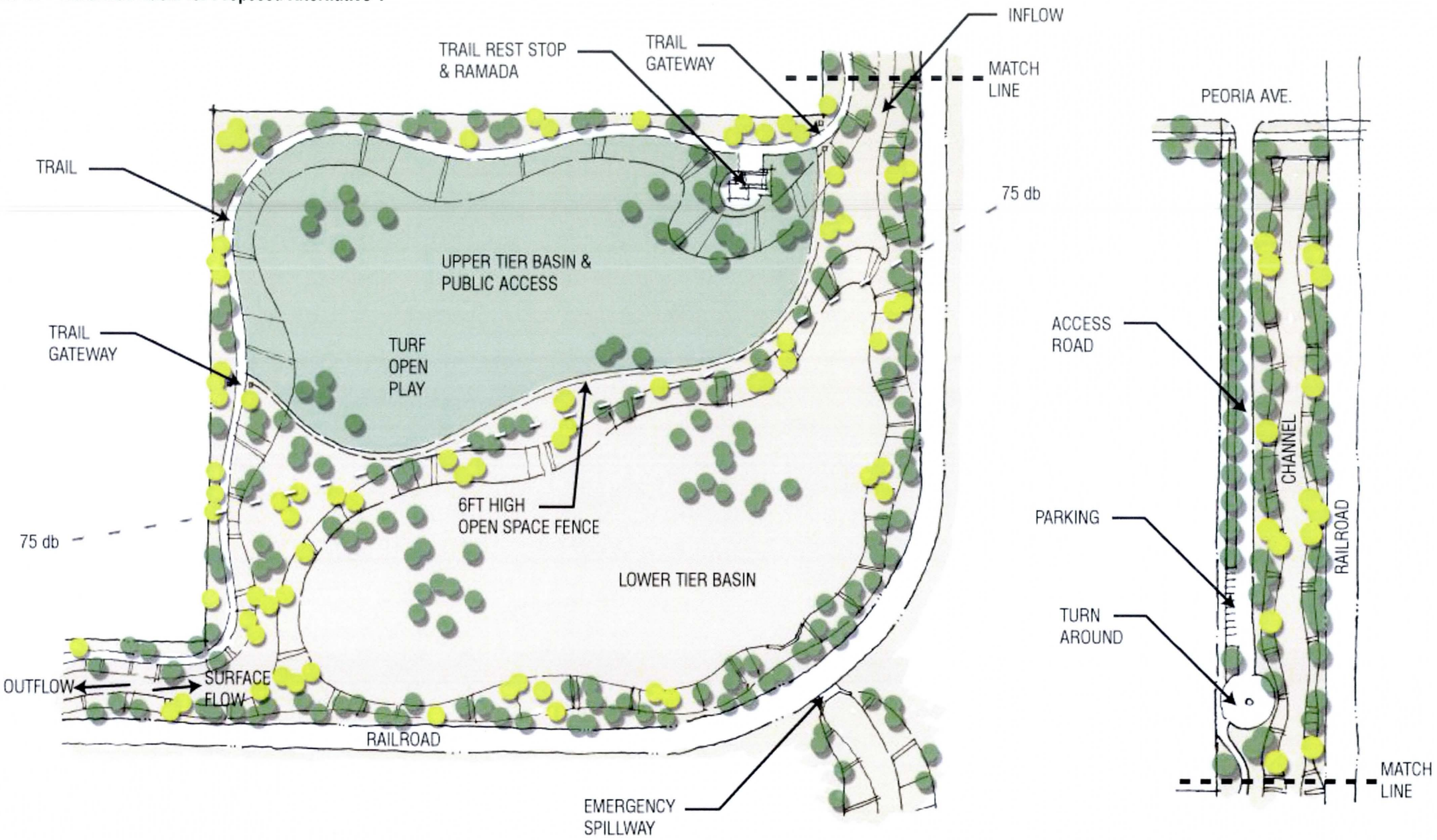
6.1.3 Multi-Use Plan

An existing channel, constructed as a part of the Surprise Pointe development, provides a point of connection to Waddell Road at the north end of the project. (Figure 4B) This channel turns east along the Sweetwater Avenue alignment. A future trail connection can be made along the Sweetwater Trail which will connect bike and trailway systems from the west, within the City of Surprise, east to the El Mirage Wash. A pedestrian underpass will be necessary under the AT&SF Channel since the BNSF Railroad will not allow additional at-grade crossings of its rail tracks. At Sweetwater Avenue, the trail and channel alignments diverge. The channel continues south from Sweetwater Avenue, adjacent to the AT&SF Railroad, whereas the trail continues south along the east side of Litchfield Road. The trail will be landscaped and have a right-of-way width that is recommended to be a minimum of 20 feet in width. The trail rejoins the AT&SF channel at the Ironwood Drive alignment (1/2 mile south of Peoria Avenue).

A 40-acre multi-use detention basin (Cheryl Basin) is proposed south of Peoria Avenue on the west side of the railroad tracks (Figure 4D). The Cheryl Basin crosses the 75db noise contour line, so portions north of that line can be used for public gathering space. The basin will be graded so that lower flows can be contained within the non-public use space. A trail connection will connect the basin with Peoria Avenue to the north and the trail system along Litchfield Road. The east-west trail will be located on the north side of an open channel collection channel and above two 72-inch diameter basin outflow pipes.

The trail continues west along the Ironwood Drive alignment past Litchfield Road to the 143rd Avenue alignment where it turns south and remains on the west side of both the railroad and the channel. At the Northern Parkway, the trail crosses through a 12' x 12' concrete box underpass before reaching Northern Avenue. The drainage channel is conveyed through a separate culvert system. At Northern Avenue, the channel crosses through box culverts and a transition structure to join the Dysart Channel. The trail returns to street grades at Northern Avenue and crosses the AT&SF channel on the north side of Northern Avenue. The trail continues east to Dysart Road and then heads south to join either a future trail along the Dysart Channel, or continue south to Glendale Avenue.

Figure 4D – Detention Basin for Proposed Alternative 1



6.1.4 Northern Parkway Impacts

Proposed Alternative 1 is similar to the Baseline Alternative which is provided in the Loop 303 ADMPU (Ref. 57). The Primary Channel within this alternative follows the BNSF Railroad. This alternative, therefore, minimizes changes to the Northern Parkway drainage design concept. Changes to the Northern Parkway drainage concept would be as follows:

- AT&SF Railroad Crossing

  The approximate size and location of the channel crossing would remain the same. Due to the multi-use nature of the proposed AT&SF Channel, a pedestrian underpass would be included adjacent to the channel crossing. The cost of this crossing is included in the Alternative 1 cost estimate.

- AT&SF Channel

  The AT&SF Channel would be earth lined, however due to its relatively steep slope, grade control structures would be necessary.

- AT&SF Channel Basin

  A proposed off-line detention basin, currently shown on the Northern Parkway plans, would be eliminated due to the new on-line detention basin, Cheryl Basin, located south of Peoria Avenue near the 135th Avenue alignment.

- Dysart Drain

  Existing culverts which enter the Dysart Drain would not be extended and would instead be removed and replaced with new culverts and a channel convergence structure. The pedestrian trail would cross the new culverts on the north side of the existing Northern Avenue and then proceed east to the intersection with Litchfield Road.

6.2 PROPOSED ALTERNATIVE 2

6.2.1 Description

Proposed Alternative 2 includes two channels. The proposed alignments and section types are indicated on Figure 5A. Land ownership along the proposed alignment is shown on Figure 5C. The first channel ties into the Surprise Pointe channel at Sweetwater Avenue and follows along the west side of the railroad. Through the City of Surprise WRF, the design is the same as is in Proposed Alternative 1, with a concrete-lined channel section transitioning to (2) 8' x 6' concrete box culverts through the WRF.

An on-line detention basin, Cheryl Basin, is located south of Peoria Avenue. The outflow from this basin is controlled by two (2) 8' x 6' CBC conveying flow under the railroad to the south. South of the basin, an unlined channel follows along the west side of the half-mile alignment between Litchfield and Dysart Roads (135th Avenue). At Northern Parkway, the channel transitions to a lined trapezoidal section with a separated trail, passing under the proposed parkway and continuing south along the ¼-mile alignment west of Dysart Road to the Dysart Drain.

In order to accommodate flow not captured by this channel, a second unlined channel follows along the west side of the railroad between Olive and Northern Avenue. The channel then passes under the proposed Northern Parkway, and ties into the Dysart Drain at Northern Avenue.

A second, off-line detention basin, Royal Palm Basin, is located at the northwest corner of the AT&SF channel and the Northern Parkway alignment. The outflow from this basin combines with the AT&SF channel and then crosses under the Parkway. Two options were considered for the trail at this location. In the first option, the trail would share the channel underpass of Northern Parkway, cross the channel at a bridged crossing, then continue east on the south side of Northern Parkway. In the second option, the trail would cross the channel at a bridged crossing north of Northern Parkway, continue east

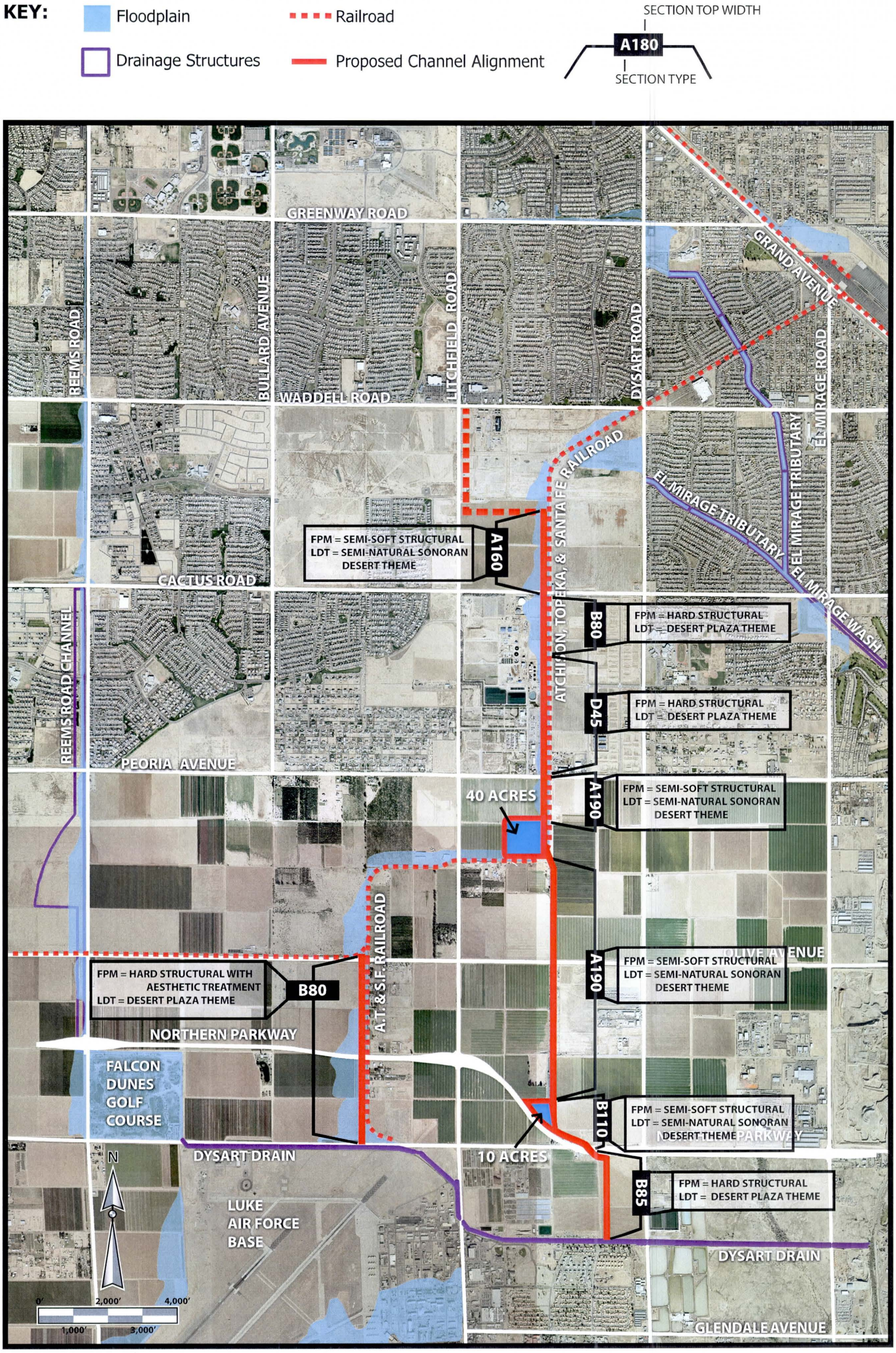


FIGURE 5A: PROPOSED ALTERNATIVE 2 - HYDROLOGY AND HYDRAULICS

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Key

- Railroad
- Proposed Trail
  *Stabilized Decomposed granite trail 20' clear width along entire length.
  *Certain lengths of the trail will serve as maintenance access.
- Proposed Channel Alignment
- Existing/Planned Trail

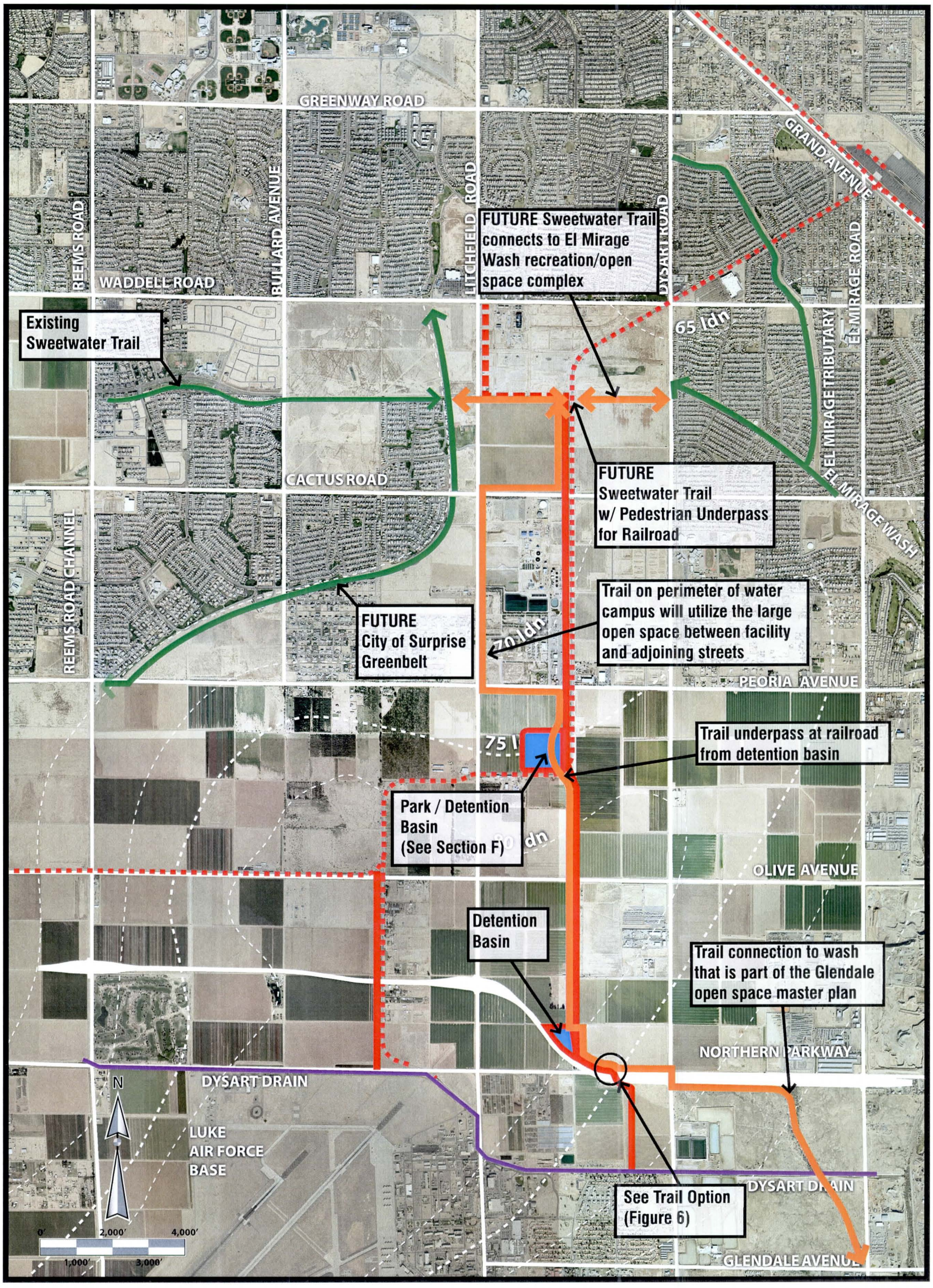

FIGURE 5B: PROPOSED ALTERNATIVE 2 - MULTI-USE MAP

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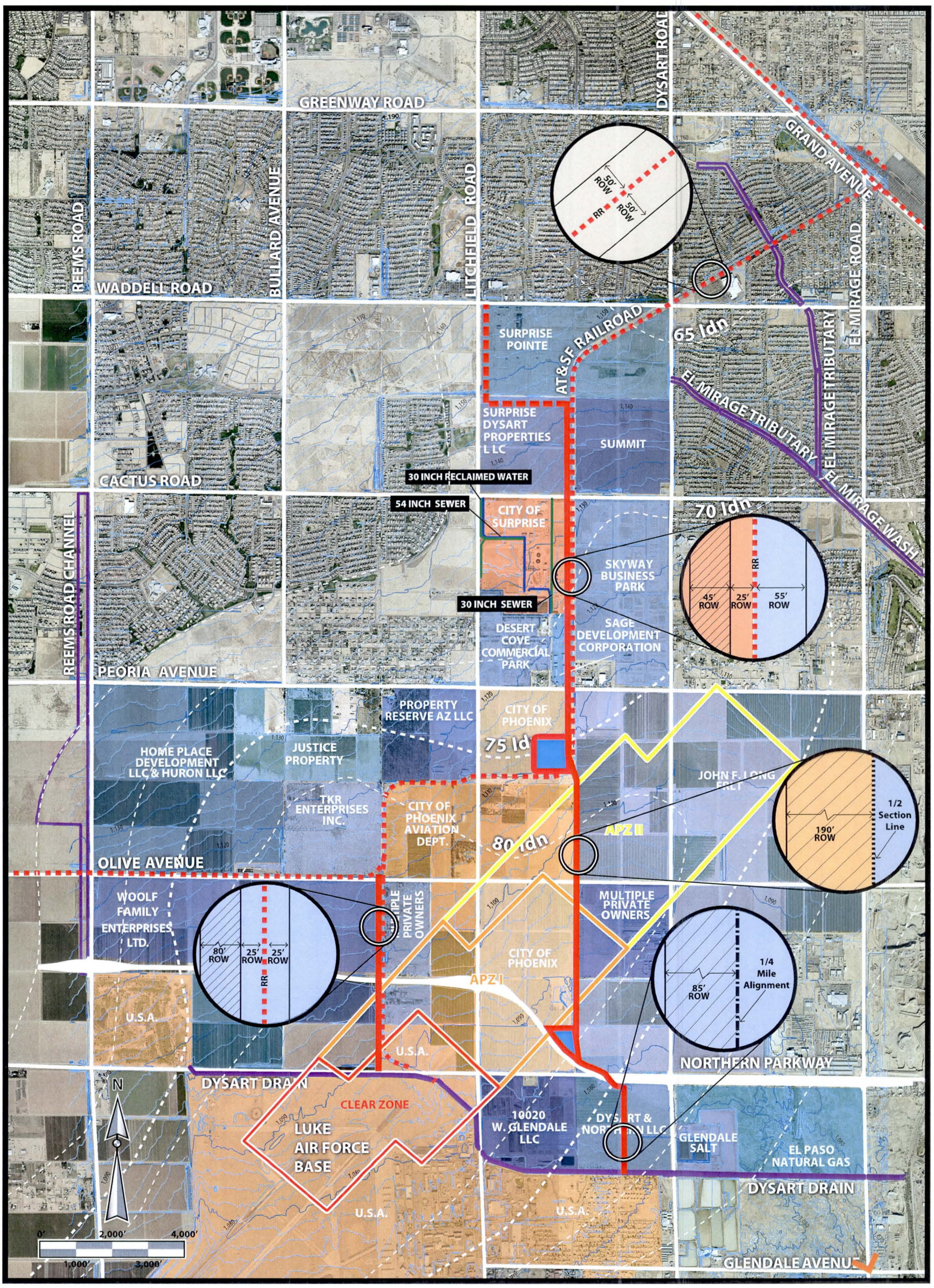

FIGURE 5C: PROPOSED ALTERNATIVE 2 - RIGHT-OF-WAY MAP

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along the north side of Northern Parkway, then cross to the south side of Northern Parkway at the Dysart Road GSI.

6.2.2 Hydrology and Hydraulics

Revisions were made to the HEC-1 model to create a proposed conditions model for Alternative 2, as described in Section 4.3. The on-line detention basin south of Peoria Avenue, Cheryl Basin, stores 120 acre-feet during the 100-year, 24-hour event peak flow, and reduces the peak flow in the channel from 622 cfs upstream of the basin, to 439 cfs downstream. The peak flow entering the Dysart Drain at 143rd Avenue is reduced from 755 cfs to 728 cfs. The second on-line detention basin, Royal Palm Basin, stores 60 acre-feet during the 100-year, 24-hour event peak flow. This reduces the peak flow in the channel from 503 cfs upstream of the basin, to 418 cfs downstream.

The peak flow in the Dysart Drain at Dysart Road is increased from 1104 cfs to 1156 cfs, however the peak flow in the Dysart Drain at 127th Avenue is reduced from 1612 to 1574 cfs. Table 6 summarizes the different channel segments, the cross-section types applied, and the hydraulics. Hydraulic calculations for Proposed Alternative 2 are included in Appendix H, located in Volume 2 of the CAR.

To prevent potential erosion, a slope of 0.15% was used to keep velocities in the unlined channel (Structure Type A – Unlined Channel) close to 3 feet per second. Since the natural slope is 0.33%, two-foot drop structures are required for every quarter-mile of channel. Proposed Alternative 2 requires four drop structures. For the lined trapezoidal channel segments (Structure Type B – Lined Trapezoidal Channel), a slope of 0.13% was used to keep subcritical flow condition in the channel, except for the channel along the 143rd Avenue alignment, which was designed with a slope of 0.33%.

Table 6: Proposed Alternative 2 Hydraulics

Location	Structure Type	Design Flow (cfs)	Bottom Width / Size (ft)	Sideslopes (H:V)	Slope (ft/ft)	Flow Depth (ft)	Total Right-of-Way Width (ft)
Sweetwater Ave – Cactus Rd	A – Unlined Channel	231	20	4:1	0.0015	3	160
Cactus Rd – Varney Rd	B – Lined Trapezoidal Channel with No Trail	497	15	2:1	0.0013	3	80
Varney Rd – Peoria Ave	D – Concrete Box Culverts	497	(2) 8' x 6' CBC	n/a	0.0033	n/a	45
Peoria Ave - Basin	A – Unlined Channel	497	50	4:1	0.0015	3	190
Basin South of Peoria Ave	F – Basin with Amenities	622 In 439 Out	120 AF	Varies	n/a	n/a	40 Ac
Basin Outlet – Northern Pkwy	A – Unlined Channel	503	50	4:1	0.0015	3	190
¼ mi. N. of Northern Pkwy – Northern Pkwy	B – Lined Trapezoidal Channel	503	15	2:1	0.0013	3	110
Basin North of Northern Pkwy	F – Basin without Amenities	503 In 418 Out	60 AF	Varies	n/a	n/a	10 Ac
Northern Pkwy – Dysart Drain	B – Lined Trapezoidal Channel with No Trail	418	15	2:1	0.0013	3	85
Olive Rd – Dysart Drain	B – Lined Trapezoidal Channel with No Trail	419	10	2:1	0.0033	3	80

6.2.3 Multi-Use Plan

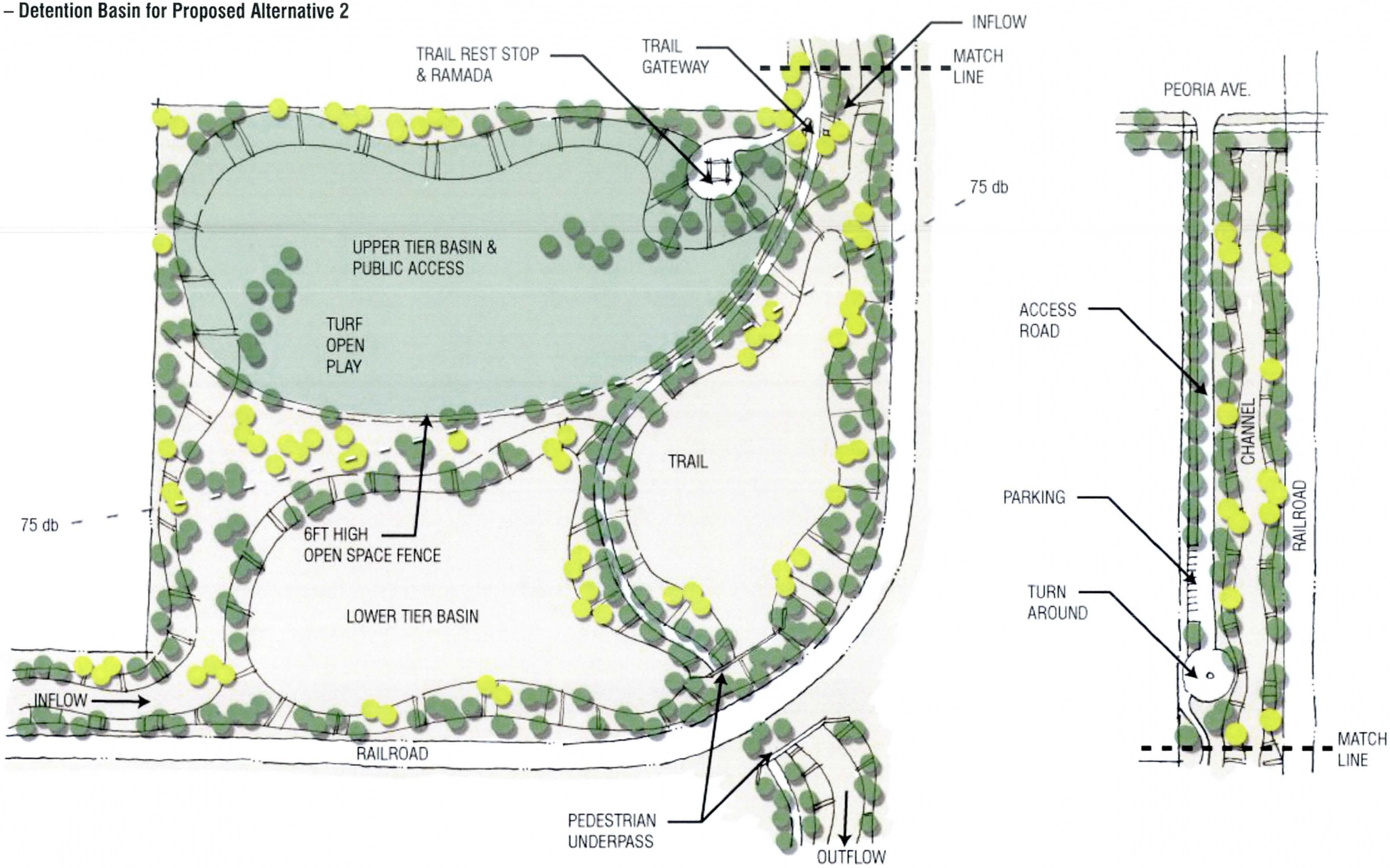
An existing channel, constructed as a part of the Surprise Pointe development, provides a point of connection to Waddell Road at the north end of the project (Figure 5B). This channel turns east along the Sweetwater Avenue alignment. A future trail connection can be made along the Sweetwater Trail which will connect bike and trailway systems from the west, within the City of Surprise, with the El Mirage Wash to the east. A pedestrian underpass will be necessary under the AT&SF channel since the BNSF Railroad will not allow additional crossings of its rail tracks. At Cactus Road, the trail and channel diverge from each other's alignment. The channel continues south from Cactus Road, adjacent to the AT&SF Railroad, whereas the trail turns west to Litchfield Road and then continues south along the east side of Litchfield

Road. The trail will be landscaped and have a right-of-way width that is recommended to be a minimum of 20 feet in width. At Peoria Avenue, the trail heads east along the south side of Peoria Avenue and rejoins the AT&SF channel on the west side of the railroad. From here, the channel and trail head south to the new multi-use detention basin, Cheryl Basin.

Cheryl Basin is a 40-acre multi-use detention basin proposed to be south of Peoria Avenue on the west side of the railroad tracks (Figure 5D). The basin crosses the 75db noise contour line, so portions north of that line can be used for public gathering space. The basin will be graded so that lower flows can be contained within the non-public use space. A 24-foot access road provides a vehicular connection for the park to Peoria Avenue. The trail crosses under the railroad tracks to the south and continues south along the 135th Avenue alignment, on the west side of the AT&SF channel. When the channel and trail reach the Northern Parkway, the channel crosses under the Parkway. Two options are proposed for the trail continuation. In the first option, the trail crosses the Northern Parkway through an underpass and then continues east to Dysart Road on the south side of the Parkway. In the second option the trail crosses the channel over a pedestrian bridge and turns east along the north side of the Parkway until it crosses to the south side of the Parkway at Dysart Road.

Both trail options continue east in new right-of-way along the south side of the Northern Parkway until they reach a natural open space area between Dysart Road and El Mirage Road. The open space area is shown on the City of Glendale's December 2005 General Plan Amendment (Ref. 6).

Figure 5D – Detention Basin for Proposed Alternative 2



6.2.4 Northern Parkway Impacts

In Alternative 2, the AT&SF Channel follows an alignment which is along the mid-section line at approximately the 135th Avenue alignment. A Secondary Channel would occur along the 143rd Avenue alignment adjacent to the AT&SF Railroad.

The AT&SF Primary Channel would be earth-lined with a pedestrian trail along its west bank. As the channel and trail meet the Northern Parkway, the channel would transition to a concrete-lined channel and grade control structure. The pedestrian trail would cross the channel and continue east along the north bank of the channel and the Northern Parkway. Changes to the Northern Parkway drainage concept would be as follows:

- AT&SF Railroad Crossing

  The size of culvert crossings of the Secondary Channel would be reduced due to the upstream drainage contribution.

- AT&SF Channel Basin

  A proposed off-line detention basin, currently shown on the Northern Parkway plans, would be eliminated due to the new on-line detention basin, Cheryl Basin, located south of Peoria Avenue near the 135th Avenue alignment.

- New Detention Basin

  A new 17-acre detention basin, Royal Palm Basin, would be constructed on the north side of the Northern Parkway and west of the new AT&SF Channel to intercept runoff from the north side of the Northern Parkway, east of Litchfield Road. The basin would also accept pavement runoff from the Northern Parkway in this area.

- Station 277+00

  A concrete box culvert located near Station 277+00 would be replaced with a larger structure to accommodate flows from the realigned AT&SF Channel.

- Potential Shared Multi-Use Trail

  The multi-use trail would extend east along the north side of the Northern Parkway to the Dysart Road GSI. It would then shift to the south side of the Northern Parkway and continue east to an existing natural wash which lies mid-point between El Mirage Road and Dysart Road.

6.3 Alternatives Evaluation

The Proposed Alternatives were evaluated based on the same criteria set forth for the Preliminary Alternatives evaluation. Right-of-way requirements and cost estimates were created for each Proposed Alternative, and the alternatives were presented at a Stakeholders Meeting in December of 2008.

6.3.1 Right-of-Way Requirements

Tables 7 and 8 summarize the right-of-way requirements for Proposed Alternatives 1 and 2. Both alternatives follow the same alignment north of Peoria Avenue. The alignment adjacent to the railroad tracks in this area passes through the City of Surprise WRF. To alleviate the actual right-of-way needs, a box culvert system is proposed within a 45-foot wide right-of-way in the most critical areas. This would require some design modifications to the existing drainage system within the WRF.

South of Peoria Avenue, both alternatives propose a detention basin which would be located on property owned by the City of Phoenix Aviation Department. The City has no current plans for this property and therefore may be a willing partner.

Alternative 1 continues west along the north side of the railroad tracks and would require private land acquisitions from multiple parties.

Alternative 2 continues south on property owned by the City of Phoenix. After reaching the Northern Parkway, the trail continues east along the north and then south side of the Northern Parkway. This right-of-way could be acquired in conjunction with the Northern Parkway acquisitions.

Table 7: Proposed Alternative 1 Right-of-Way Requirements

Location	Ownership	Right-of-Way Required	
		Width (ft)	Acreage (Ac)
Sweetwater Ave – Cactus Rd	Surprise Dysart Properties, LLC	160	9
Cactus Rd – Varney Rd	City of Surprise	80	5
Varney Rd – Peoria Ave	Sage Development Corp.	45	3
Peoria Ave – Basin	City of Phoenix	190	4
Basin South of Peoria Ave	City of Phoenix	n/a	40
N. of RR Between Basin and 143rd Ave	City of Phoenix and Property Reserve AZ, LLC	170	14
W. of RR Between Mountain View and Olive Ave	TKR Enterprises, Inc.	45	3
Olive Ave – Dysart Drain	Woolf Family Enterprises, Ltd.	180	22
Total			**100**

Table 8: Proposed Alternative 2 Right-of-Way Requirements

Location	Ownership	Right-of-Way Required	
		Width (ft)	Acreage (Ac)
Sweetwater Ave – Cactus Rd	Surprise Dysart Properties, LLC	160	9
Cactus Rd – Varney Rd	City of Surprise	80	5
Varney Rd – Peoria Ave	Sage Development Corp.	45	3
Peoria Ave – Basin	City of Phoenix	190	4
Basin South of Peoria Ave	City of Phoenix	n/a	40
Basin Outlet – Northern Pkwy	City of Phoenix and City of Phoenix Aviation	190	32
¼ mi. N. of Northern Pkwy – Northern Pkwy	City of Phoenix	110	6
Basin North of Northern Pkwy	City of Phoenix	n/a	10
Northern Pkwy – Dysart Drain	Dysart & Northern, LLC	85	5
Olive Rd – Dysart Drain	Woolf Family Enterprises, Ltd.	80	10
Total			**124**

6.3.2 Cost Estimate and Evaluation

The cost estimates included in Tables 9 and 10 are for comparison purposes only and should not be used for project budget projections. A 30% contingency factor has been applied to cover for miscellaneous cost items and for engineering and construction administration. The estimates provided do not include right-of-way for the landscaped trail where it is not coincident with the channel.

Table 9: Proposed Alternative 1 Cost Estimate

Item	Quantity	Cost
Section A – Unlined Channel	12,400 Feet	$2,368,348
Section B – Lined Trapezoidal Channel	2,600 Feet	$1,099,591
Section D – Concrete Box Culvert	2,600 Feet	$2,616,250
Section E – Pipe Culvert	2,600 Feet	$2,276,059
Section F – Basin with Amenities	1	$4,273,707
Section F – Basin without Amenities	0	$0
Additional (2) 72-inch Pipe from Basin west to Railroad Bend	3,600 Feet	$2,808,000
Major Roadway Crossings	6	$871,927
Sub-Total Construction		$16,313,882
Engineering Design, Construction Admin., Utility Relocation, Misc.	30%	$4,894,165
Sub-Total Construction, Engineering, and Administration		$21,208,047
Right of Way Acquisition	100 Acres	$8,991,163
Total		**$30,199,210**

Table 10: Proposed Alternative 2 Cost Estimate

Item	Quantity	Cost
Section A – Unlined Channel	10,800 Feet	$2,273,817
Section B – Lined Trapezoidal Channel	12,800 Feet	$5,794,944
Section D – Concrete Box Culvert	2,600 Feet	$2,616,250
Section E – Pipe Culvert	0	$0
Section F – Basin with Amenities	1	$4,273,707
Section F – Basin without Amenities	1	$539,660
Additional (2) 72-inch Pipe	0	$0
Major Roadway Crossings	8	$1,182,916
Sub-Total Construction		$16,681,294
Engineering Design, Construction Admin., Utility Relocation, Misc.	30%	$5,004,388
Sub-Total Construction, Engineering, and Administration		$21,685,682
Right of Way Acquisition	124 Acres	$10,851,511
Total		**$32,537,193**

The Northern Parkway has anticipated improvements, rights-of-way, and costs for drainage facilities necessary to construct this roadway. Some of the drainage facilities proposed by the Northern Parkway either overlap with the proposed alternatives for the AT&SF Channel, or they are redundant. In order to have a common basis for comparison of costs for both alternatives, the cost of right-of-way and construction for duplicate drainage structures, including all contingencies, is shown as a credit to the project in Tables 11 and 12. It should be noted that the unit costs, contingencies and land costs prepared for the Northern Parkway project may not be on the same basis as this study. These estimates are for comparison purposes only. A comparison of the cost estimates for Proposed Alternatives 1 and 2 shows that they are remarkably similar, despite many differences in construction types and locations.

Table 11: Proposed Alternative 1 Cost Comparison

Item	Cost
Proposed AT&SF Alternative 1 – Construction, Engineering, and Administration	$21,208,047
Proposed AT&SF Alternative 1 – Right-of-Way	$8,991,163
Total AT&SF Alternative 1	$30,199,210
Credit for Overlapping Drainage Structures – Construction	-$2,448,499
Credit for Overlapping Drainage Structures – Right-of-Way	-$4,316,299
Total Credit	-$6,764,798
Total Combined AT&SF and Northern Parkway Drainage Costs	**$23,434,412**

Table 12: Proposed Alternative 2 Cost Comparison

Item	Cost
Proposed AT&SF Alternative 2 – Construction, Engineering, and Administration	$21,685,682
Proposed AT&SF Alternative 2 – Right-of-Way	$10,851,511
Total AT&SF Alternative 2	$32,537,193
Credit for Overlapping Drainage Structures – Construction	-$4,315,266
Credit for Overlapping Drainage Structures – Right-of-Way	-$4,672,130
Total Credit	-$8,987,396
Total Combined AT&SF and Northern Parkway Drainage Costs	**$23,549,797**

6.3.3 Stakeholder Input

The Proposed Alternatives Stakeholder Meeting was held at the offices of Hoskin-Ryan Consultants on December 4, 2008. Representatives from the Cities of Glendale, Surprise, and El Mirage, the FCDMC, and Luke Air Force Base attended the meeting. All stakeholders supported Proposed Alternative 2, with minor modifications. The Recommended Alternative was therefore created based on Proposed Alternative 2. Following is a summary of the comments from the meeting:

Proposed Alternative 1 Constraints

- The multi-use trail crosses through the Luke AFB APZ Clear Zone south of Northern Parkway.
- Two large (72" diameter) pipes are required to drain the basin south of Peoria Avenue. The pipes flow against natural grade, which loses approximately 12 feet in one mile.
- The channel and trail cross multiple existing railroad spurs.
- The alternative requires a new pedestrian crossing of Northern Parkway at 143rd Avenue.
- An overflow spillway is required at the basin.

Proposed Alternative 1 Benefits

- Does not require a Secondary Channel to mitigate the floodplain.
- Less impact to the railroad, due to no crossings or underpasses.

Proposed Alternative 2 Benefits

- The multi-use trail is not aligned to go through the Luke AFB APZ Clear Zone.
- The channel and trail are clear of the 80db noise contour limits.
- The alignment follows the natural drainage patterns and grade.
- The system is more hydrologically efficient.
- The channel and basin demonstrate better constructability.

- The individual property owners of industrial properties favor Alternative 2.
- The trail crosses the proposed Northern Parkway using the proposed grade-separated interchange at Dysart Road.
- Land acquisition is potentially easier than for Proposed Alternative 1 due to a majority of the right-of-way falling on City of Phoenix land.
- The south half of the Primary Channel provides an outfall for properties between the railroad and the 135th Avenue alignment.
- The Royal Palm Basin provides an outfall for drainage along the northern side of Northern Parkway between the railroad and the 135th Avenue alignment.

Benefits Common to Both Proposed Alternatives

- Both alternatives eliminate the need for the large triangular basin north and west of Northern Avenue and the railroad, proposed as part of the Northern Parkway drainage design.
- Both alternatives provide emergency services access to the railroad at the Cheryl Basin location.
- Benefits the Surprise WRF infrastructure.
- The Cheryl Basin has potential to be enlarged to include more park space.
- Provides bleed-off for Surprise developments.
- Benefits property owners east of the railroad.
- Both alternatives resolve floodplain issues in the Surprise WRF.

Specific Stakeholder Alternative Recommendation

- The City of El Mirage supports Proposed Alternative 2, given that the drainage structures do not fall within the City of El Mirage limits.
- The City of Glendale supports Proposed Alternative 2.
- The City of Surprise supports Proposed Alternative 2, given that the available right-of-way through the WRF is confirmed versus the proposed design.
- Luke AFB supports Proposed Alternative 2, given that the multi-use characteristics of the alternative that lie within the 75db/80db noise contour limits are checked versus the State Statutes and the Regional Compatibility Plan.

7 RECOMMENDED ALTERNATIVE

7.1 Description

The Recommended Alternative is based on Proposed Alternative 2, and includes two channels (Primary and Secondary) and two detention basins (Royal Palm Basin and Cheryl Basin). The recommended alignment and section types are indicated on Figure 6A. Land ownership along the recommended alignment is shown in Figure 6C. Modifications made to Proposed Alternative 2 to create the Recommended Alternative include:

- The lined rectangular channel section is specified for a portion of the Primary Channel through the City of Surprise WRF, instead of the box culvert section.
- The lined rectangular channel section is specified for the reach of the Secondary Channel between Olive Avenue and Northern Parkway, instead of the lined trapezoidal section.
- The multi-use trail crosses to the east side of the channel between Olive Avenue and the Northern Parkway.

At the upstream end, the Primary Channel ties into a new channel that has been graded around the west and south sides of the Surprise Point commercial development. The unlined channel follows along the west side of the railroad, and south of Cactus, transitions to a lined trapezoidal channel within the Surprise WRF. Further south within the WRF, the channel has a lined rectangular section. South of the WRF to Peoria Avenue, underground concrete box culverts are proposed.

The recommended Cheryl Basin lies north of the railroad, at the railroad bend south of Peoria Avenue. Outflow from the on-line basin is controlled by one (1) 36" pipe and (1) 12' x 8' concrete box culvert. The 12' x 8' box culvert also serves as pedestrian access for the trail continuation.

South of the Cheryl Basin, the channel is unlined and follows along the west side of the half-mile alignment between Litchfield and Dysart Roads (135th Avenue). North of Northern Parkway, the channel enters the second on-line basin, Royal Palm Basin. Outflow from the basin is controlled by one (1) 10' x 6' concrete box culvert, which conveys flow under Northern Parkway. The box culvert outlets to a lined trapezoidal channel section south of Northern Parkway, which continues east to and south along the ¼-mile alignment west of Dysart Road, to the Dysart Drain. The trail remains on the north side of Northern Parkway east from the Royal Palm Basin, crosses Northern Parkway at the Dysart Road GSI, then continues east along the south side of Northern Parkway.

In order to accommodate flow not captured by the Primary Channel, the Secondary Channel follows along the west side of the railroad from Northern Avenue to Olive Avenue. The channel begins north of the railroad bend on the north side of Olive Avenue and passes under the railroad through two (2) 48-inch pipes. South of the railroad the channel has a lined rectangular section until Northern Parkway, where it passes under the Parkway through two (2) 8' x 6' concrete box culverts. South of Northern Parkway, the channel has a lined trapezoidal section. The channel discharges to the Dysart Drain after it crosses Northern Avenue through two (2) 10' x 4' concrete box culverts.

7.2 Hydrology and Hydraulics

Revisions were made to the HEC-1 model to create a proposed conditions model for the Recommended Alternative, as described in Section 4.4. The on-line detention basin south of Peoria Avenue, Cheryl Basin, stores 58.5 acre-feet during the 100-year, 24-hour event peak flow, and reduces the peak flow in the channel from 806 cfs upstream of the basin, to 544 cfs downstream. The on-line detention basin at Northern Parkway, Royal Palm Basin, stores 62 acre-feet during the 100-year, 24-hour event peak flow, and reduces the peak flow in the channel from 633 cfs upstream of the basin, to 505 cfs downstream.

A summary of the stage-storage-discharge relationships for the basins are included in Section 8.1 of this report, and the detailed hydraulic calculations are included in Appendix J, located in Volume 2 of the CAR. Table 13 summarizes the different channel segments, the cross-section types applied, and the hydraulics.

KEY:

Floodplain

Drainage Structures

Railroad

Proposed Channel Alignment

SECTION TOP WIDTH
A180
SECTION TYPE

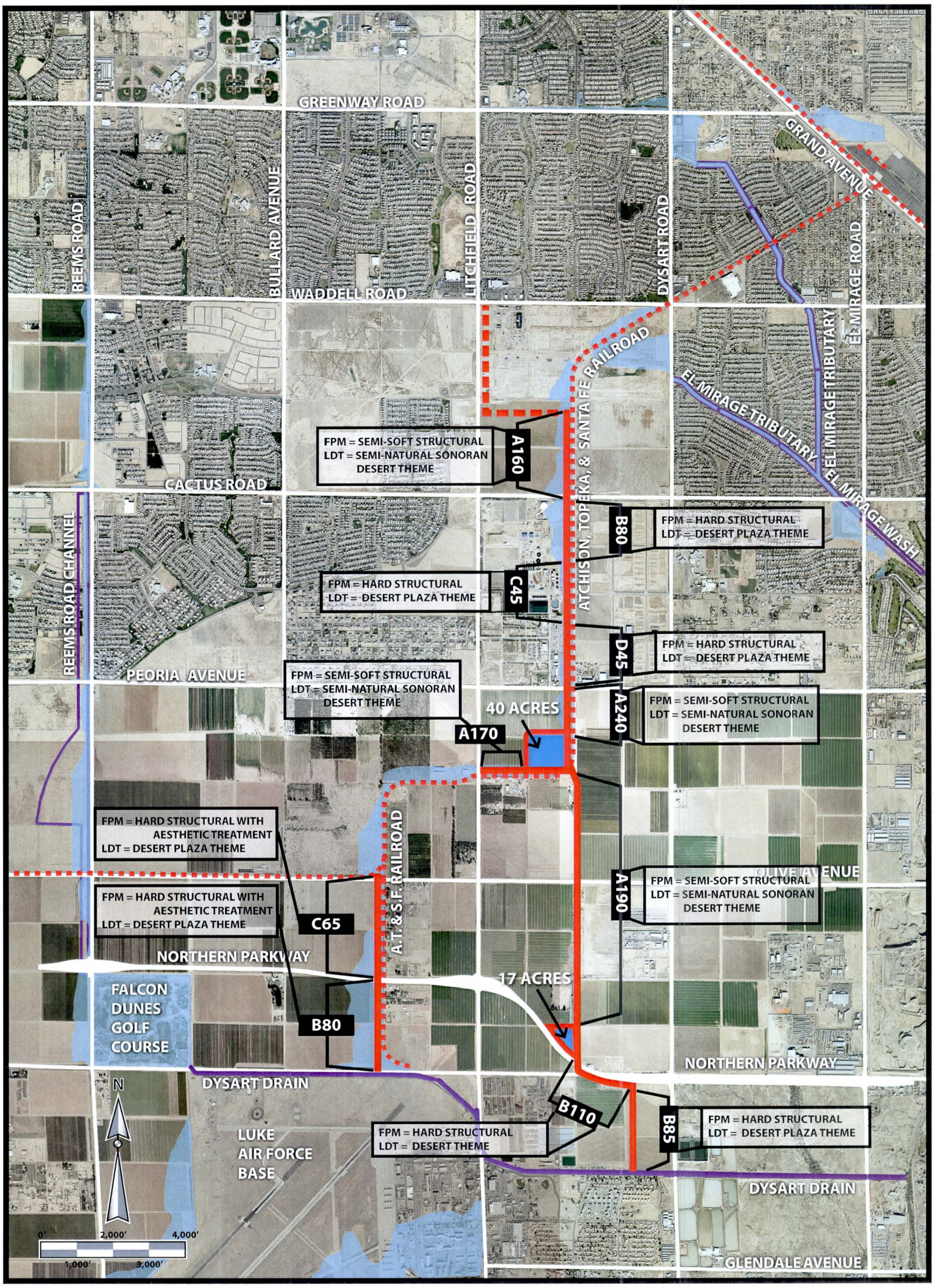


FIGURE 6A: RECOMMENDED ALTERNATIVE - HYDROLOGY AND HYDRAULICS

AT&SF Railroad Channel and Basin Candidate Assessment Report

Hoskin • Ryan Consultants, Inc.
creative engineering solutions

Flood Control District of Maricopa County

FCD 2007C016

Key

- Railroad
- Proposed Trail
  *Stabilized Decomposed granite trail 20' clear width along entire length.
  *Certain lengths of the trail will serve as maintenance access.
- Proposed Channel Alignment
- Existing/Planned Trail

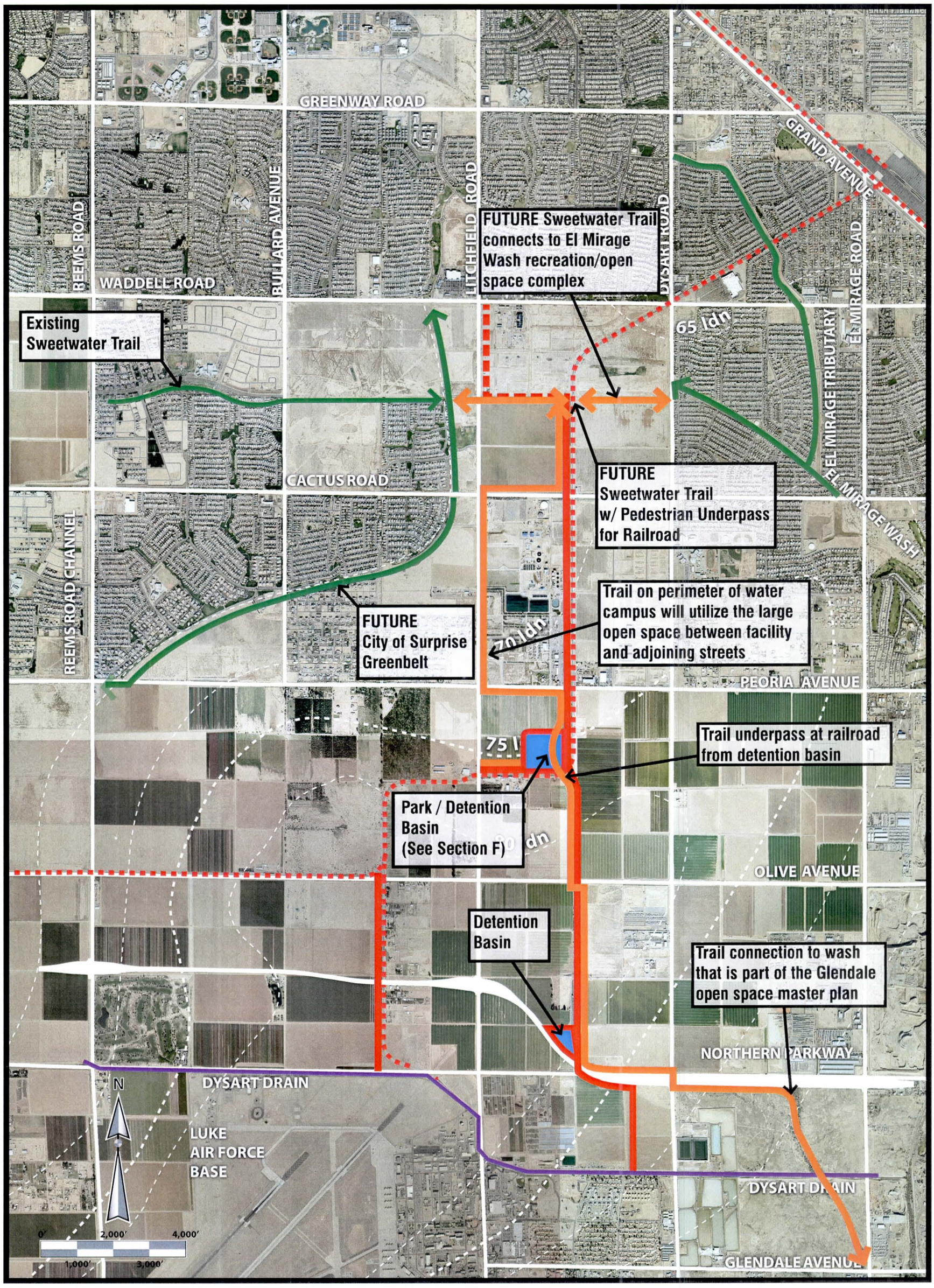


FIGURE 6B: RECOMMENDED ALTERNATIVE - MULTI-USE MAP

AT&SF Railroad Channel and Basin Candidate Assessment Report

Hoskin • Ryan Consultants, Inc.
creative engineering solutions

Flood Control District of Maricopa County

FCD 2007C016

Key — Railroad; Drainage Structures; Reclaimed Water Line; Sewer; Index Contour; Intermediate Contour; Proposed Channel Alignment

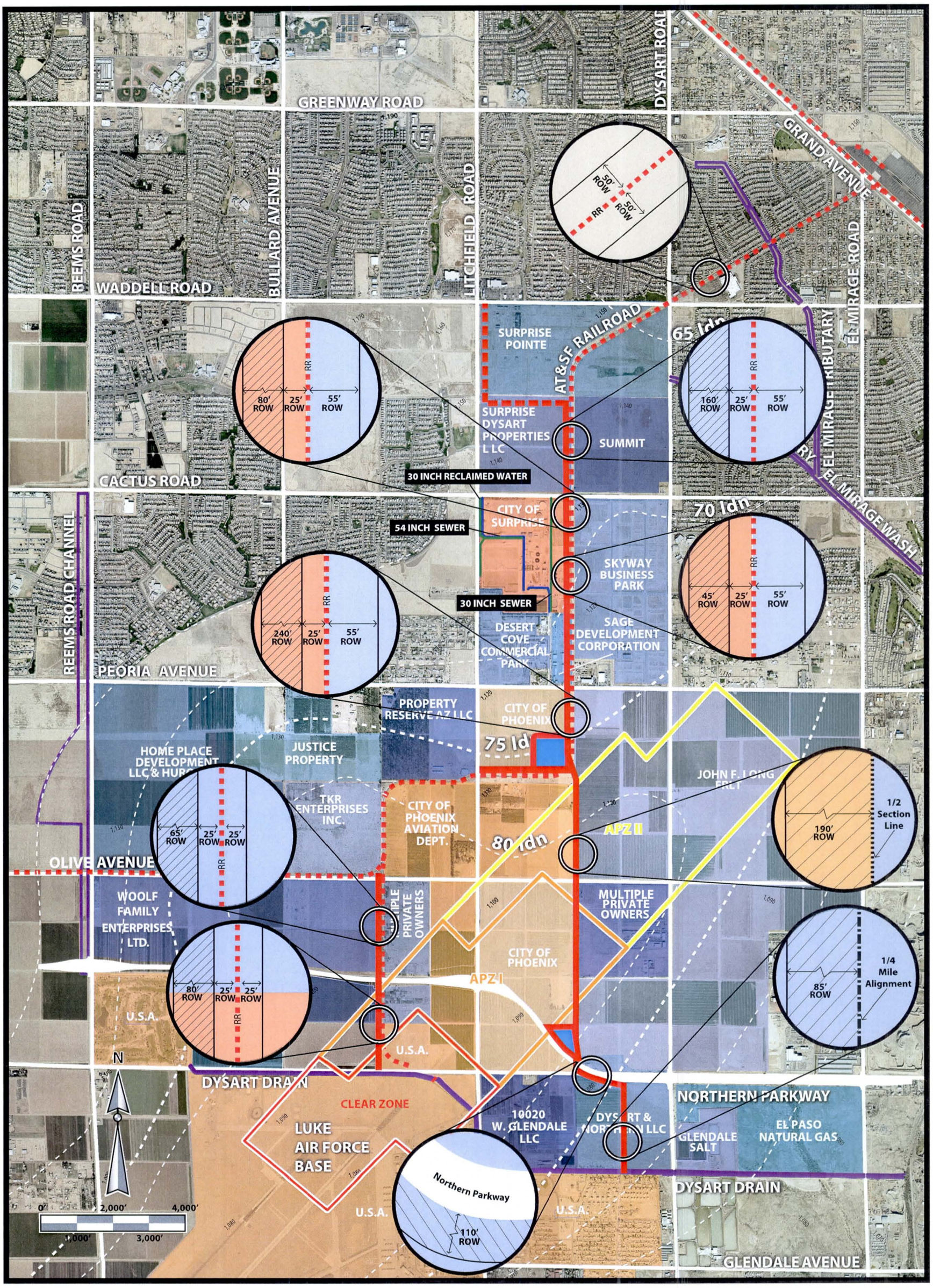


FIGURE 6C: RECOMMENDED ALTERNATIVE - RIGHT-OF-WAY MAP

AT&SF Railroad Channel and Basin Candidate Assessment Report

Hoskin • Ryan Consultants, Inc.
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Flood Control District of Maricopa County

FCD 2007C016

Table 13: Recommended Alternative Hydraulics

Location	Structure Type	Design Flow (cfs)	Bottom Width / Size (ft)	Sideslopes (H:V)	Slope (ft/ft)	Flow Depth (ft)	Total Right-of-Way Width (ft)
PRIMARY CHANNEL (ALONG 135TH AVE ALIGNMENT)							
Sweetwater Ave – Cactus Rd	A – Unlined Channel	441	40	4:1	0.0015	3	160
Cactus Rd – Varney Rd	B – Lined Trapezoidal Channel with No Trail	441	15	2:1	0.0013	3	80
Varney Rd – Desert Cove Rd	C – Lined Rectangular Channel with No Trail	441	15	n/a	0.0040	3	45
Desert Cove Rd – Peoria Ave	D – Concrete Box Culverts with No Trail	414	(2) 8' x 6' CBC	n/a	0.0040	n/a	45
Peoria Ave – Cheryl Basin	A – Unlined Channel	583	50	4:1	0.0015	3	240
Cheryl Basin	F – Basin with Amenities	806 In 544 Out	80 AF	Varies	n/a	n/a	40 Ac
Cheryl Basin Outlet – Royal Palm Basin	A – Unlined Channel	544	50	4:1	0.0015	3	190
Royal Palm Basin	F – Basin without Amenities	633 In 505 Out	60 AF	Varies	n/a	n/a	17 Ac
Royal Palm Basin Outlet – 133rd Avenue	B – Lined Trapezoidal Channel with No Trail	505	15	2:1	0.0013	3	110
133rd Ave – Dysart Drain	B – Lined Trapezoidal Channel with No Trail	670	15	2:1	0.0013	3.8	85
SECONDARY CHANNEL (ALONG 143RD AVE ALIGNMENT)							
Olive Rd – Northern Pkwy	C – Lined Rectangular Channel with No Trail	383	15	n/a	0.0040	3	65
Northern Pkwy – Dysart Drain	B – Lined Trapezoidal Channel with No Trail	516	15	2:1	0.0040	3	80
CHERYL BASIN INFLOW CHANNEL (WEST TO EAST, NORTH OF RAILROAD)							
Litchfield Rd – Cheryl Basin	A – Unlined Channel	363	30	4:1	0.0015	3	170

7.3 Multi-Use Plan

The multi-use plan for the Recommended Alternative is based on Proposed Alternative 2. The alignment and features of the plan are shown in Figure 6C. Modifications made versus the Proposed Alternative 2 trail layout include:

- At Olive Avenue, the trail crosses from the west to the east side of the channel.
- The trail passes under the railroad from the Cheryl Basin through the (1) 12' x 8' CBC, instead of having a separate, pedestrian-only crossing.

At the north end of the trail, a connection can be made to the future Sweetwater Trail along Sweetwater Avenue. The Sweetwater Trail will connect bike and trailway systems from the west, within the City of Surprise, with the El Mirage Wash to the east. Between Sweetwater Avenue and Cactus Road, the trail follows the channel alignment. At Cactus Road, the trail diverges from the channel alignment, heading west to Litchfield Road. Between Cactus Road and Peoria Avenue, the trail lies along the east side of Litchfield Road. The trail will be landscaped and have a right-of-way width that is recommended to be a minimum of 20 feet in width.

At Peoria Avenue, the trail heads east along the south side of Peoria Avenue and rejoins the AT&SF channel on the west side of the railroad. From here, the channel and trail head south into the proposed 40-acre Cheryl Basin. The on-line detention basin lies partially within the 75db noise contour line. Luke AFB has indicated that they believe the entire basin can be used for public gathering space. The basin is graded such that lower flows do not inundate the public-use space, and are contained in two small basins on the south and east sides of the trail. A 20-foot access road with head-in parking and a turnaround provide vehicular access from Peoria Avenue.

The trail passes under the railroad through the 12' x 8' box culvert crossing, and continues south with the channel along the 135th Avenue alignment on the west side of the railroad. At Olive Avenue, the trail crosses from the west to the east side of the channel. At Northern Parkway, the trail continues east along the north side of the Parkway, crossing at the Dysart Road interchange. East of Dysart Road, the trail lies along the south side of the Parkway, tying into a natural open space area between Dysart Road and El Mirage Road. The open space area is shown on the City of Glendale's December 2005 General Plan Amendment (Ref. 6).

7.4 Northern Parkway Impacts

There are two locations in the Recommended Alternative where the channel crosses the Northern Parkway. The Primary Channel crosses at approximately the 135th Avenue alignment, and the Secondary Channel crosses at approximately the 143rd Avenue alignment. Changes to the Northern Parkway drainage concept plan include:

- AT&SF Railroad Crossing at 143rd Avenue Alignment

  The size of culvert crossings of the Secondary Channel are reduced due to a reduction in the upstream drainage contribution.

- Cheryl Basin

  The off-line detention basin currently shown on the Northern Parkway plans, located north and west of Northern Avenue and the railroad, is eliminated due to the recommended Cheryl Basin, a new on-line detention basin located south of Peoria Avenue near the 135th Avenue alignment.

- Royal Palm Basin

  The recommended Royal Palm Basin, a new 10-acre on-line detention basin is located on the north side of the Northern Parkway, west of the new AT&SF Channel. The basin intercepts runoff from the north side of Northern Parkway, east of Litchfield Road, and pavement runoff from Northern Parkway.

- Station 277+00

  A concrete box culvert located near Northern Parkway Station 277+00 (Ref. 63) is replaced with a larger structure to accommodate flows from the realigned AT&SF Channel.

- Multi-Use Trail

  The multi-use trail extends east along the north side of the Northern Parkway to the Dysart Road GSI. It then shifts to the south side of the Northern Parkway and continues east to an existing natural wash which lies mid-point between El Mirage Road and Dysart Road.

- Sta 333+00

  A 5-acre detention basin is recommended to be included in the design of the Northern Parkway.

7.5 Right-of-Way Requirements

Table 14 summarizes the right-of-way requirements for the Recommended Alternative. Through a portion of the City of Surprise WRF, there is sufficient space to use a lined rectangular cross-section. A box culvert system is implemented from south of the WRF to Peoria Avenue to alleviate the impact of the existing industrial use.

South of Peoria Avenue, the channel alignment and both on-line detention basins are located on property owned by the City of Phoenix and City of Phoenix Aviation Department. There are no current plans for this property, therefore they may be willing partners.

Table 14: Recommended Alternative Right-of-Way Requirements

Location	Ownership	Right-of-Way Required	
		Width (ft)	Acreage (Ac)
PRIMARY CHANNEL (ALONG 135TH AVE ALIGNMENT)			
Sweetwater Ave – Cactus Rd	Surprise Dysart Properties, LLC	160	9
Cactus Rd – Varney Rd	City of Surprise	80	3
Varney Rd – Desert Cove Rd	City of Surprise	45	2
Desert Cove Rd – Peoria Ave	Sage Development Corp.	45	2
Peoria Ave – Cheryl Basin	City of Phoenix	240	6
Cheryl Basin	City of Phoenix	n/a	40
Cheryl Basin Outlet – Royal Palm Basin	City of Phoenix and City of Phoenix Aviation	190	28
Royal Palm Basin	City of Phoenix	n/a	17
Royal Palm Basin Outlet – 133rd Ave	Dysart & Northern, LLC	110	3
133rd Ave – Dysart Drain	Dysart & Northern, LLC	85	5
SECONDARY CHANNEL (ALONG 143RD AVE ALIGNMENT)			
Olive Rd – Northern Pkwy	Woolf Family Enterprises, Ltd.	65	4
Northern Pkwy – Dysart Drain	Woolf Family Enterprises, Ltd.	80	4
CHERYL BASIN INFLOW CHANNEL (WEST TO EAST, NORTH OF RAILROAD)			
Litchfield Rd – Cheryl Basin	City of Phoenix	170	4
Total			**127**

7.6 Cost Estimate and Evaluation

The cost estimate included in Table 15 for the Recommended Alternative is provided for comparison against the Proposed Alternatives 1 and 2 cost estimates provided in Tables 9 and 10 in Section 6.3.2 of this report. These cost estimates should not be used for project budget projections. A detailed cost estimate is provided in Section 8.4 of this report, based on quantity takeoffs from the Preliminary Plans.

A 30% contingency factor has been applied to cover for miscellaneous cost items and for engineering and construction administration. The estimates provided do not include right-of-way for the landscaped trail where it is not coincident with the channel.

Table 15: Recommended Alternative Cost Estimate

Item	Quantity	Cost
Section A – Unlined Channel	11,010 Feet	$2,406,302
Section B – Lined Trapezoidal Channel	7,748 Feet	$3,832,440
Section C – Lined Rectangular Channel	4,177 Feet	$2,162,906
Section D – Concrete Box Culvert	1,920 Feet	$1,932,000
Section F – Basin with Amenities	1	$4,273,707
Section F – Basin without Amenities	1	$1,097,067
Major Roadway / Railway Crossings	10	$1,869,670
Sub-Total Construction		$17,574,092
Engineering Design, Construction Admin., Utility Relocation, Misc.	30%	$5,272,227
Sub-Total Construction, Engineering, and Administration		$22,846,319
Right of Way Acquisition	127 Acres	$11,093,575
Total		**$33,939,894**

The Northern Parkway has anticipated improvements, rights-of-way, and costs for drainage facilities necessary to construct this roadway. Some of the drainage facilities proposed by the Northern Parkway either overlap with the AT&SF Recommended Alternative, or they are redundant. In order to have a common basis for comparison of costs for both alternatives, the cost of right-of-way and construction, including all contingencies, for the redundant drainage structures is shown as a credit to the project in Table 16. It should be noted that the unit costs, contingencies and land costs prepared for the Northern Parkway project may not be on the same basis as this study. These estimates are for comparison purposes only.

Table 16: Recommended Alternative Cost Evaluation

Item	Cost
AT&SF Recommended Alternative – Construction, Engineering, and Administration	$22,846,319
AT&SF Recommended Alternative – Right-of-Way	$11,093,575
Total AT&SF Recommended Alternative	$33,939,894
Credit for Overlapping Drainage Structures – Construction	-$4,315,266
Credit for Overlapping Drainage Structures – Right-of-Way	-$4,672,130
Total Credit	-$8,987,396
Total Combined AT&SF and Northern Parkway Drainage Costs	**$24,952,498**

(1) Construction costs as summarized in Table 1 and documented in the *Northern Parkway Draft Design Concept Report, Volume I,* dated January 25, 2008.
(2) Right-of-way areas and costs area based upon only the land required for drainage improvements impacted by the Recommended Alternative.

7.7 MCDOT Evaluation

The Recommended Alternative was reviewed by MCDOT, with consideration towards the connection to the proposed Northern Parkway. Following are issues identified by MCDOT and how they were addressed:

Issue 1

Include a narrative analysis of the potential flooding impacts assuming interim build of project components. Include potential for zoning and development approvals by partner agencies to change existing conditions.

Issue 1 Response

Flooding north of the Northern Parkway would not be exacerbated if Phase 1 construction includes the AT&SF components south of Northern Parkway and the Royal Palm Basin. Interim conditions for the remaining phases of the AT&SF components would also not negatively impact properties, as there are currently FEMA

floodplains in the same location, or the proposed channel provides a local or regional outfall. The effects of potential flooding during interim conditions, considering potential zoning and development approvals, were not evaluated for this CAR.

Issue 2

Assume the AT&SF project will be phased such that the Primary and Secondary Channel outfalls to Dysart Drain, south of Northern Parkway, are built with or prior to the Northern Parkway. The remainder of the AT&SF system would be a second phase.

Issue 2 Response

The preferred AT&SF project phasing is discussed in Section 8.3 of this report. The AT&SF components south of Northern Parkway plus the Royal Palm Basin are considered Phase 1A, with the remainder of the project broken into four more phases.

Issue 3

Consider two additional outfall alignments for the Primary Channel south of Northern Parkway. The first alignment takes the outfall from Royal Palm Basin in a conduit within the proposed right-of-way along the north side of Northern Parkway to Dysart Road, then continues south within existing Dysart Road right-of-way to the Dysart Drain. The second alignment takes the outfall from Royal Palm Basin in a conduit straight south from the basin along the mid-section line to the Dysart Drain, with Northern Parkway drainage from Dysart Road west to the mid-section line being piped west to the conduit.

Issue 3 Response

At both the Preliminary Alternatives and Proposed Alternatives stakeholders meetings, the City of El Mirage stressed that they will not allow any new open channels within their jurisdiction. The first alignment was not considered to be economically feasible for this CAR due to structure costs and potential utility conflicts in Dysart Road. The box culvert along Northern Parkway to convey flow from Royal Palm Basin to Dysart Rd would need to (1) 10' x 6' CBC, and the box culvert south along Dysart Road from Northern Parkway to the Dysart Drain would need to be (2) 8' x 6' CBC.

The second alignment south of Northern Parkway is similar to that of the Recommended Alternative, however it is too far to the west to pick up the flow from the Dysart Road channel. Therefore, a parallel drainage system along Dysart Road would be required. A further evaluation of both alternatives is recommended prior to final design.

8 PRELIMINARY PLANS

Preliminary design plans were prepared to provide additional detail on the right-of-way needs, the actual channel size and alignment, and on the profile and structure locations along the length of the channel. These plans were prepared at a scale of 1" = 100' on a 24 x 36-inch sheet size. These plans are plotted at half scale and included in this report.

8.1 Design Description

The preliminary design illustrates a channel that consists of a Primary and a Secondary Channel. The Primary Channel's principal alignments are along the west side of the 135th Avenue alignment, from the Dysart Drain to Sweetwater Avenue. The Secondary Channel is along the 143rd Avenue alignment from the Dysart Drain to just north of Olive Avenue and the AT&SF Railroad spur. The following is a description of the key features of each channel and associated structures, from downstream to upstream:

Primary Channel

- Sta. 9+34 – The Dysart Channel is concrete lined with a total depth to top of bank of 12 feet and an approximate flow depth of 5.0 feet with a discharge of 1297 cfs.
- Sta. 10+30 – The AT&SF channel has been designed to minimize the total channel depth. At the outlet to the Dysart Drain, a box culvert is anticipated to confluence the two channels. This will allow maintenance vehicles to cross the AT&SF channel and helps to reduce the disturbance to the Dysart Drain flows. A drop structure with stilling blocks will help to ensure that the flow which merges from the AT&SF channel is in the subcritical flow regime, and will prevent backwater from the Dysart Drain from influencing the AT&SF channel.
- Sta. 10+60 to Sta. 47+14 – A concrete-lined channel will extend from the Dysart Drain outfall to the Northern Parkway. This channel will be constructed to the full ground height on the west bank. The maintenance road will be on the west bank.
- Sta. 47+14 to Sta. 50+84 – A 10' x 6' concrete box culvert will cross the Northern Parkway and connect to a new basin called the Royal Palm Basin. A concrete spillway and low flow pipe will meter the flow from the basin.
- Royal Palm Basin will attenuate the flow that enters from the north. It will also accept drainage from the Northern Parkway collection channel from east of 143rd Avenue, from Litchfield Road, and from the Parkway's on-site storm drainage systems.

Table 17: Royal Palm Basin Stage-Storage-Discharge Table

Elevation (feet)	Storage Volume (acre-feet)	Discharge (cfs)
Bottom – 1073	0.0	0
Weir – 1077	23.7	50
HW – 1080	62.0	500

- Sta. 63+80 to Sta. 98+43 – The channel is unlined and landscaped. A combination maintenance road and trail will be located on the east side of the channel.
- Sta. 100+34 to Sta. 129+48 – The channel is unlined and landscaped. A combination maintenance road and trail will be located on the west side of the channel.
- Cheryl Basin will attenuate flow which enters the basin from both the north and from the west (Litchfield Road). A 36-inch pipe will control the primary outflow from the basin and a pedestrian underpass will control greater flows. The basin is segmented into three basins, which will allow continued use during more frequent storm events. This will be a public accessed basin and will be landscaped.

Table 18: Cheryl Basin Stage-Storage-Discharge Table

Elevation (feet)	Storage Volume (acre-feet)	Discharge (cfs)
Bottom – 1095	0.0	0
Weir – 1100	22.1	60
HW – 1103.1	58.5	544

- Sta. 20+00 to Sta. 29+24 – The channel is unlined and landscaped. An asphalt paved driveway will provide access and parking for the Cheryl Basin. This driveway will also serve as the maintenance road and trail connection.
- Sta. 29+24 to Sta. 50+01 – The flow is conveyed within an enclosed concrete box culvert system. This will minimize any impacts to the Sage Development property, which is currently being used as an industrial service yard and has a railroad spur from the AT&SF channel.
- Sta. 50+01 to Sta. 63+36 – The channel extends through the City of Surprise WRF. The right-of-way will be limited in this section due to existing structures and basin within the WRF. A maintenance road will be provided along the east bank
- Sta. 63+36 to Sta. 81+92 – The channel widens to a trapezoidal section as the available right-of-way widens. A maintenance road will be provided along the east bank.
- Sta. 83+80 to Sta. 108+65 – The channel is unlined and landscaped. A combination maintenance road and trail will be located on the west side of the channel.

Secondary Channel

- Sta. 40+00 – The Dysart Channel is concrete lined with a total depth to top of bank of 7.0 feet, and an approximate flow depth of 4.0 feet with a discharge of 849 cfs.
- An existing 10' x 4' concrete box culvert crosses Northern Avenue and conveys flow that accumulates along the west side of the AT&SF Railroad. This culvert will be replaced with (2) 10' x 4' concrete box culvert. Depth of cover is limited due to the existing grades of the Dysart Drain and Northern Avenue.
- Sta. 41+53 to Sta. 63+70 – A concrete-lined channel will extend from the Dysart Drain outfall to the Northern Parkway. This channel will be constructed to the full ground height on the west bank. The maintenance road will be on the west bank.
- Sta. 63+70 to Sta. 67+04 – A (2) 8' x 6' concrete box culvert will cross the Northern Parkway.
- Sta. 67+04 to Sta. 92+61 – A rectangular concrete channel will be used to minimize the required right-of-way through the Woolf properties.
- Sta. 92+61 to Sta. 97+45 – Two (2) 48-inch pipes will cross Olive Avenue to the north side of the AT&SF Railroad and provide a future outfall for the property to the north.

8.2 Utility Conflicts

Existing utility locations researched as part of this CAR are shown on the Preliminary Plans, when they occur near or cross the Recommended Alternative alignment. Following are descriptions of potential utility conflicts:

Primary Channel

- Sta. 10+00 – 24-inch and 18-inch existing storm drain pipes outfalling to the Dysart Drain, draining the irrigation ditches.
- Sta. 10+00 – Existing overhead electric power lines are on the north side of the Dysart Drain, based upon the information on the quarter section maps received from APS.

- Sta. 15+40 – 6-inch petroleum products pipeline crossing the channel alignment. The location of the pipeline is based upon as-built information received from Kinder Morgan dated March 31, 1956. The line is used by Amerigas, on land leased from Morton Salt on the East side of Dysart Road. Due to the severe subsidence within this area (on the order of 18 feet or more), the profile view of the pipeline with the depths may not be accurate.
- Sta. 38+60 – Existing overhead electric power lines crossing the channel.
- Sta. 45+00 – Existing overhead electric power lines along the north side of Northern Avenue, with potential conflicts to the proposed trail along the north side of Northern Avenue.
- Sta. 49+00 to 66+00 – Existing overhead electric power lines along the east bank of the Royal Palm Basin.
- Sta. 72+50 – Existing overhead electric power lines along the trail/maintenance road.
- Sta. 99+50 – Existing overhead electric power lines along the north side of Olive Avenue.
- Sta. 118+75 – Existing overhead electric power lines intersecting the trail/maintenance road.
- Sta. 29+80 – Existing overhead electric power lines along the south side of Peoria Avenue.
- Sta. 54+00 to 63+00 – Extensive drainage infrastructure within the City of Surprise WRF, including a shotcrete channel and storm drain culvert.
- Sta. 82+50 – Existing overhead electric power lines along the south side of Cactus Road, and existing underground electric power lines buried along approximately the centerline of Cactus Road.

Cheryl Basin Inflow Channel

- Sta. 41+00 – Existing overhead electric power lines located on the property northwest of the AT&SF Railroad and Litchfield Road.

Secondary Channel

- Sta 40+00 – Existing 10' x 4' Box Culvert draining the existing channel adjacent to the railroad into the Dysart Drain at Northern Avenue.
- Sta. 93+00 – Existing overhead electric power lines along the south side of Olive Avenue.

8.3 Project Phasing

It is likely that the Northern Parkway schedule for construction may be more rapid than that for the AT&SF Railroad. Because of funding limitations, it may be desirable to construct the project in phases. The AT&SF Railroad channel will provide an outfall for drainage from a portion of the Northern Parkway. A Phasing Plan (Figure 7, after Page 38) has been prepared to allow the channel to be constructed in up to five different phases. Phase 1A is the minimum necessary to allow construction of the Northern Parkway and its associated drainage improvements. Phase 1B has been identified separately as it could be constructed in conjunction with future development improvements for the Woolf properties. Phase 2 includes Cheryl Basin and the channel between Peoria Avenue and the Royal Palm Basin. Cheryl Basin is a potential location for fill material excavation. If fill material is required for the Northern Parkway, cost savings to both projects could be realized. Phase 3 Includes the channel between Cactus Road and Peoria Avenue, through the WRF. Phase 4 includes the channel from Sweetwater Avenue to Cactus Road.

8.4 Detailed Cost Estimate

A detailed cost estimate was created from quantity estimates taken from the Preliminary Plans. The detailed cost estimate is broken into phases (Table 19), as described in the previous section. A summary of the cost estimate is shown in Table 20, and the detailed break out for each phase is located in Appendix L of Volume 2 of the CAR.

Key

Phase 1A
Phase 1B
Phase 2
Phase 3
Phase 4

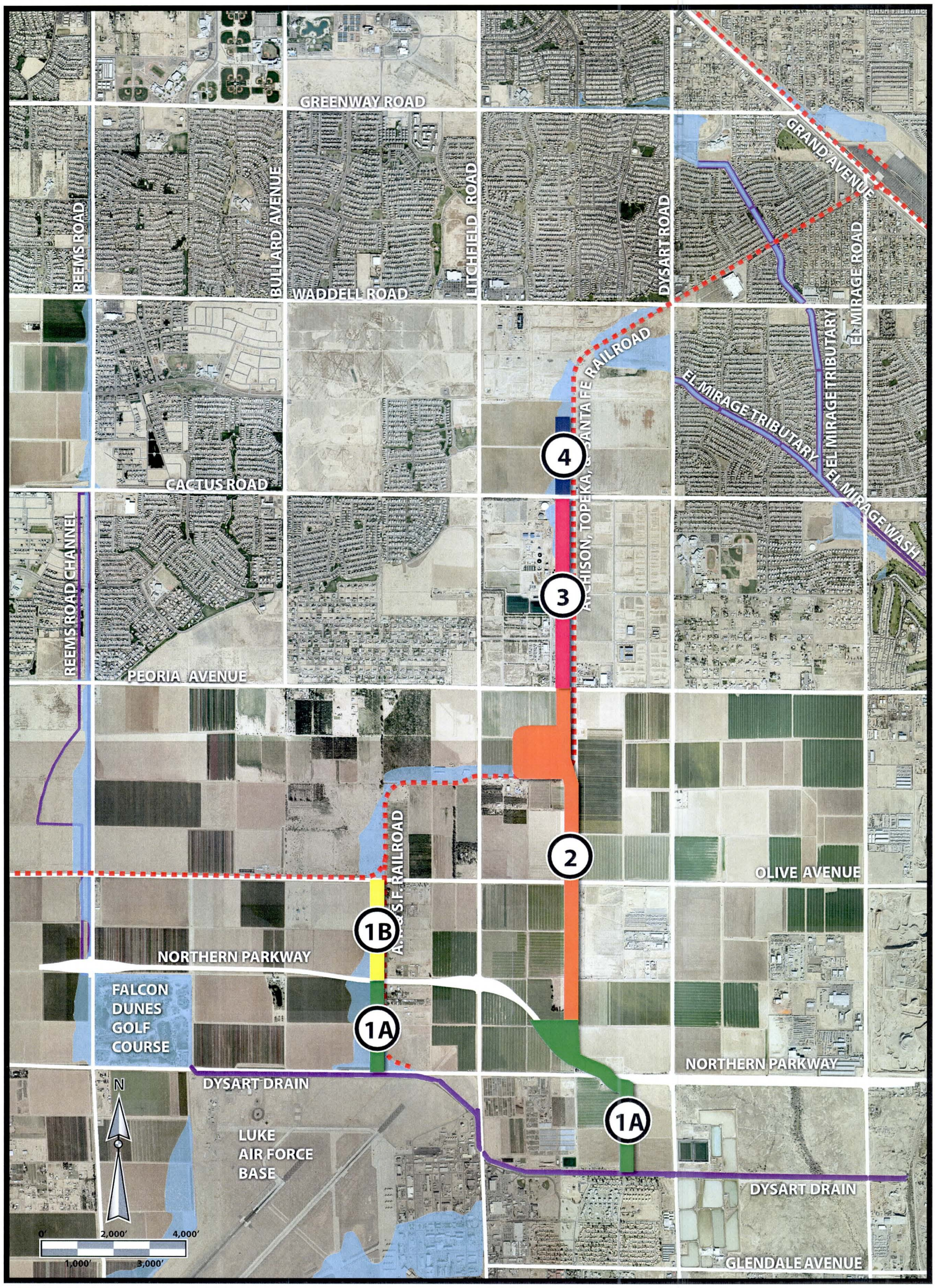

FIGURE 7: RECOMMENDED ALTERNATIVE - PHASING DIAGRAM

AT&SF Railroad Channel and Basin Candidate Assessment Report

Hoskin • Ryan Consultants, Inc.
creative engineering solutions

Flood Control District of Maricopa County

FCD 2007C016

Table 19: Preliminary Plan Cost Estimate by Phase

Item	Cost
Phase 1A Construction	$6,579,200
Phase 1B Construction	$1,436,564
Phase 2 Construction	$9,639,557
Phase 3 Construction	$4,727,040
Phase 4 Construction	$600,724
Sub-Total Construction	$22,983,084
Utility Relocation and Miscellaneous Costs (10% of Construction Sub-Total)	$2,298,309
Engineering Design (10% of Construction Sub-Total)	$2,298,309
Construction Administration / Management (10% of Construction Sub-Total)	$2,298,309
Sub-Total Contingencies	$6,894,927
Sub-Total Construction and Contingencies	**$29,878,011**
Right-of-Way North of Peoria Avenue (17 Acres at $150,000 per Acre)	$2,569,301
Right-of-Way South of Peoria Avenue (110 Acres at $78,250 per Acre)	$8,595,231
Sub-Total Right-of-Way Acquisition	**$11,164,532**
Total Recommended Alternative Cost	**$41,042,543**

Table 20: Preliminary Plan Cost Summary

Item	Cost
AT&SF Preliminary Plan – Construction, Engineering, and Administration	$29,878,011
AT&SF Preliminary Plan – Right-of-Way	$11,164,532
Total AT&SF Preliminary Plan Cost	$41,042,543
Credit for Royal Palm Basin Excavation	-$2,182,024
Credit for Cheryl Basin Excavation	-$6,296,025
Total AT&SF Including Credit for Basin Excavation	$32,564,494
Credit for Overlapping Drainage Structures – Construction	-$4,315,266
Credit for Overlapping Drainage Structures – Right-of-Way	-$4,672,130
Total AT&SF Preliminary Plan Cost	**$23,577,098**

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FIGURE 8 – HEC-1 SCHEMATIC, EXISTING CONDITION

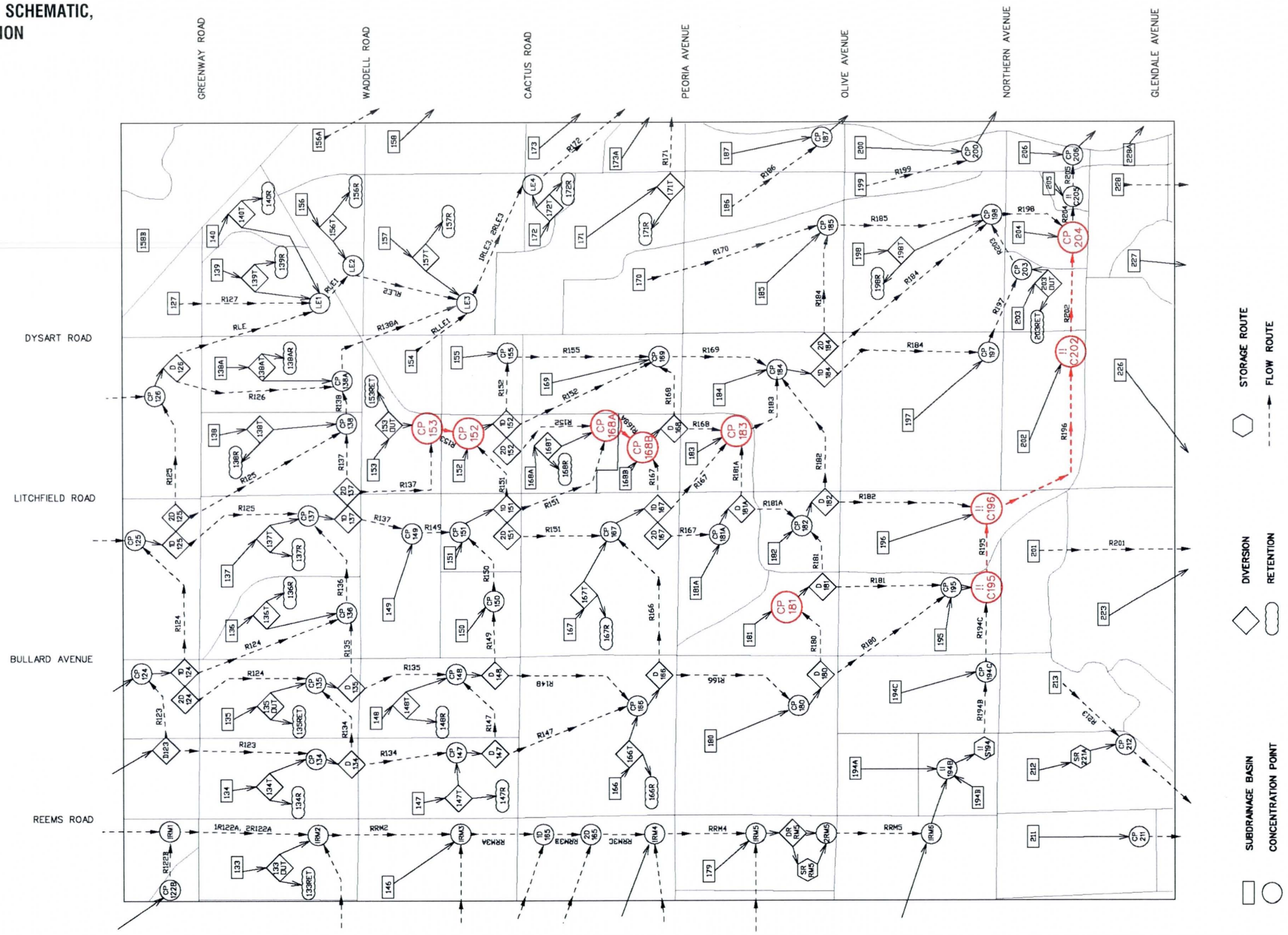

FIGURE 9 – HEC-1 SCHEMATIC, PROPOSED ALTERNATIVE 1

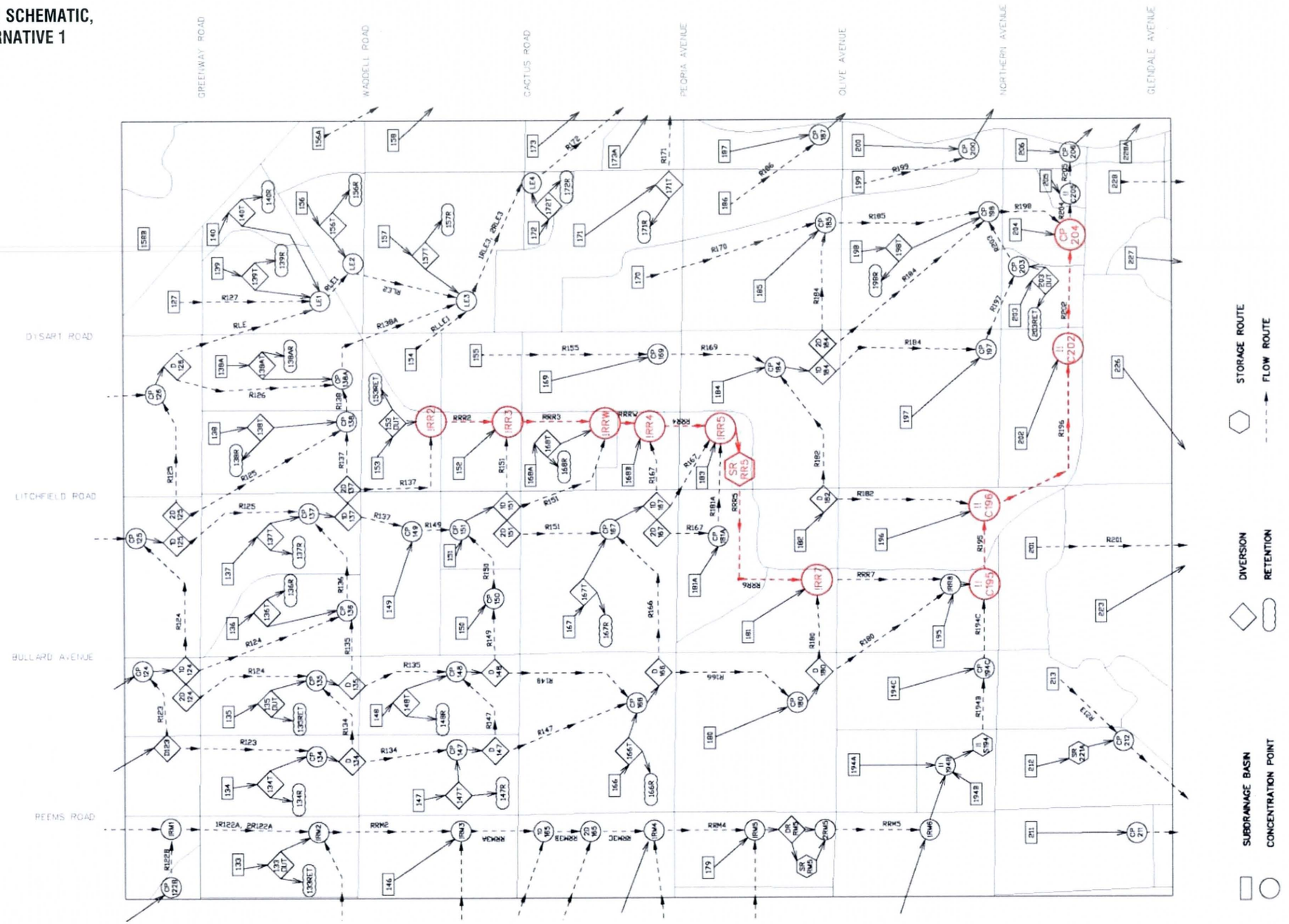

FIGURE 10 – HEC-1 SCHEMATIC, PROPOSED ALTERNATIVE 2

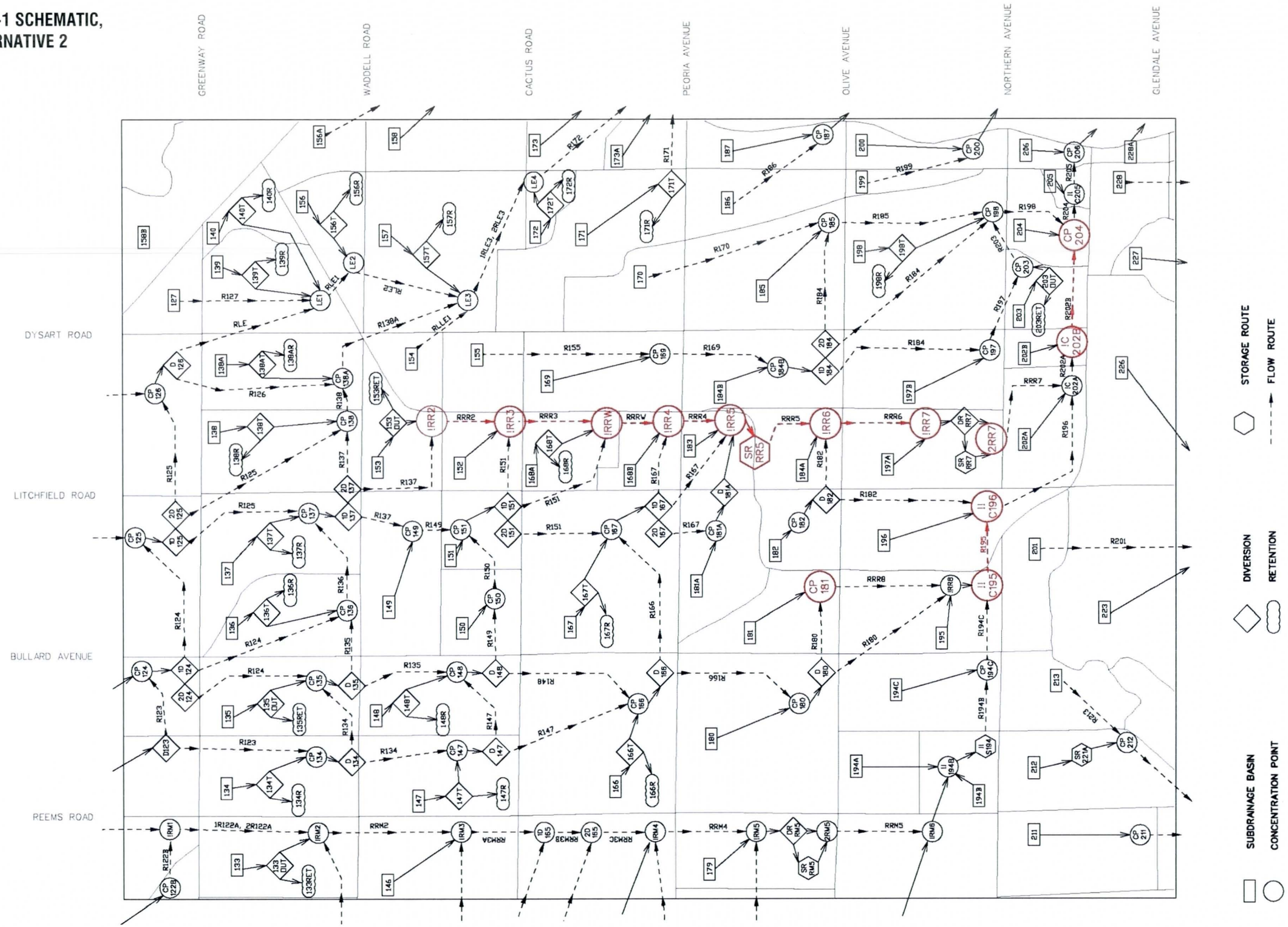

FIGURE 11 – HEC-1 SCHEMATIC, RECOMMENDED ALTERNATIVE