Central Laveen Commercial District Pedestrian Mall Demonstration Project

Design Concept Report

Prepared for:

MARICOPA ASSOCIATION of GOVERNMENTS

Prepared by:

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March 31, 2006
091980003

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PROJECT SUMMARY AND REGIONAL SIGNIFICANCE

The Maricopa Association of Governments (MAG) Pedestrian Design Assistance Program provided funding to the City of Phoenix to initiate design of the Central Laveen Commercial District Pedestrian Mall Demonstration Project. The focus of this project was to provide a Design Concept Report for the Central Laveen Commercial District Pedestrian Mall Demonstration Project. This project was developed through the cooperation of the Public and the stakeholders involved, which included representatives from City of Phoenix City Council, City of Phoenix Planning Department, City of Phoenix Streets and Transportation Department, Laveen Village Planning Committee, Maricopa Association of Governments, US Bureau of Reclamation, and LEADS (land-owner representative and developer).

The pedestrian mall will be constructed in the southeast quadrant of the intersection of 59th Avenue and Dobbins Road. Pedestrian crossing facilities (e.g. crosswalk) will be constructed at the intersection of 59th Avenue and Dobbins Road to connect the Laveen Commercial Core and the Town Center. The pedestrian mall will traverse through the future Town Center in a southeast-northwest direction. A future community park will be constructed at the southeast terminus of the mall. The future Commercial Core will be located on the west side of 59th Avenue. The pedestrian mall will be a crowning feature of the future Laveen Town Center and include a mix of urban, residential, and commercial uses in a concentrated pedestrian scale environment.

Key objectives of the Pedestrian Mall Demonstration Project were to:

- Preserve view corridors to the bordering mountains;
- Establish a link to Laveen's agricultural heritage; and
- Provide a pedestrian facility to connect the Commercial Core and the Laveen Town Center.

Preserve View Corridors to the Bordering Mountains

This project will include a landscaped pedestrian mall with an interactive watercourse running the length of the mall. Walking and bicycling will be permitted exclusively along the mall and watercourse. The mall will also provide a view corridor of South Mountain, Carver Foothills, and the Estrella Mountains located to the south, and will provide access to residential and commercial properties that will border the pedestrian mall.

Establish a Link to Laveen's Agricultural Heritage

The agricultural economy of the Laveen area is based on a heritage that remains vitally important to the local residents of the area. The beauty of Laveen with its tremendous views of the surrounding mountains and downtown Phoenix has resulted in many areas of this agricultural community being replaced by both commercial and residential development. The agricultural engine that was the basis for Laveen's initial development has the potential to be lost. The pedestrian mall and watercourse will reflect the agricultural heritage of Laveen and its historical canal system. An educational component will reflect the agricultural history and heritage of Laveen and the Salt River Project (SRP) canal system. The design of the watercourse will also replicate SRP laterals and irrigation ditches that are integral to the area's past. As a further link to the area's agricultural tradition, low water-use plantings at the entry are representative of the many crops found in the Laveen area.

Provide a Pedestrian Facility to Connect the Commercial Core and the Laveen Town Center

The Town Center is being designed to invite people to walk along the channel, visit the shops, restaurants, and learn about the history of Laveen. It has been recommended that a 15-foot wide, at grade pedestrian crossing facility, across all four legs of the intersection be constructed. Countdown pedestrian signals are also recommended to be installed at this intersection. These devices provide pedestrians valuable information on the crossing time remaining when crossing the intersection.

The future Town Center will serve as the 'heart', or Main Street of the Laveen Community. This project will provide a sense of place for the residents of the area, as well as pride of ownership. This concept of capturing regional history can and should be considered for other municipalities throughout the MAG Region. History is the backbone of a great community. The Valley has a great and historical past that should not be forgotten but integrated into current and future development.

1. INTRODUCTION

The City of Phoenix received funding from the MAG Pedestrian Design Assistance Program to initiate design of the Central Laveen Commercial District Pedestrian Mall Demonstration Project. The Central Laveen Commercial District Pedestrian Mall will be a crowning feature of the future Laveen Town Center. The Town Center will include a mix of urban, residential, and commercial uses in a concentrated pedestrian scale environment. The future Town Center will serve as the 'heart', or Main Street of the Laveen Community.

The project design will be completed in multiple phases. This *Design Concept Report* represents completion of the first phase of the project. It is anticipated that construction of the project will be funded through a combination of public and private sources.

1.1 Project Location

The pedestrian mall will be constructed in the southeast quadrant of the intersection of 59th Avenue and Dobbins Road. Pedestrian crossing facilities (e.g. crosswalk) will be constructed at the intersection of 59th Avenue and Dobbins Road to connect the Laveen Commercial Core and the Town Center. The pedestrian mall will be constructed in the shaded area shown in **Figure 1**.

The pedestrian mall will traverse through the future Town Center in a southeast-northwest direction. A future community park will be constructed at the southeast terminus of the mall. The future Commercial Core will be located on the west side of 59th Avenue.

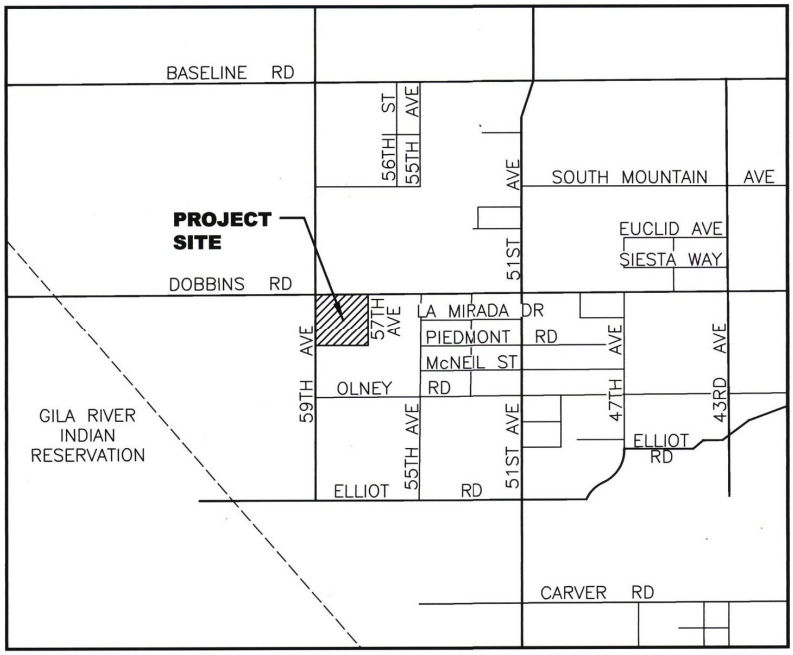


Figure 1 – Project Location Vicinity Map

1.2 Project Objectives

The agricultural economy of the Laveen area is based on a heritage that remains vitally important to the local residents of the area. The beauty of Laveen with its tremendous views of the surrounding mountains and downtown Phoenix has resulted in many areas of this agricultural community being replaced by both commercial and residential development. The agricultural engine that was the basis for Laveen's initial development has the potential to be lost. The Central

Laveen Commercial District Pedestrian Mall Demonstration Project will be the first of many projects that establishes a way to secure areas where this heritage can be celebrated, remembered, and handed down by education to generations to come.

Key objectives of the Pedestrian Mall Demonstration Project are to:

- Preserve view corridors to the bordering mountains;
- Establish a link to Laveen's agricultural heritage; and
- Provide a pedestrian facility to connect the Commercial Core and the Laveen Town Center.

1.3 Existing Conditions

The proposed site for the pedestrian mall is currently undeveloped. 59th Avenue and Dobbins Road are both two lane roads. Land use in the area is primarily agricultural. In support of the agricultural use of the area, several irrigation ditches are located in the vicinity.

While a majority of the site is undeveloped and vacant, an existing farm-house is located east of the project area, and another on the southwest corner of 59th Avenue and Dobbins Road. New subdivisions and residential developments exist several blocks east of the project area at 55th Avenue and Dobbins Road.

1.4 Stakeholder Issues and Needs

Public and stakeholder input were important during the development of the design concept report. Three stakeholder meetings were held throughout the concept design process. Attendees included representatives from City of Phoenix City Council, City of Phoenix Planning Department, City of Phoenix Streets and Transportation Department, Laveen Village Planning Committee, Maricopa Association of Governments, US Bureau of Reclamation, and LEADS (land-owner representative and developer). To facilitate input from the general public, two public open houses were held.

At the open houses and stakeholder meetings, the following needs and issues were expressed by stakeholders and the public:

- Laveen has an agricultural and rural character that should be maintained. Design elements should further the agricultural feeling. The design should try to capture a piece of history and build on rural character and culture.
- Build on rural character of the Town Center through decorative art and water features. Water features should interpret the historical canal system.
- Make the Town Center a destination area and a place that people want to live.
- The design for the pedestrian mall should be safe for children.
- Utilize park space. The future park is one of the most critical aspects to the overall success of the project.
- Maximize the sound of water through design and texture.
- Incorporate activity stations for the kids to play, and parents to watch the children at play.
- Design must be efficient. Design features must be durable, and able to endure wear and tear.
- Design must be a benefit to retailers.
- Design elements should fit in with the elements, e.g. river rock embedded in the material.
- Landscape design should include native trees and plant life that will attract native wildlife and will represent the history of the area.

2. LANDSCAPE DESIGN CONCEPT

The Central Laveen Commercial District Pedestrian Mall Demonstration Project will contain a landscaped pedestrian mall with an interactive watercourse running the length of the pedestrian mall as illustrated in **Figure L-1**. Walking and bicycling will be permitted exclusively along the mall and watercourse.

The proposed pedestrian mall width is 70 feet, with one large gathering area that is approximately 200 feet by 200 feet. The mall will provide a view corridor of South Mountain, Carver Foothills, and the Estrella Mountains located to the south. According to the City of Phoenix *Central Laveen Commercial Planning Area Plan* the mall will be bordered by residential and commercial land uses.

The mall and watercourse will reflect the agricultural heritage of Laveen and its historical canal system. An educational component will reflect the agricultural history and heritage of Laveen and the SRP canal system. In order to incorporate the agricultural heritage of the Laveen area, and to reflect the history and importance of the canals and irrigation, donated SRP equipment will be incorporated into the mall design. The design of the watercourse will also replicate SRP laterals and irrigation ditches that are integral to the area's history (see **Figure L-2**).

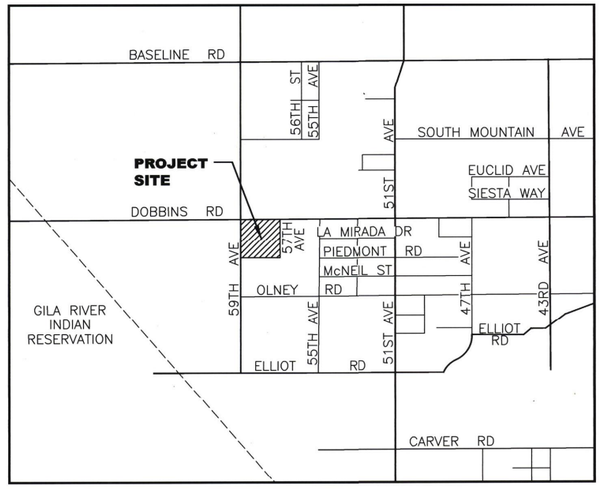
As a further link to the area's agricultural heritage, low water-use plantings at the entry are representative of the many crops found in the Laveen area. These are planted in rows with furrows, reminiscent of the agricultural history of the area. These plantings will be irrigated with bubblers to simulate flood irrigation. Some suggestions of plant materials are as follows:

Botanical Name	**Crop Represented**
Muhlenbergia rigens	Wheat
Ruellia peninsularis	Alfalfa
Leucophyllum frutescens	Alfalfa
Cordia parvifolia	Cotton

Pedestrians then follow a channelized canal which interprets the modern canal systems and its relationship to the agricultural community of Laveen. The reflective nature and playfulness of water is to be celebrated in the adjacent pavement. Pavement patterns, textures, colors, and forms were designed to mimic the movement of water through the canals and add to the overall appeal.

Two open plazas present themselves with shade, educational signage, seating, and educational art. They create a diversity of space that would allow for both large group and community gatherings along with individual reflective spaces. The first plaza has integrated public art that is envisioned to be truly representative of the value of the agricultural theme that serves as the basis for the overall design. The second plaza reflects the groves of agricultural Laveen and suggests a water play area for community activities. The plant suggestion for the plaza is as follows:

Botanical Name	**Crop Represented**
Pistachia chinensis	Pistache



VICINITY MAP
N.T.S.

OBJECTIVE:

THE LAVEEN VILLAGE PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT OFFERS A MULTIPLE USE SITE THAT PROVIDES OUTSTANDING OPPORTUNITIES FOR PEDESTRIAN CONNECTIVITY BETWEEN THE COMMERCIAL CORE AND LAVEEN TOWN CENTER. THE PROJECT PRESENTS A LINK TO LAVEEN'S AGRICULTURAL HERITAGE AND ESTABLISHES A SPECTACULAR VIEW CORRIDOR OF BORDERING MOUNTAINS.

THE LAVEEN VILLAGE PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT IS A LANDSCAPED PEDESTRIAN MALL WITH AN INTERACTIVE WATERCOURSE THAT INCORPORATES SALVAGED SRP EQUIPMENT AND STRUCTURES. AN EDUCATIONAL COMPONENT REFLECTS THE AGRICULTURAL HISTORY AND HERITAGE OF LAVEEN AND THE SRP CANAL SYSTEM.

0 30' 60' 120'

LAVEEN VILLAGE PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT

Figure L-1 – Project Layout

SRP EQUIPMENT


EXPANDED METAL GRATE


RUSTED ANGLED IRON


CONCRETTE BRIDGE


GEARS


SLUICE GATE

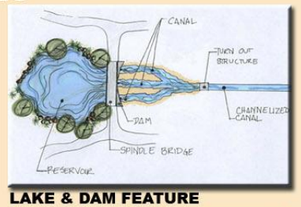

RUSTED PIPES


CHAIN

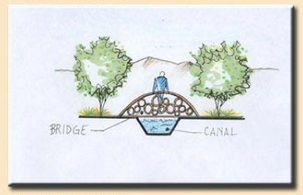

WATER CHUTES

CONCEPT SKETCHES

WAY FINDING SIGNAGE

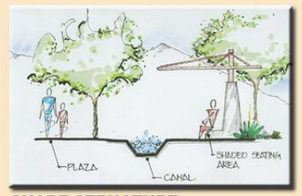


LAKE & DAM FEATURE



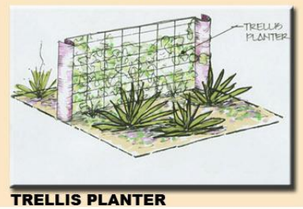
GEAR BRIDGE


SHADE STRUCTURE



SHADE STRUCTURE

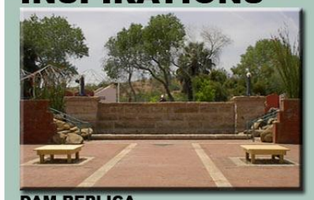

ART FEATURE



TRELLIS PLANTER


ENTRY FEATURE

INSPIRATIONS


DAM REPLICA


ROW CROPS


INTERACTIVE WATER FEATURE


WATER FEATURE


COLONNADE

SAND BLASTED CONCRETE


COLONNADE


INTERACTIVE WATER FEATURE

SITE AMENITIES:

AMERON TRADITIONAL SERIES - VICTORIAN

WABASH VALLEY BIKE LOOPS BL100 COLOR: BLACK

NEENAH TREEGATE R-8740-1

LANDSCAPEFORMS PLAINWELL 72” BENCH, COLOR: GROTTO

LANDSCAPEFORMS PETOSKEY 72” BENCH, COLOR: GROTTO

LANDSCAPEFORMS PLAINWELL TRASH RECEPTACLE, COLOR: GROTTO

LANDSCAPE FORMS PETOSKEY TRASH RECEPTACLE, COLOR: GROTTO

LAVEEN VILLAGE PROMENADE

Figure L-2 – Landscape Design Elements

These gathering areas are intended for pedestrian respite, reflection, and escape will be created along the project. They will allow the user to experience and reflect upon this project, and this community, from an active educational perspective or a more personal reflective space.

Throughout the plan, canal crossings are designed to be reflective of the SRP canal systems that are at the core of this project's purpose. Sluice gates are incorporated into the design for public contact and will provide an interactive tool to experience the pure enjoyment and amusement of water diversion. The crossings, along with many other elements, are to be constructed of recycled materials donated by SRP and are to provide a basis for teaching about the agriculture of the area and its significance in Laveen.

The pedestrian mall continues towards the southeastern corner of the project and incorporates a lake and symbolic dam element, inspired by the forms of Roosevelt Dam. The water flows through a lush Native Desert Riparian Area with rugged boulder features. Educational signage tells of early canals and the development of the dams and its relationship to modern systems. Interactive water play areas explore this evolution. Planting suggestions are as follows (see **Figure L-3**):

Botanical Names	**Common Names**
Caesalpinia pulcherrima	Red Bird of Paradise
Dasylirion wheeleri	Desert Spoon
Encelia farinosa	Brittle Bush
Fouquieria splendens	Ocotillo
Hesperaloe parviflora	Red Yucca
Justicia spicigera	Mexican Honeysuckle
Leucophyllum frutescens	Green Cloud Sage
Muhlenbergia capillaries	Pink Muhly
Tecoma stans	Yellow Bells
Verbena pulchella	Moss Verbena

Way finding nodes and pass through areas have been planned throughout the plaza to assist the visitor in orientation to the pedestrian mall and to provide a link to the surrounding development and potential parking areas. The incorporation of open turf areas throughout the design have been created to both cool the space visually and physically while also providing a public space for use and enjoyment.

The design element for the pedestrian mall entry will include shade structure landmarks inspired by radial gate forms that create an entry portal from the intersection of 59th Avenue and Dobbins Road to the Promenade, as illustrated in **Figure L-4**.

Illustrated schematics of the pedestrian mall and watercourse are presented in **Figure L-5**, **Figure L-6**, and **Figure L-7**.

LAVEEN PROMENADE INSPIRATIONS

PLANT MATERIALS

TREES


ACACIA SALICINA / WILLOW ACACIA


SOPHORA SECUNDIFLORA / TEXAS MOUNTAIN LAUREL


CERCIDIUM FLORIDUM/ BLUE PALO VERDE


TIPUANA TIPU / TIPU


CERCIDIUM PRAECOX/ SONORAN PALO VERDE


ULMUS PARVIFOLIA / EVERGREEN ELM


PISTACIA CHINENSIS / PISTACHE


AGAVE GEMINIFLORA / TWIN FLOWERED AGAVE


PROSOPIS HYBRID 'PHOENIX' / PHOENIX MESQUITE


BOUGAINVILLEA GLABRA / RED BOUGAINVILLEA

SURFACE MATERIALS

CONCRETE COLORS

SOLOMON 5092

SOLOMON 306


SOLOMON DSC6605

DG COLOR


GRANDE ROSE

SHRUBS


CAESALPINIA PULCHERRIMA / RED BIRD OF PARADISE


CAESALPINIA PULCHERRIMA / RED BIRD OF PARADISE


CORDIA PARVIFOLIA / LITTLE LEAF CORDIA


DASYLIRION WHEELERI/ DESERT SPOON


ENCELIA FARINOSA / BRITTLEBUSH


FOUQUIERIA SPLENDENS/ OCOTILLO


HESPERALOE PARVIFLORA / RED YUCCA


JUSTICIA SPICIGERA/ MEXICAN HONEYSUCKLE


LEUCOPHYLLUM FRUTESCENS / GREEN CLOUD SAGE


MUHLENBERGIA CAPILLARIS/ PINK MUHLY


MUHLENBERGIA RIGENS / DEER GRASS


RUELLIA PENINSULARIS/ BAJA RUELLIA


TECOMA STANS SP. 'SUNRISE' / YELLOW BELLS


VERBENA PULCHELLA GRACILIOR/ MOSS VERBENA

LAVEEN VILLAGE PROMENADE

Figure L-3 – Landscape Design Hardscape and Planting Elements

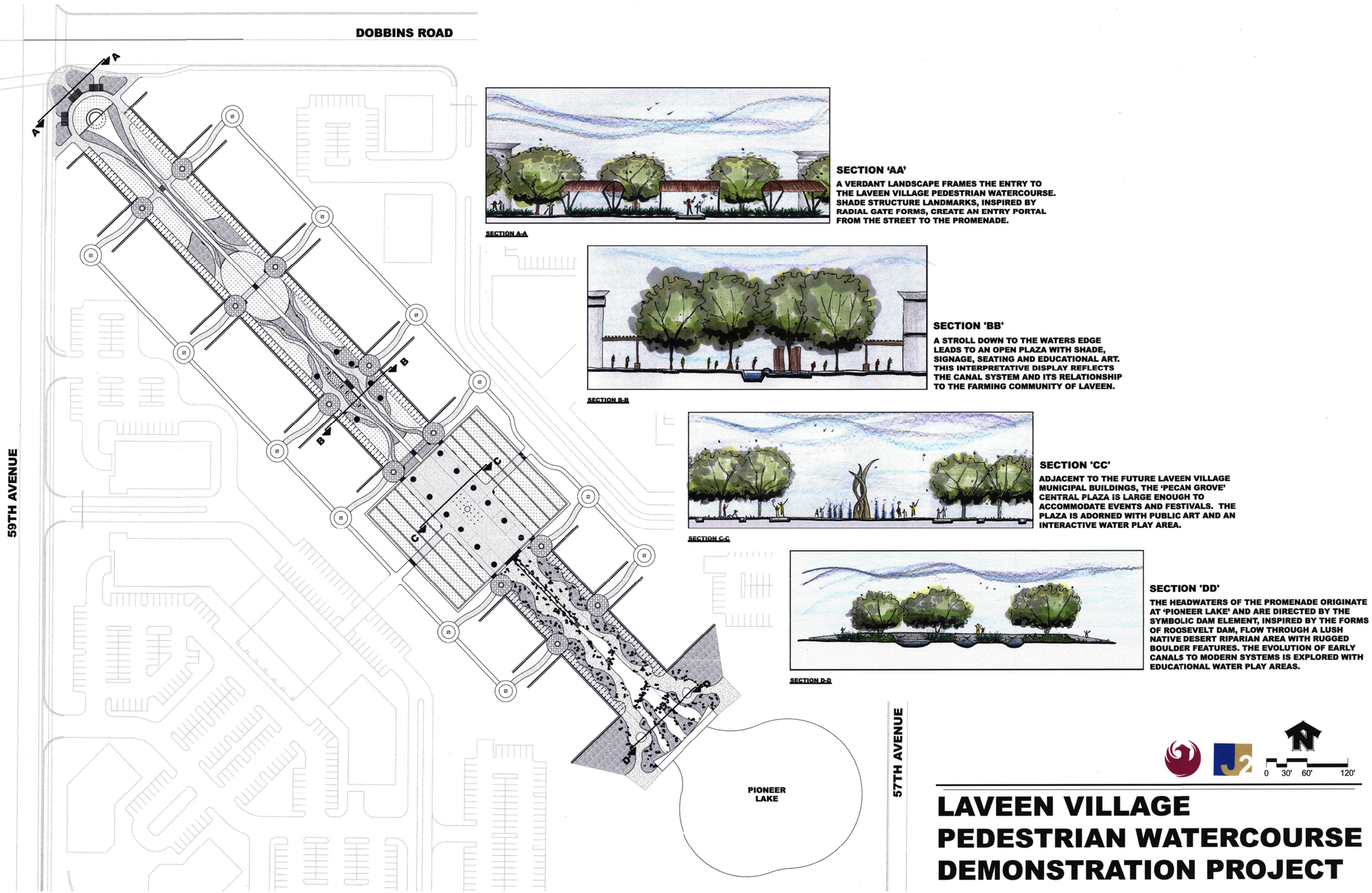
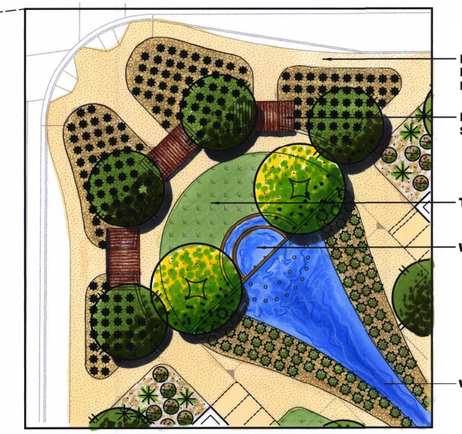


Figure L-4 – Landscape Concept

ENTRY AND WATER FEATURE WITH SHADE STRUCTURES



WATER FEATURE ENLARGEMENT
N.T.S.

0 15' 30' 60'

LAVEEN VILLAGE PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT

Figure L-5 – Site Plan (Lower Reach)

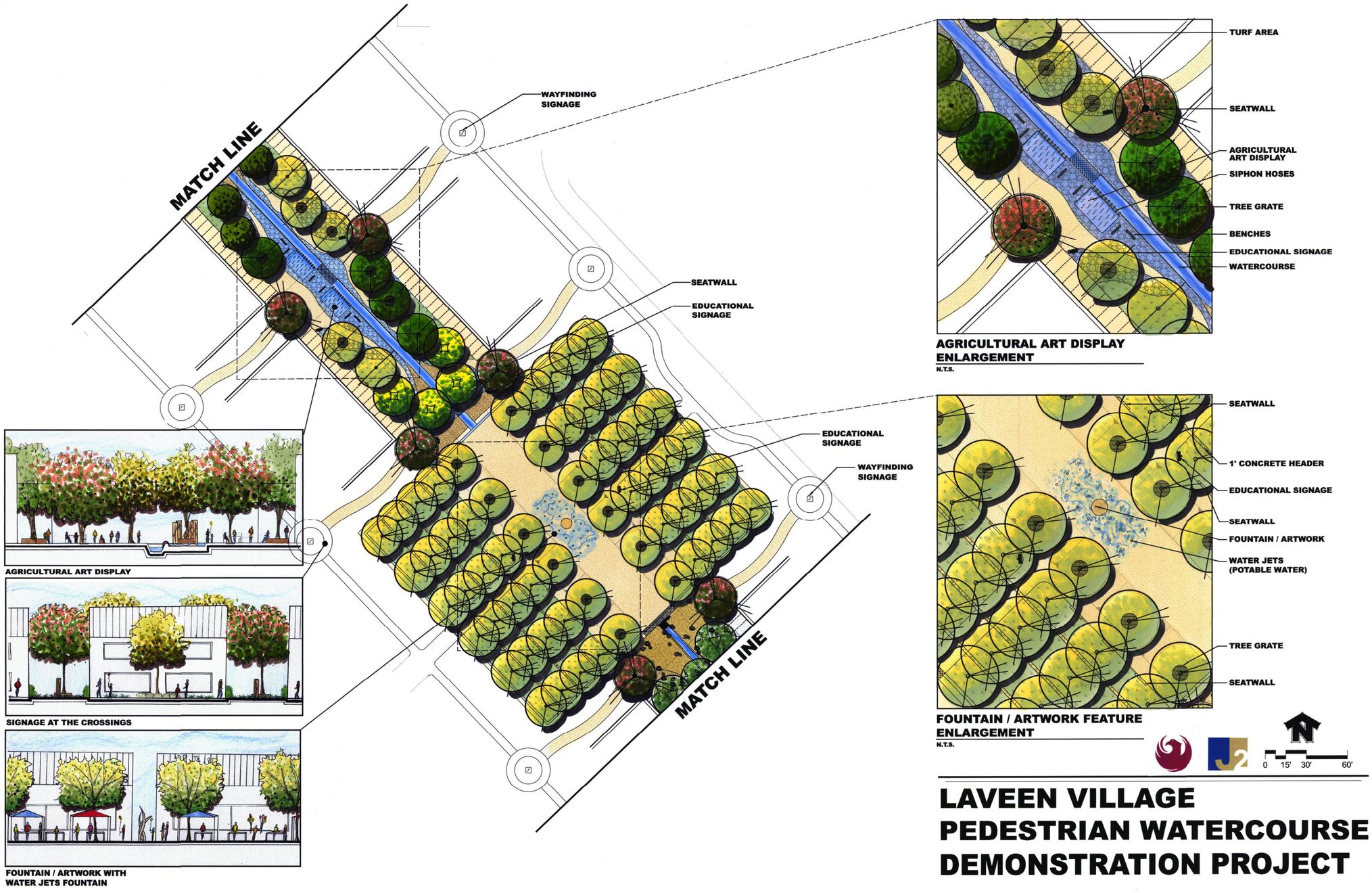
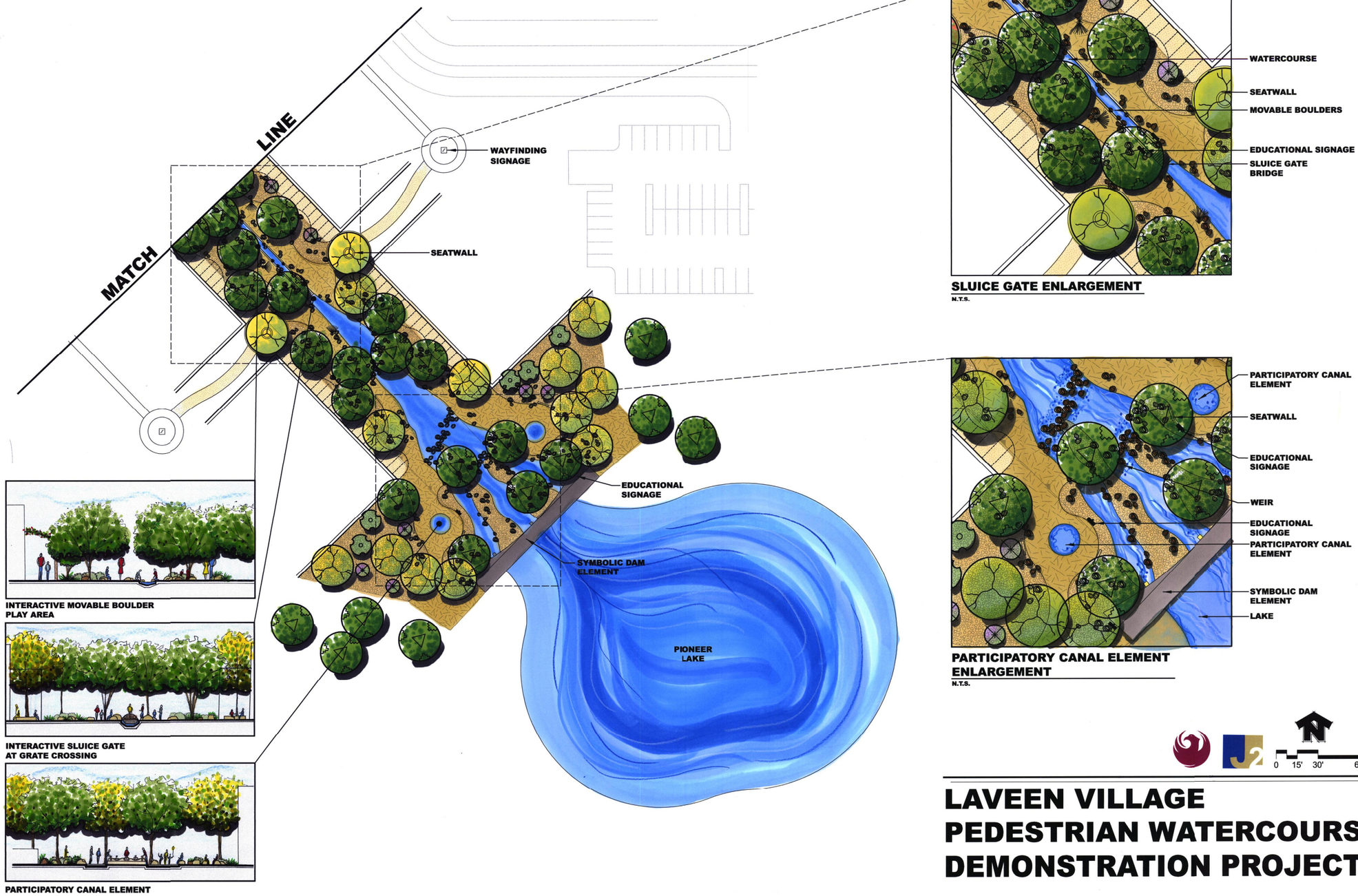


Figure L-6 – Site Plan (Middle Section)



LAVEEN VILLAGE PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT

Figure L-7 – Site Plan (Upper Reach)

3. HYDRAULICS

As illustrated in **Figure L-1** and discussed in Section 2, a watercourse feature will be a central design element of the pedestrian mall. This section presents an overview of the hydraulic design concepts for the watercourse feature.

3.1 Watercourse Canal

The watercourse project layout is presented in **Figure H-1**. As illustrated in **Figure H-1**, the watercourse feature includes a canal that runs the length of the pedestrian plaza from a minimum one-acre lake. Two water fountains will be constructed along the length of the canal.

This section presents preliminary sizing of the watercourse elements, including canal depth, estimation of the volume of water required to supply these elements, recommendations regarding grades needed to maintain hydraulic conditions, and identification of potential water sources.

3.1.1 Canal Depth

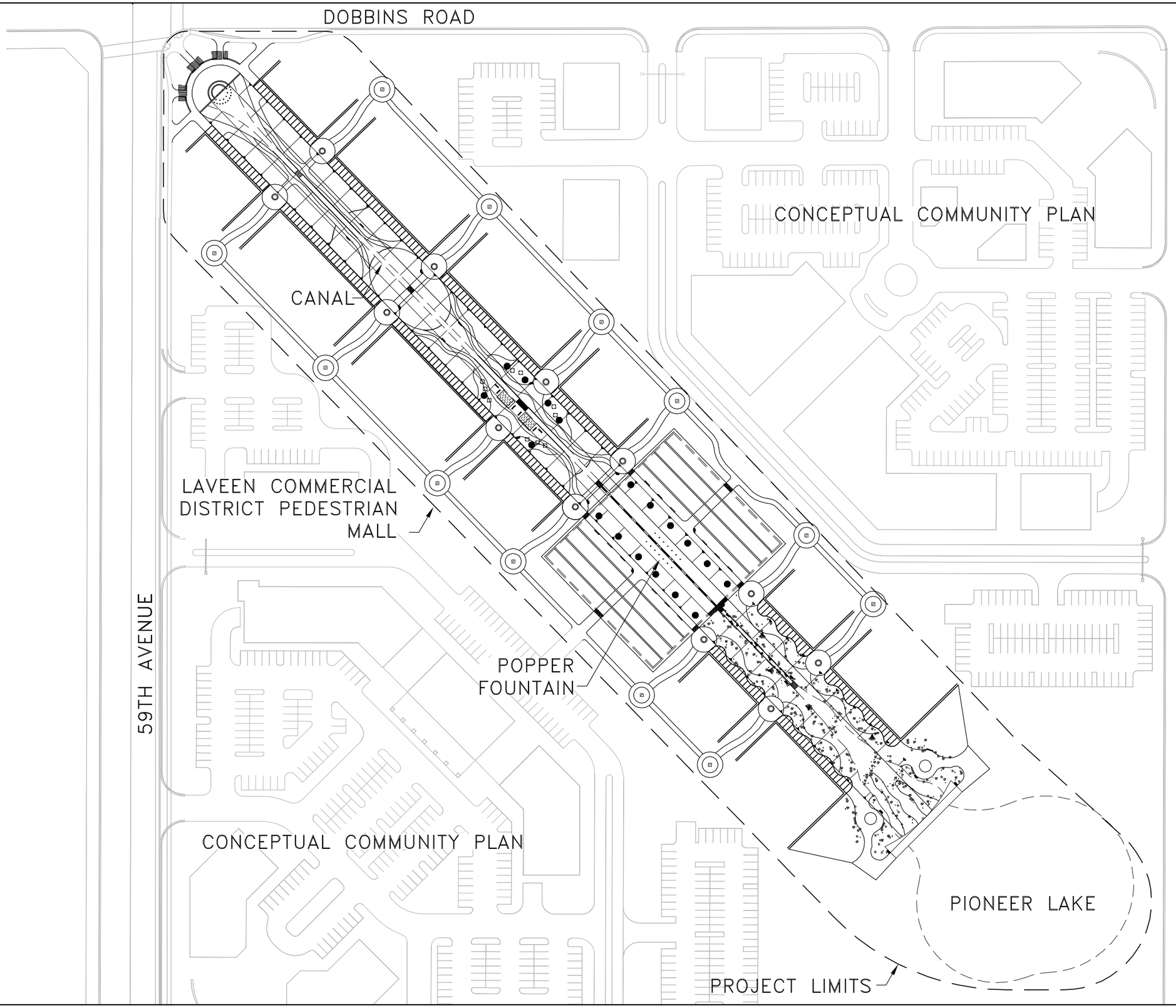
Safety is a primary design consideration for the watercourse canal. The watercourse canal will be unenclosed. The Maricopa County Planning and Development Department Pool and Barrier Requirements require that any body of water greater than 18 inches in depth shall be surrounded by a barrier of at least 60 inches in height. Given that no such barrier is planned, the maximum depth in the canal will be limited to 18 inches.

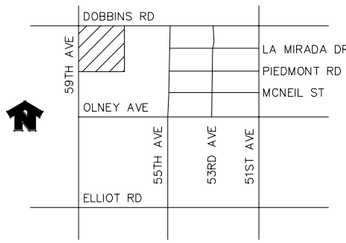
3.1.2 Canal Velocity and Flow Rate

The maximum flow velocity in the canal was determined by consulting the *Downstream Hazard Classification Guidelines* published by the U.S. Department of the Interior. **Appendix A** presents two charts from this publication that relates depth and velocity to safety of adults and children. The Department of the Interior charts are meant to serve merely as guidelines, and are based on flood flow with debris (trees, logs, etc.). As the canal will be in a controlled environment, it is anticipated that it will be free and clean of debris and will not contain large debris such as logs and trees. For this reason, it is acceptable to select a velocity at the high-end of the "judgment zone" as defined on the Department of Interior charts.

The charts illustrate that for a maximum depth of 18 inches, the corresponding maximum water velocity should be two feet per second (ft/s). Considering the physical and safety constraints of the area, it was calculated that the volume of flow through the canal should be eight cubic feet per second (cfs). These calculations are shown in **Appendix B**.

The main canal segments will have a slope of 0.12%. As demonstrated in **Appendix B** calculations, a flow rate of eight cfs will allow the water surface and velocities to remain below maximum levels.





VICINITY MAP
N.T.S.

GRAPHIC SCALE
60 0 30 60 120
(IN FEET)

CONCEPTUAL COMMUNITY PLAN PROVIDED BY THE CITY OF PHOENIX AND IS SHOWN IN GRAY.

SUBMITTAL
15%
PRELIMINARY
NOT FOR
CONSTRUCTION

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Phoenix, Arizona 85020 (602) 944-5500

LAVEEN VILLAGE
CITY OF PHOENIX, ARIZONA

PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT

PROJECT LAYOUT

DR	DES	CK	SHEET	TOTAL
PAC	PAC	LSM	NO	SHEETS
DATE	DATE	DATE	H-1	4
12/05	12/05	12/05		

3.1.3 Canal Geometry

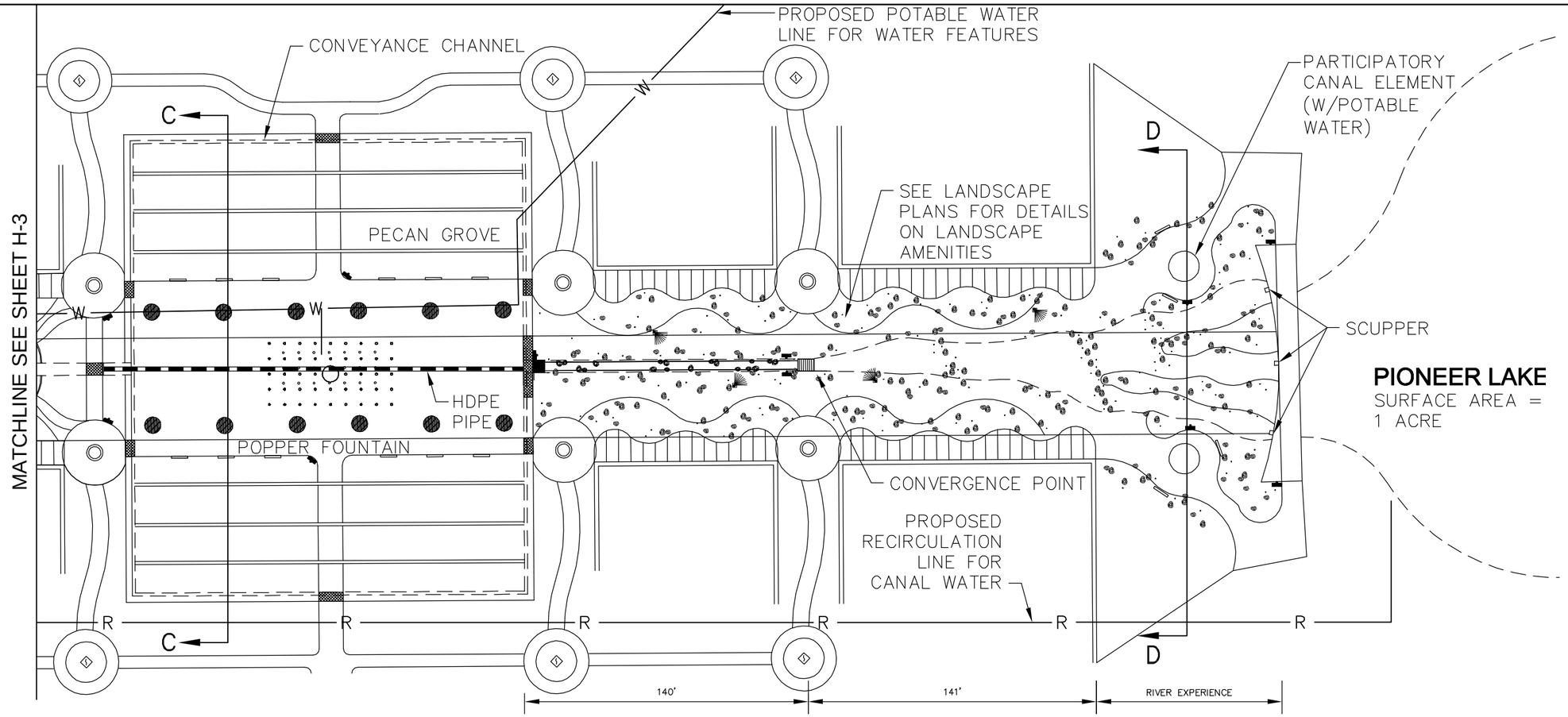
The canal is a concrete lined trapezoidal channel with a top width of six feet, a bottom width of two feet, and side slopes of 1:1 (horizontal to vertical). The flow will enter the watercourse from the proposed Pioneer Lake through three scuppers that will be positioned approximately three feet above the canal invert. This portion of the watercourse is called "River Experience" and incorporates boulder weirs in three canals which converge into the main canal approximately 230 feet downstream of the outfall (**Figure H-2**). In order to pass the required flow and still maintain a depth less than one and one-half feet, the "boulder weirs" will need to be spaced such that an opening of no less than 18 inches in width exists between the boulders.

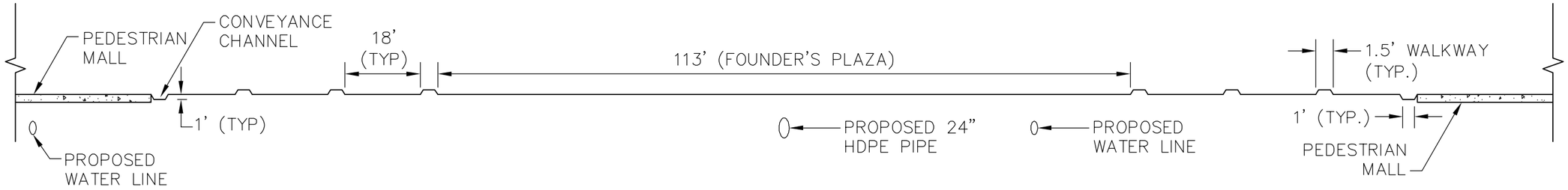
As shown in **Figure H-2** approximately 140 feet downstream of the convergence point, the flow will split. A portion of the flow will be conveyed around the perimeter of the grove in a one-foot deep, one and one-half-foot wide conveyance channel. The conveyance channel is a landscape amenity. The remainder of the flow in the canal will be conveyed under the pistache grove in a pipe. This pipe will be 24-inch High Density Polyethylene (HDPE). Beyond the grove, the pipe will discharge back into the canal and flow to the lower water feature, at the northwest end of the watercourse (see **Figure H-3)**. This water feature will serve as the collection area for the canal water, and will also incorporate a fountain that will utilize potable water. The system is designed to re-circulate the water in the canal; therefore, the canal water will be collected through drain holes and conveyed back up to Pioneer Lake through a pump system.

Geographically, the area where the water feature is to be located is very flat, with no more than six feet of fall over the entire length of the water feature. The drop from Pioneer Lake to the canal is three feet, and the pipe in the pistache grove has a drop in elevation of two feet; therefore, the remainder of the canal needs to be very flat. This fits well with depth and flow requirements dictated by Maricopa County. In order to maintain hydraulic conditions with a velocity of no more than two ft/s, the slope of the canal can be no more than 0.12%.

3.1.4 Overflow Storage

As a preliminary design, the pumping system has been sized (see section 3.2) to require very limited storage. An overflow system should be provided in the event that the pumping system goes offline. If the pump goes offline, the first requirement will be to block the scuppers at the upstream end of the watercourse from discharging additional flow to the system. Once that is completed, there are two possible options to drain the watercourse. The first alternative is to install an underground storage tank at the downstream end that could retain the entire canal volume of 5,600 cubic feet. A second option is to have an overflow into a storm drain that connects with a City of Phoenix storm drain. At this time there is no storm drain in the vicinity to tie into; however, it is likely with the development in the area that one will be designed in the future.





SECTION C-C
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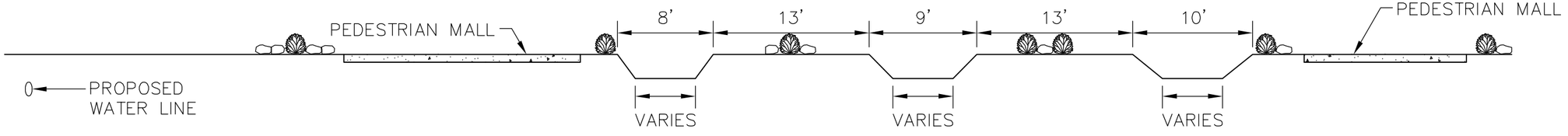

SECTION D-D
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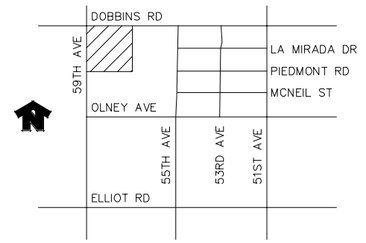


VICINITY MAP
N.T.S.

GRAPHIC SCALE
30 0 15 30 60
(IN FEET)

LEGEND:

PROPOSED WATER LINE (POTABLE) —W—

PROPOSED RECIRCULATION WATER LINE —R—

WATER SURFACE ELEVATION ▽ =

STORM DRAIN

SUBMITTAL
15% PRELIMINARY
NOT FOR CONSTRUCTION

Kimley-Horn and Associates, Inc.

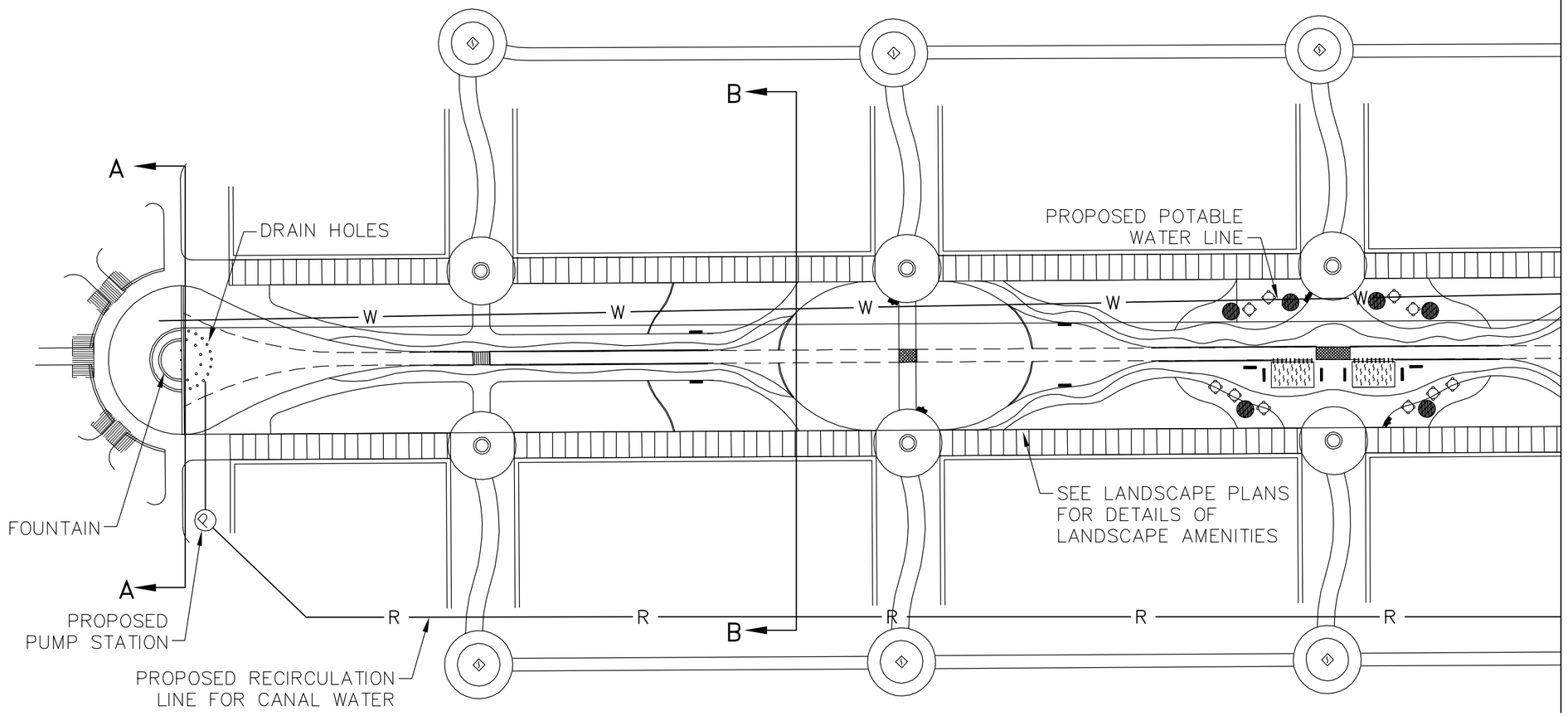
7878 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500

LAVEEN VILLAGE
CITY OF PHOENIX, ARIZONA

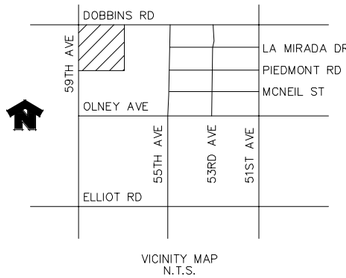
PEDESTRIAN WATERCOURSE DEMONSTRATION PROJECT

SITE PLAN

DR	DES	CK	SHEET NO	TOTAL SHEETS
PAC	PAC	LSM	H-2	4
DATE 12/05	DATE 12/05	DATE 12/05		



MATCHLINE SEE SHEET H-2



VICINITY MAP
N.T.S.

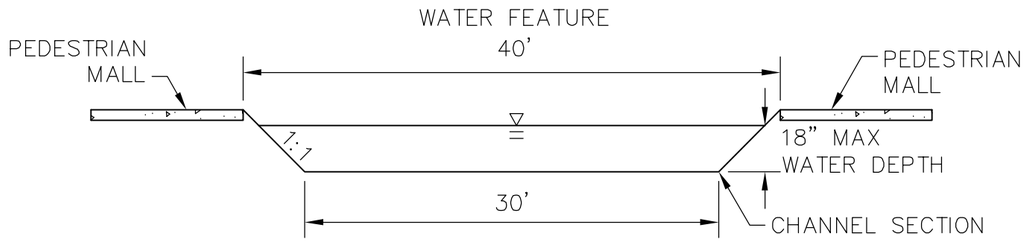
GRAPHIC SCALE
30 0 15 30 60
(IN FEET)

LEGEND:

PROPOSED WATER LINE (POTABLE) ——W——

PROPOSED RECIRCULATION WATER LINE ——R——

WATER SURFACE ELEVATION ▽



SECTION A-A
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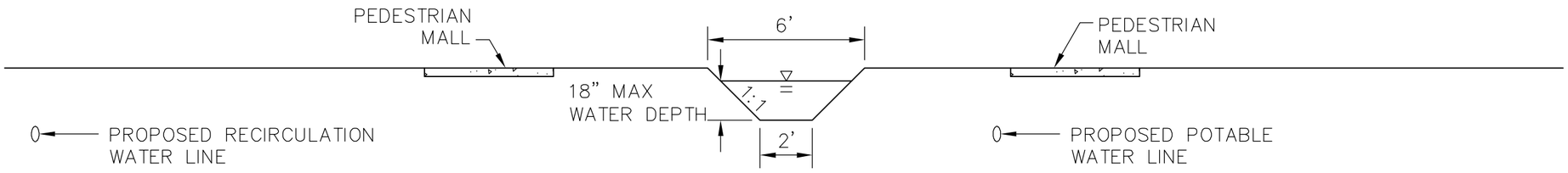

SECTION B-B
N.T.S.

SUBMITTAL
15%
PRELIMINARY
NOT FOR
CONSTRUCTION

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Phoenix, Arizona 85020 (602) 944-5500

LAVEEN VILLAGE
CITY OF PHOENIX, ARIZONA

PEDESTRIAN WATERCOURSE
DEMONSTRATION PROJECT

SITE PLAN

DR	DES	CK	SHEET	TOTAL
PAC	PAC	LSM	NO	SHEETS
DATE 12/05	DATE 12/05	DATE 12/05	H-3	4

3.2 Pump System

As previously explained, the water that flows through the canal will be conveyed from the lower water feature back up to Pioneer Lake through a pump system. Because limited storage will be available at the downstream end of the water feature, the pumping system will be required to manage the entire eight cfs, or 3,590 gallons per minute (gpm) as the canal.

The City of Phoenix specifies that ductile iron pipe should be used for the re-circulation pipe. The total head loss in the pipe is the sum of the friction head generated by the flow through the pipe, the change in elevation, and any minor losses throughout the system. The size of the pipe, and the size of the pump/motor are interrelated—a smaller pipe requires a larger pump to overcome the friction forces within the pipe. With the flow and pressure requirements needed to re-circulate the water for the watercourse system, it is recommended that a single pump with a 12-inch pipe be used with a 150 horsepower motor. **Appendix D** provides the pump and pipe calculations.

3.3 Water Supply Sources

Both potable and non-potable water will be required for the watercourse. The fountains will utilize potable water, while the canal will use non-potable water that is to be re-circulated by a pump.

3.3.1 Culinary Water Source

It is proposed that potable water be obtained from the City of Phoenix culinary water system. **Figure H-4** provides two possible alignments for potable water to the watercourse.

The first alignment alternative extends along Dobbins Road from the existing waterline at the intersection of 55th Avenue and Dobbins Road. The second alignment alternative connects into the waterline along 55th Avenue at the quarter section line and extends west to the pistache grove. Both of these alignment alternatives would require approximately 2,000 feet of pipe. The amount of potable water required for the two fountains amenities will be determined by the landscape architect as part of their design.

3.3.2 Non-Potable Water Source

SRP maintains several irrigation canals in the Laveen area near the proposed Town Center. These canals may serve as a potential source of non-potable water. These canals currently deliver irrigation water to property owners in the area; however, rights to this water belong to local property owners and not to SRP, so use of this water for the proposed project would require coordination with the City of Phoenix and nearby property owners.

Non-potable water from SRP irrigation canals may be obtained in two ways.

The first alternative is for the City of Phoenix to obtain water rights to water currently used for irrigation purposes. When farmland is developed, water rights are often turned over to the City for municipal use at water treatment plants. With the development of this project the water rights for this property shall be turned over to the City of Phoenix. It is possible that as development in this area occurs, these water rights and some of the other water allotments from the area could be set aside for use in this water feature.

The second option involves using part of the City's water allotment which is transported via SRP canals.

DOBBINS ROAD

59TH AVENUE

PROPOSED LAND PLAN FROM LEADS
(LAND ENTITLEMENT AND
DEVELOPMENT SERVICES, INC.)

PIONEER LAKE

PROPOSED LAND PLAN FROM LEADS
(LAND ENTITLEMENT AND
DEVELOPMENT SERVICES, INC.)

Multi-Family
Residential

POTABLE WATER LINE
ALTERNATIVE 1

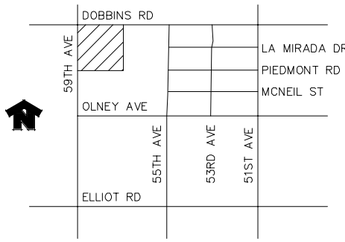
Multi-Family
Residential

PROPOSED LAND PLAN FROM LEADS
(LAND ENTITLEMENT AND
DEVELOPMENT SERVICES, INC.)

57TH AVENUE

POTABLE WATER LINE
ALTERNATIVE 2

55TH AVENUE



VICINITY MAP
N.T.S.

GRAPHIC SCALE
100 0 50 100 200
(IN FEET)

LEGEND:

PROPOSED WATER LINE (POTABLE) — W —

PROPOSED RECIRCULATION WATER LINE — R —

EXISTING COP WATER LINE (POTABLE) — W —

EXISTING SRP CANAL — SRP —

CONCEPTUAL COMMUNITY PLAN PROVIDED BY CITY OF PHOENIX

SUBMITTAL
15%
PRELIMINARY
NOT FOR
CONSTRUCTION

Kimley-Horn and Associates, Inc.

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Phoenix, Arizona 85020 (602) 944-5500

LAVEEN VILLAGE
CITY OF PHOENIX, ARIZONA

PEDESTRIAN WATERCOURSE
DEMONSTRATION PROJECT

POTENTIAL WATER SOURCES
AND ALIGNMENTS

DR	DES	CK	SHEET	TOTAL
PAC	PAC	LSM	NO	SHEETS
DATE	DATE	DATE	H-4	4
12/05	12/05	12/05		

K:\~Systems\091980003-MAG_Ped_(Laveen)\CADD\980003PWSA.dwg Dec 20, 2005 Jaron.Hasenbalg

SRP delivers water every two weeks during the summer months, and once a month during the winter months. Under both non-potable water sources explained in Section 3.3.2, Pioneer Lake will have to be sized such that variations in volume will not adversely affect the water feature, and recognize that the exact time of water delivery can vary.

3.3.3 Evaporation Loss

Evaporation losses experienced by open water bodies in the Phoenix area amount to 6.2 feet per year for every acre of surface area (see **Appendix C**). Over a period of 12 months, evaporation will cause the surface elevation of any given body of water in this area to lower by 6.2 feet, if none of the evaporated water is replaced. A lake of approximately one acre in surface area should provide enough water to compensate for evaporative losses, and to keep the watercourse full between SRP deliveries. Because the water in the canal is re-circulated, the non-potable water requirement (after the system is filled initially) will be largely dictated by evaporation losses. Given that Pioneer Lake will be approximately one acre in size, the non-potable water demand will be approximately 6.2 acre-feet per year. **Appendix C** provides the water supply calculations.

3.3.4 Non-potable Water Emergency Overflow

SRP facilities could potentially be used as an outlet for emergency overflow from the water feature. This option presents two main concerns. The first concern relates to the capacity of SRP facilities. As farmland is developed, irrigation canals are often converted to underground pipelines. If these pipelines are to be used for overflow conveyance, they would have to have enough capacity to handle both the regular SRP delivery rate, as well as any overflow that may come from the watercourse.

A second concern relates to the quality of overflow water coming out of the watercourse. SRP is not able to control the environmental quality of the water once it leaves their system. Trying to reintroduce overflow from the watercourse back into the SRP system may therefore raise National Pollutant Discharge Elimination System (NPDES) issues. According to SRP, coordination with the Arizona Department of Environmental Quality (ADEQ) will be necessary in order to determine any permitting requirements.

Another option for emergency overflow would be to allow it to flow into a storm drain system that would likely be constructed as part of the development of this area. This option would require that the storm drain be sized to handle this excess capacity.

4. PEDESTRIAN CROSSING ALTERNATIVES

It is envisioned that the Laveen Town Center will become a destination where people will gather to eat, work, shop, and live. The intersection of 59th Avenue and Dobbins Road is the point where pedestrians from the Commercial Core and surrounding area will access the amenities of the Town Center; therefore, this intersection must be developed to encourage pedestrian access.

There are two primary alternatives for accommodating the pedestrian traffic at this intersection. The first option is to construct an at grade crossing (e.g. crosswalk). The second option is to construct a grade-separated crossing (e.g. pedestrian bridge). Several options exist within these two alternatives that will be explored to provide access between the pedestrian mall on the southeast corner and the Commercial Core on the northwest corner.

All of the design elements of the intersection of 59th Avenue and Dobbins Road will need to be approved by the City of Phoenix Street Transportation Department, and adhere to the pedestrian design considerations in the following documents:

- MAG Pedestrian Policies and Design Guidelines, 2005; and
- Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.

As design of the Commercial Core and the Town Center are finalized, significant consideration must be given to pedestrian crossing alternatives at the intersection of 59th Avenue and Dobbins Road.

4.1 At Grade Crossing Alternative

An at grade pedestrian crossing at a signalized intersection is the most common intersection crossing solution used within the MAG Region. This system provides a signalized pedestrian indication, a transition ramp from the sidewalk to roadway surface, and a crosswalk defined to both the pedestrian and driver. It is anticipated that contingent with the development of the Town Center and surrounding area, the intersection of 59th Avenue and Dobbins Road will require signalization. A signal warrant analysis will need to be completed for this intersection prior to installation of a traffic signal. Until the point in time that a traffic signal is warranted, the intersection will operate under a two-way or four-way stop condition, dependent upon traffic volumes. To provide an appropriate pedestrian crossing environment the following design criteria must be included in the final intersection design:

- Provide sufficient lighting;
- Directional pedestrian ramps;
- Detectable warning strips;
- Fifteen-foot wide crosswalk widths; and
- When signalized, sufficient pedestrian crossing time shall be provided.

Once the above requirements have been met there are primarily two alternatives—either a striped crosswalk or a decorative crosswalk.

There are advantages and disadvantages associated with both of these alternatives. The primary advantage associated with the striped crosswalk includes lower installation and maintenance costs. The disadvantage of a striped crosswalk is that there is little aesthetic value; therefore, this crossing treatment does not help to tie the four corners of the intersection together as a cohesive place. The advantage associated with the decorative crosswalk addresses the shortcomings of the striped crosswalk because materials, patterns, and colors can be used that capture the character of the Laveen Town Center and tie the four quadrants of the intersection together; however, there

are significant disadvantages associated with the decorative crosswalk alternative. These disadvantages include an increase in traffic noise due to the use of either a paver or concrete surface and additional installation and maintenance costs.

Through discussions with the City of Phoenix Street Transportation Department, concerns with increased traffic noise were raised due to the proximity of the proposed Loop 202 Corridor, approximately one quarter-mile west of the 59th Avenue and Dobbins Road intersection. The freeway corridor alone will introduce increased traffic noise to this area. In order to minimize additional noise for the residents anticipated to live in this area it was recommended that decorative crosswalks not be installed at this intersection. In addition, the Street Transportation Department mentioned that as maintenance of the crosswalk is required in the future it will most likely be maintained utilizing asphalt and crosswalk striping. In effect, over time, the aesthetic qualities of the decorative crosswalk would be lost as asphalt and striping is applied.

4.2 Grade Separated Crossing Alternative

The second pedestrian crossing alternative is a grade separated pedestrian crossing. At a minimum, to provide access between the Commercial Core and the Town Center, the pedestrian bridge will need to provide access between the northwest and southeast quadrants of the intersection (a pedestrian bridge also could be provided crossing each of the legs of the intersection, with a significant increase in cost). The minimum requirement was assumed in order to provide an appropriate minimum cost for a grade separated treatment. In addition, even with the installation of a grade separated facility, the at grade crossing alternative, as discussed previously in Section 3.1, also will need to be installed unless pedestrian access to the intersection can be completely restricted with physical barriers.

This analysis assumes that a pedestrian truss bridge will be constructed to span the intersection from the southeast corner to the northwest corner. The walking surface of the bridge will need to be approximately 22.5 feet above the roadway surface and will be nine feet in width. The 22.5-foot high walking surface allows for the supporting members below the deck of the bridge to provide a sufficient height providing adequate sight clearance for passenger vehicles to view upcoming traffic signal heads mounted at a mast arm height of 21 feet. In order to access the bridge deck, stairs, and an elevator at each end of the bridge will be constructed and incorporated into the landscaping providing an attractive and simple access for all pedestrians to utilize the bridge. The stairs rising to the bridge must be in compliance with Americans with Disabilities Act (ADA) standards—the step dimensions used in this analysis are 11 inches high by 11 inches deep.

The feasibility of an ADA compliant ramp was also investigated to be used for access to the bridge deck. This was found to require approximately 260 lineal feet of space, which would then extend into and impact the character of the pedestrian mall. For this reason this alternative was not considered feasible.

The intersection will have to be signalized and striped to accommodate pedestrians for both grade separated and at grade alternatives; therefore, the difference is in the cost of the bridge. A 180-foot prefabricated steel truss bridge including deck, abutments, foundations, and elevators is anticipated to cost between $3,000,000 and $4,000,000. This estimate was determined by reviewing construction costs for pedestrian bridges that the City of Phoenix has recently designed and/or constructed.

The advantages associated with the use of the pedestrian bridge include a safer manner for pedestrians to traverse the intersection and a reduction in the travel time from the Town Center to the Commercial Core (see Section 4.3). The disadvantages associated with the installation of the

pedestrian bridge include cost, lack of use, and the entrance to the Town Center will be blocked from the view of people on other corners of the intersection. Pedestrians tend not to use grade separated crossings, when an at grade crossing option is available. The view will be obstructed due to the installation of the bridge abutments, stairs, and elevator shafts on the southeast and northwest corners.

4.3 Travel Time Analysis

According to MAG, as stated in the *Pedestrian Policies and Design Guidelines*, dated April 2005, the travel time for the at grade crossing alternative for a pedestrian to cross from the southeast corner to the northwest corner is approximately 100 seconds; this assumes a 120 second cycle length. Assuming the pedestrian crosses one leg of the intersection and then has to wait for the end of the 60-second ped-phase cycle at the first corner, and then continues at an average walk speed of 2.8 ft/s across the final leg of the intersection.

According to the US Army Corps of Engineers, as stated in *Technical Instructions – Elevator Systems*, dated August 1998, the total travel time for pedestrians to cross the bridge from entrance to exit is 102 seconds for those using the stairs, and 106 seconds for pedestrians using the elevator. Once again the average walking speed used in the calculation was 2.8 ft/s and an elevator speed of 2.46 ft/s.

The pedestrian bridge causes a slight increase in travel time for pedestrians who utilize the stairs or elevator, versus those pedestrians who cross at grade.

4.4 Recommended Pedestrian Crossing Alternative

The Town Center is being designed to invite people to walk along the channel, visit the shops, restaurants, and learn about the history of Laveen.

An at grade crossing alternative provides a typical crossing for pedestrians and allows the pedestrians to cross in all directions. The major drawback to this alternative is that pedestrians are exposed to crossing traffic.

The grade separated crossing alternative provides safe crossing for pedestrians crossing from the pedestrian mall to the Commercial Core. Unfortunately, this only allows the one crossing movement. The faster walking time makes this an unattractive alternative; and in addition, the cost is much more than the at grade alternative. Finally, the construction of large concrete structures at the entrance to the pedestrian mall is not consistent with the goals of the project.

Considering the above-stated advantages and disadvantages, it is recommended that a 15-foot wide, at grade pedestrian crossing facility, across all four legs of the intersection be constructed. The crosswalk should conform to current City of Phoenix Pavement Marking Standards. Based on the input received from the Street Transportation Department, the freedom to cross in any direction and the additional $3,000,000 to $4,000,000 savings in cost best fits the needs for the community.

4.5 Additional At Grade Crossing Pedestrian Amenities

As the intersection of 59th Avenue and Dobbins Road is anticipated to be an area of high pedestrian activity, every effort must be made to make it functional and comfortable for pedestrians. It is recommended that the following device be considered in consultation with the City of Phoenix Street Transportation Department.

Countdown Pedestrian Signals

Countdown Pedestrian Signals should be considered for installation at the intersection of 59th Avenue and Dobbins Road. The City of Phoenix has received positive feedback from intersections where this technology has been deployed. The countdown feature provides useful information on the crossing time remaining to pedestrians crossing the intersection.

5. ESTIMATE OF PROBABLE COST

An estimate of probable cost for landscape and hydraulic features was developed. **Table 1** contains a break-down of cost elements by category. A detailed cost estimate by quantity is presented in **Appendix D**. The estimate of probable cost for construction of the Central Laveen Commercial District Watercourse Demonstration Project is $3,201,052.00.

Table 1 – Estimate of Probable Cost

Item Description	Amount
Sub-Total Site Prep	$22,950.00
Sub-Total Traffic Control	$8,500.00
Sub-Total Landscape	$746,267.50
Sub-Total Irrigation	$127,505.50
Sub-Total Site Feature Items	$846,025.00
Sub-Total Hydraulic Items	$152,486.00
Sub-Total Pedestrian Crossing Items	$200,000.00
Sub-Total Miscellaneous Items	$118,500.00
Total Direct Construction Cost	$2,222,234.00
Overhead and Indirect Costs	$978,818.00
Total Construction Cost	**$3,201,052.00**

6. REFERENCES

Maricopa County. Planning and Development Department. One Stop Shop. *Pool and Pool Barrier Requirements* 24 July 2003. 12 July 2005 <www.maricopa.gov/planning>.

United States. Department of the Interior. Bureau of Reclamation. *Downstream Hazard Classification Guidelines*. Denver: Department of the Interior, 1988.

Henderson, F.M. *Open Channel Flow*. Upper Saddle River: Prentice-Hall, Inc., 1966.

Robertson, J., J. Cassidy, and M. Chaudhry. *Hydraulic Engineering*. New York: John Wiley & Sons, Inc., 1998.

Maricopa County. Maricopa Association of Governments. *Pedestrian Policies and Design Guidelines*. Phoenix: Maricopa Association of Governments, 2005.

United States. Americans with Disabilities Act. *Accessibility Guidelines for Buildings and Facilities*. Washington, D.C.: U.S. Architectural and Transportation Barriers Compliance Board (Access Board), 2002.

United States. Army Corps of Engineers. *Technical Instructions – Elevator Systems*. Washington, D.C.: US Army Corps of Engineers

APPENDIX A – REFERENCE MATERIALS

Planning & Development Department

POOL & POOL BARRIER REQUIREMENTS

ONE STOP SHOP

POOL REQUIREMENTS
All fishponds, spas and other contained bodies of water, either above or below ground level, being 18 inches or more in depth, and/or wider than eight feet at any two measured points, shall require a barrier.
Pools must be located in the rear or side yard of the property.
Pools must be set back at least three feet from all property lines.
Permits for outdoor swimming pool barriers must be issued prior to installing the barrier, plastering the pool, and/or filling the pool with water.
POOL BARRIER REQUIREMENTS
The top of a barrier should be at least 60 inches above finished grade (exterior side of barrier).
The maximum gap between the bottom of the barrier and finished grade shall be two inches. For a solid base grade, such as concrete, the gap may be four inches.
If a barrier is constructed with horizontal members less than 54 inches apart, such members must be placed on the interior side of the barrier.
Decorative design work that allows for easy climbing on the exterior barrier is prohibited.
Protective barriers must be located at least 54 inches from any exterior object that could be used to climb the protective barrier.
The owner will ensure that the entire barrier is maintained. No section may be altered or removed except to reconstruct, repair or replace the barrier.
Barrier openings are restricted to one and three quarter inches.
If chain link fencing is used as a barrier, it must be eleven gauge or greater.
Openings in the barrier shall not allow passage of a one and three quarter inch diameter (44.5 mm) sphere. Exception: o When vertical spacing between such openings is 54 inches (1143 mm) or more, the opening size may be increased such that the passage of a 4-inch diameter (102mm) sphere is not allowed. o For fencing composed of vertical and horizontal members, the spacing between vertical members may be increased up to 4 inches (102 mm) when the distance between the tops of horizontal members is 54 inches (1143 mm) or more.
Access gates will comply with all pool barrier requirements and will be equipped with self-closing, self-latching devices. All access gates must open away from the pool.
When the latching mechanism is less than 54 inches above ground, it must be on the poolside of the gate and at least three inches below the top of the gate.
If the building wall comprises a part of the pool barrier and subject wall contains a door providing direct access to the pool area, a separate barrier shall be installed between the door and the pool. Exception: The building official may approve the substitution of a self-closing, self-latching device with a release mechanism at least 54 inches above ground; or an alarm which sounds continuously for a minimum of 30 seconds at a level not less than 85 decibels, within seven seconds of the door or the screen being opened.

411 North Central Avenue, 3rd Floor ▪ Phoenix AZ 85004-2191 ▪ (602) 506-3301 ▪ (602) 506-3601 fax
≻Internet: www.maricopa.gov/planning≺
07/24/03

POOL BARRIER REQUIREMENTS CONTINUED
A window facing a pool enclosure shall be equipped with a mesh screen and a lock and key that restricts opening the window to no more than four inches or a latching device 54 inches above the floor.
Emergency escape or rescue windows must be equipped with a latching device at least 54 inches from the floor.
Call (602) 506-7147 for additional information

ACER TECHNICAL MEMORANDUM NO. 11
ASSISTANT COMMISSIONER - ENGINEERING AND RESEARCH
DENVER, COLORADO

DOWNSTREAM HAZARD CLASSIFICATION GUIDELINES

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
1988

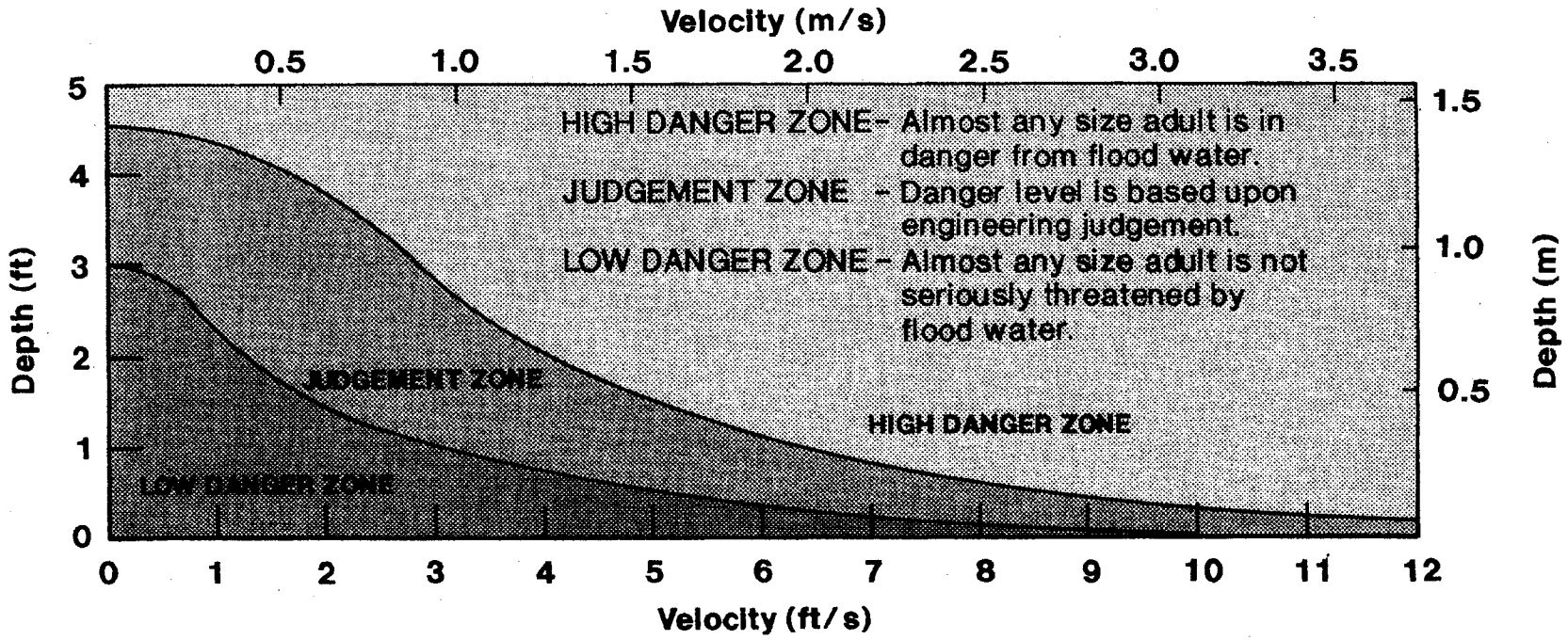


Figure 5. – Depth–velocity flood danger level relationship for adults.

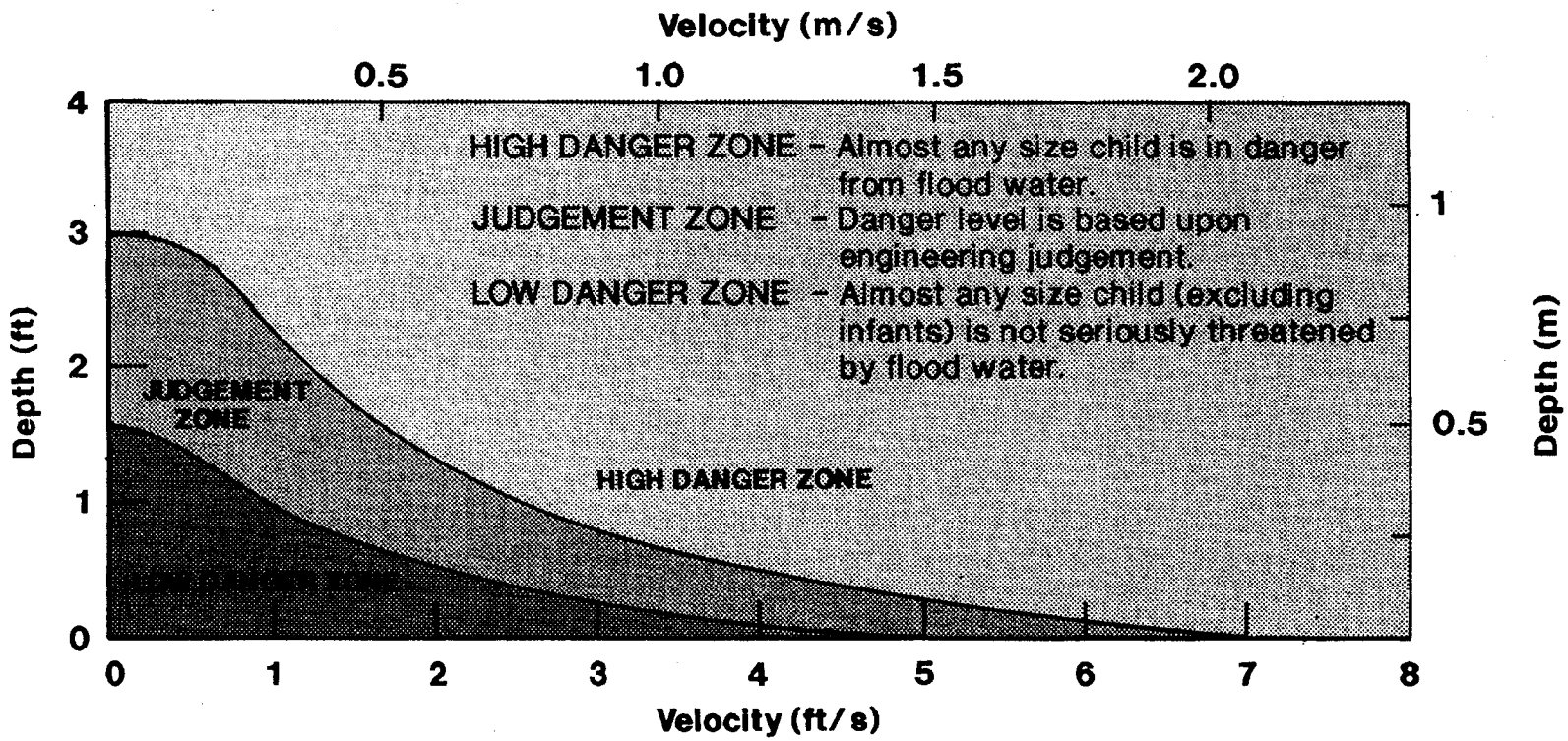


Figure 6. – Depth–velocity flood danger level relationship for children.

APPENDIX B – DESIGN CALCULATIONS: CANAL

"River Experience" Area

Flow Requirements

Depth [ft]	V_{max} [ft/s]	Area [ft^2]	Area [cfs]
1	2	3.75	7.5

=> Use 8cfs at 1.27 ft in depth

Width between boulders

Assumptions: Rectangular opening at critical flow

Depth [ft]	q [cfs/ft]
1.5	2

$$E = y + \frac{V^2}{2g} = E_C$$

$$q = \sqrt{gy^3}$$

=> Use 18 inches between boulders

Lower Reach Gradually Varied Flow Profile

Bottom width (ft) =	2	**Discharge (cfs) =**	8	**g (ft/s^2) =**	32.2
Side slopes (H:V) =	1	**Initial station (ft) =**	0	**c =**	1.49
Bottom slope(ft/ft) =	0.0012	**Initial bottom elev. (ft) =**	0	**y_o (ft) =**	1.5
Manning n =	0.02	**Initial depth (ft) =**	1.5		
		Depth step (ft)	-0.03		

Channel Depth (y) (ft)	Cross Sectional Area (ft^2)	Velocity (ft/s)	Energy (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Friction Slope (ft/ft)	Average Friction Slope (ft/ft)	dx (ft)	x (ft)	z (ft)	y+z (ft)	Momentum (ft^3)
1.50	5.25	1.52	1.54	6.24	0.84	0.00053			0.00	0.00	1.50	3.75
1.47	5.12	1.56	1.51	6.17	0.83	0.00056	0.000545	-36.00	-36.00	0.04	1.52	3.63
1.45	5.00	1.60	1.49	6.10	0.82	0.00060	0.000582	-37.99	-73.99	0.09	1.54	3.51
1.42	4.88	1.64	1.47	6.03	0.81	0.00064	0.000623	-40.43	-114.43	0.14	1.56	3.40
1.40	4.75	1.68	1.44	5.96	0.80	0.00069	0.000667	-43.51	-157.94	0.19	1.59	3.29
1.37	4.63	1.73	1.42	5.88	0.79	0.00074	0.000715	-47.50	-205.44	0.25	1.62	3.18
1.35	4.51	1.77	1.40	5.81	0.78	0.00079	0.000767	-52.84	-258.28	0.31	1.66	3.07
1.32	4.39	1.82	1.37	5.74	0.77	0.00085	0.000824	-60.37	-318.65	0.38	1.70	2.97
1.30	4.28	1.87	1.35	5.67	0.75	0.00092	0.000886	-71.72	-390.37	0.47	1.77	2.87
1.27	4.16	1.92	1.33	5.60	0.74	0.00099	0.000954	-90.72	-481.08	0.58	1.85	2.78
1.25	4.05	1.98	1.31	5.52	0.73	0.00107	0.001029	-128.92	-610.00	0.73	1.98	2.69

Upper Reach Gradually Varied Flow Profile

Bottom width (ft) =	2	**Discharge (cfs) =**	8	**g (ft/s^2)=**	32.2
Side slopes (H:V) =	1	**Initial station (ft) =**	0	**c =**	1.49
Bottom slope(ft/ft) =	0.0012	**Initial bottom elev. (ft) =**	0	**$y_{o\,(ft)}$ =**	1.5
Manning n =	0.02	**Initial depth (ft) =**	1.5		
		Depth step (ft)	-0.01		

Channel Depth (y) (ft)	Cross Sectional Area (ft^2)	Velocity (ft/s)	Energy (ft)	Wetted Perimeter (ft)	Hydraluic Radius (ft)	Friction Slope (ft/ft)	Average Friction Slope (ft/ft)	dx (ft)	x (ft)	z (ft)	y+z (ft)	M (ft^4)
1.50	5.25	1.52	1.54	6.24	0.84	0.001			0.00	0.00	1.50	3.75
1.49	5.21	1.54	1.53	6.22	0.84	0.001	0.001	-12.34	-12.34	0.01	1.51	3.71
1.48	5.16	1.55	1.52	6.19	0.83	0.001	0.001	-12.55	-24.89	0.03	1.51	3.67
1.47	5.12	1.56	1.51	6.17	0.83	0.001	0.001	-12.77	-37.66	0.05	1.52	3.63
1.46	5.07	1.58	1.50	6.14	0.83	0.001	0.001	-13.02	-50.68	0.06	1.53	3.58
1.46	5.03	1.59	1.50	6.12	0.82	0.001	0.001	-13.28	-63.95	0.08	1.53	3.54
1.45	4.99	1.60	1.49	6.09	0.82	0.001	0.001	-13.56	-77.51	0.09	1.54	3.50
1.44	4.94	1.62	1.48	6.07	0.81	0.001	0.001	-13.86	-91.36	0.11	1.55	3.46
1.43	4.90	1.63	1.47	6.04	0.81	0.001	0.001	-14.18	-105.55	0.13	1.56	3.42
1.42	4.86	1.65	1.46	6.02	0.81	0.001	0.001	-14.53	-120.08	0.14	1.56	3.38
1.41	4.82	1.66	1.45	5.99	0.80	0.001	0.001	-14.92	-135.00	0.16	1.57	3.34

Worksheet for Trapezoidal Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.00100	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	8.00	ft^3/s

Results

Normal Depth	1.27	ft
Flow Area	4.15	ft^2
Wetted Perimeter	5.59	ft
Top Width	4.54	ft
Critical Depth	0.70	ft
Critical Slope	0.00874	ft/ft
Velocity	1.93	ft/s
Velocity Head	0.06	ft
Specific Energy	1.33	ft
Froude Number	0.36	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	0.70	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.00874	ft/ft

Cross Section for Trapezoidal Channel - 1

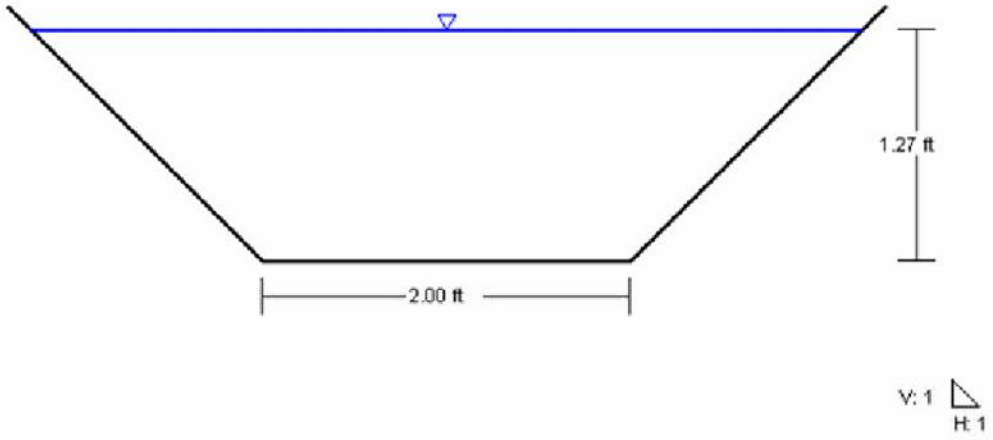
Project Description

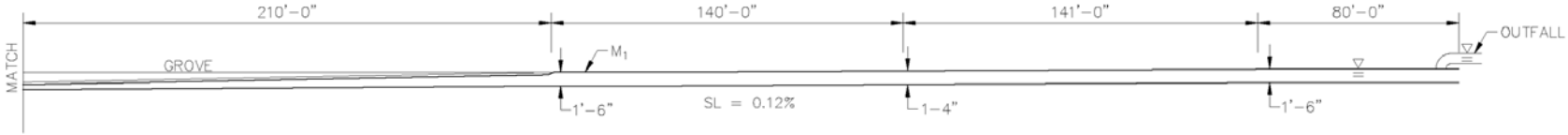
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

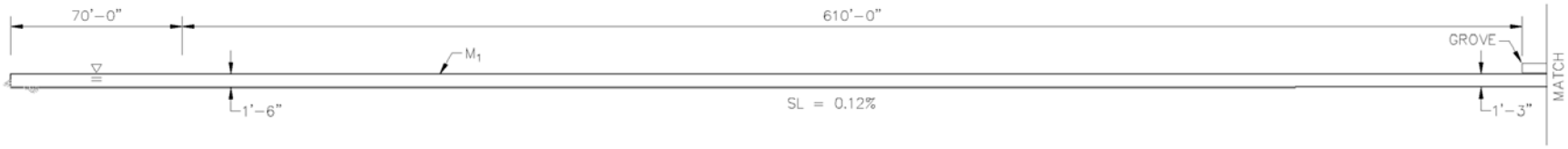
Roughness Coefficient	0.020	
Channel Slope	0.00100	ft/ft
Normal Depth	1.27	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	8.00	ft³/s

Cross Section Image





UPPER REACH FROM GRADUALLY VARIED FLOW TABLE
NOT TO SCALE



LOWER REACH FROM GRADUALLY VARIED FLOW TABLE
NOT TO SCALE

1

CURRENT DATE: 07-12-2005
CURRENT TIME: 12:23:20

FILE DATE: 07-12-2005
FILE NAME: LAVEEN

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA: INLET ELEV. (ft)	SITE DATA: OUTLET ELEV. (ft)	SITE DATA: CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	98.00	196.01	1 RCP	1.50	1.50	.010	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: LAVEEN DATE: 07-12-2005

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
100.48	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.00	1
100.72	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.00	1
100.92	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.08	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.23	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.37	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.45	7.0	6.5	0.0	0.0	0.0	0.0	0.0	0.00	30
101.52	8.0	7.0	0.0	0.0	0.0	0.0	0.0	0.89	25
101.53	9.0	7.1	0.0	0.0	0.0	0.0	0.0	1.81	10
101.54	10.0	7.2	0.0	0.0	0.0	0.0	0.0	2.72	8
101.50	6.9	6.9	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: LAVEEN DATE: 07-12-2005

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
100.00	0.000	0.00	0.00	0.00
100.48	0.000	1.00	0.00	0.00
100.72	0.000	2.00	0.00	0.00
100.92	0.000	3.00	0.00	0.00
101.08	0.000	4.00	0.00	0.00
101.23	0.000	5.00	0.00	0.00
101.37	0.000	6.00	0.00	0.00
101.45	-0.002	7.00	0.47	6.71
101.52	0.000	8.00	0.08	1.00
101.53	0.000	9.00	0.07	0.78
101.54	0.000	10.00	0.09	0.90

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 07-12-2005
CURRENT TIME: 12:23:20

FILE DATE: 07-12-2005
FILE NAME: LAVEEN

PERFORMANCE CURVE FOR CULVERT 1 - 1(1.50 (ft) BY 1.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	0.00	0-NF	0.00	0.00	0.00	-3.00	0.00	0.00
1.00	100.48	0.48	0.48	1-S2n	0.27	0.37	0.17	-2.69	11.00	1.42
2.00	100.72	0.72	0.72	1-S2n	0.38	0.53	0.38	-2.54	5.66	1.77
3.00	100.92	0.92	0.92	1-S2n	0.47	0.65	0.35	-2.42	9.30	2.00
4.00	101.08	1.08	1.08	1-S2n	0.55	0.76	0.46	-2.32	8.62	2.17
5.00	101.23	1.23	1.23	1-S2n	0.62	0.86	0.56	-2.22	8.34	2.32
6.00	101.37	1.37	1.37	1-S2n	0.69	0.94	0.68	-2.14	7.65	2.44
6.53	101.45	1.45	1.45	1-S2n	0.73	0.99	0.73	-2.06	7.68	2.55
7.03	101.52	1.52	1.52	5-S2n	0.76	1.03	0.76	-1.99	7.83	2.64
7.12	101.53	1.53	1.53	5-S2n	0.76	1.03	0.77	-1.93	7.85	2.73
7.19	101.54	1.54	1.54	5-S2n	0.77	1.04	0.77	-1.86	7.88	2.81

El. inlet face invert 100.00 ft El. outlet invert 98.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** EMBANKMENT TOE **********

UPSTREAM STATION	0.00 ft
UPSTREAM ELEVATION	100.00 ft
UPSTREAM EMBANKMENT SLOPE (X:1)	0.00
DOWMSTREAM STATION	196.00 ft
DOWNSTREAM ELEVATION	98.00 ft
DOWNSTREAM EMBANKMENT SLOPE (X:1)	0.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	1.50 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.010
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 07-12-2005
CURRENT TIME: 12:23:20

FILE DATE: 07-12-2005
FILE NAME: LAVEEN

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	2.00 ft
SIDE SLOPE H/V (X:1)	1.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.013
CHANNEL INVERT ELEVATION	95.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	98.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	95.00	0.000	0.00	0.00	0.00
1.00	95.31	0.452	0.31	1.42	0.02
2.00	95.46	0.460	0.46	1.77	0.03
3.00	95.58	0.462	0.58	2.00	0.04
4.00	95.68	0.463	0.68	2.17	0.04
5.00	95.78	0.463	0.78	2.32	0.05
6.00	95.86	0.464	0.86	2.44	0.05
7.00	95.94	0.464	0.94	2.55	0.06
8.00	96.01	0.464	1.01	2.64	0.06
9.00	96.07	0.464	1.07	2.73	0.07
10.00	96.14	0.464	1.14	2.81	0.07

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	186.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	101.50 ft

APPENDIX C – DESIGN CALCULATIONS: PUMP SYSTEM AND LAKE

Evaporation Rates

Method 1
This method was taken from the University of Arizona irrigation management series (Table 1, p.39)

Area = Arid Sub-Tropics
Temp > 30° C

=> Evaporation = 10mm/day = 0.0328 ft/day

Max Evaporation Rate = 11.71 ft/year

Method 2
This method uses the evaporation rate observed at the Tempe Town Lake (City of Tempe, AZ)

Evaporation Rate = 6.2 ft/year

System Evaporation

Since the pipe and channel volumes are small in comparison to the lake, it is assumed that their evaporation loss will be essentially zero in comparison.

Assumption: The Lake surface area will be one acre

Evaporation Rate = 6.2 ft/year (method 1, City of Tempe)
Evaporation Volume = 6.2 acre-feet/year

Daily Evaporation Volume = 270,072 ft^3/year = 739.9 ft^3/day

Worksheet
Worksheet for Pressure Pipe

Project Description	
Worksheet	pump_syst
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data		
Pressure at 2	0.00	feet H20
Elevation at 1	0.00	ft
Elevation at 2	6.00	ft
Length	1,500.00	ft
C Coefficient	130.0	
Diameter	12	in
Discharge	8.000	cfs

Results		
Pressure at 1	46.59	feet H20
Headloss	40.59	ft
Energy Grade at 1	48.20	ft
Energy Grade at 2	7.61	ft
Hydraulic Grade at 1	46.59	ft
Hydraulic Grade at 2	6.00	ft
Flow Area	0.8	ft^2
Wetted Perimeter	3.14	ft
Velocity	10.19	ft/s
Velocity Head	1.61	ft
Friction Slope	0.027058	ft/ft

Kimley-Horn and Associates, Inc
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

KIMLEY HORN
LAVEEN

AURORA PUMPS

Selection list: ---

Search Criteria:
Flow: 3600 US gpm
Head: 60 ft
Tolerance: --- % of head

Fluid: Water
Temperature: 60 °F
SG: 1
Viscosity: 1.105 cP
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: --- ft

Advanced Criteria:
Preferred Operating Area: ---
Secondary Operating Point: ---
Max temperature: --- °F
Max suction pressure: --- psi g
Max sphere size: --- in
Max power: --- bhp
Max suction specific speed: --- (Nss)
Min trim: --- % of max diameter
Min head rise: --- % to shutoff

Curve Corrections: none

Catalog: Aurora Pumps 60 Hz vers 2

Pump: 10x12x15B
Type: 410-HSC
Synch speed: 1200 rpm
Speed: 1170 rpm
Dia: 13.4375 in
Curve no.: PC-117402

Specific Speeds
Ns: 2674 Nss: 7821

Dimensions:
Suction: 12 in Discharge: 10 in

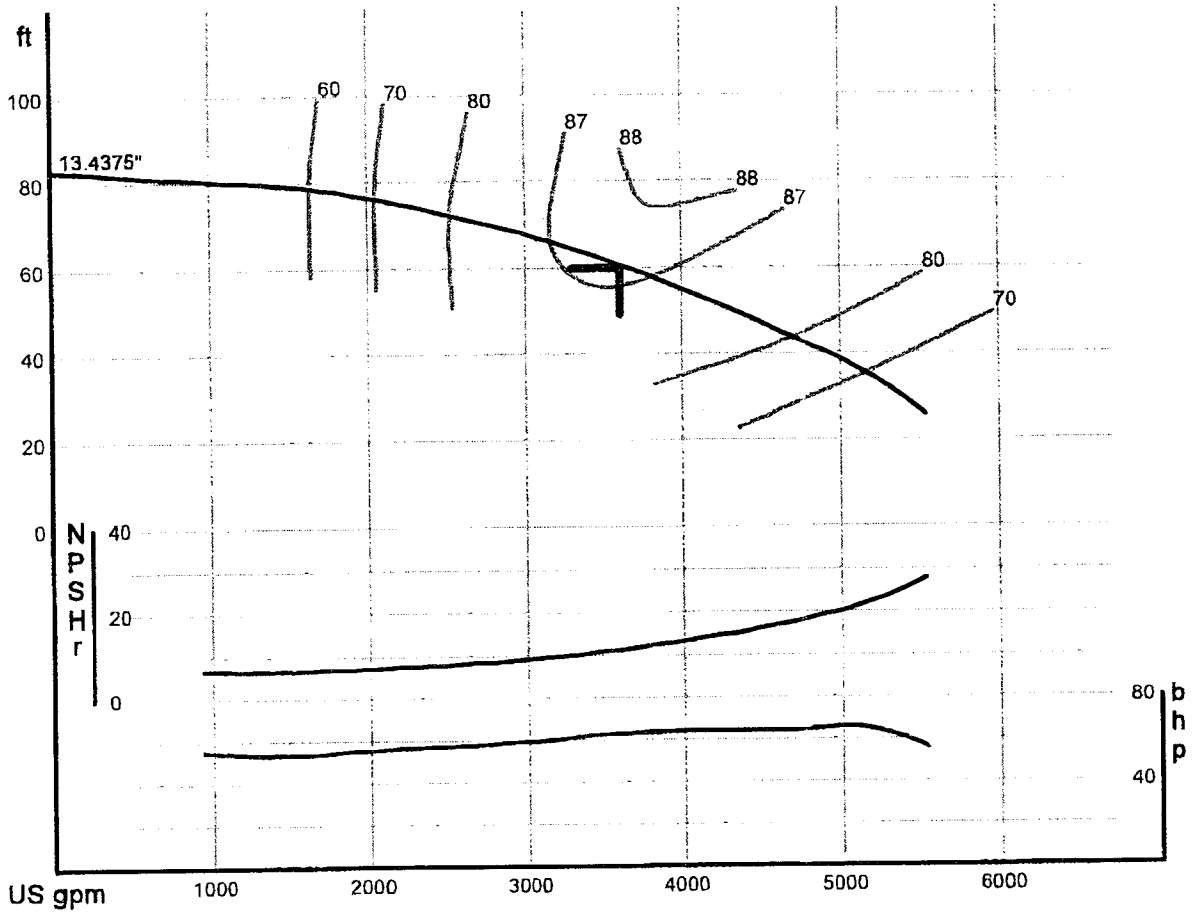
Pump Limits:
Temperature: 275 °F
Pressure: 250 psi g
Sphere size: 1.437 in
Power: --- bhp

Motor: 75 hp
Speed: 1200
Frame: 405T
Standard: NEMA
Enclosure: ODP
Sizing criteria: Max Power on Design Curve

---- Data Point ----
Flow: 3600 US gpm
Head: 60.6 ft
Eff: 87%
Power: 63.1 bhp
NPSHr: 11.6 ft

-- Design Curve --
Shutoff Head: 82.8 ft
Shutoff dP: 35.8 psi
Min Flow: --- US gpm
BEP: 87% eff
@ 3528 US gpm
NOL Pwr: 65.6 bhp
@ 5156 US gpm

-- Max Curve --
Max Pwr: 106 bhp
@ 5966 US gpm



KIMLEY HORN
LAVEEN

AURORA PUMPS

Selection list: ---

Catalog: Aurora Pumps 60 Hz vers 2

Pump: 10x12x15B

Performance Evaluation:

Flow	Speed	Head	Pump	Power	NPSHr	Motor	Motor	Hrs/yr	Cost
US gpm	rpm	ft	%eff	bhp	ft	%eff	kW		/kWh
4320	1170	49.7	83	64.2	15.6				
3600	1170	60.6	87	63.1	11.6				
2880	1170	68.8	84	59.2	9.12				
2160	1170	75.2	72	56.5	7.64				
1440	1170	79.1	53	54.4	7				

APPENDIX D – OPINION OF PROBABLE COST

OPINION OF PROBABLE COST

15% ESTIMATE

PROJECT LOCATION: 59TH AVENUE AND DOBBINS ROAD

PROJECT DESCRIPTION: CENTRAL LAVEEN COMMERCIAL DISTRICT WATERCOURSE

ITEM DESCRIPTION	UNIT	PRELIMINARY CONCEPT DESIGN		
		QUANTITY	UNIT PRICE	AMOUNT
SITE PREPARATION				
CLEARING AND GRUBBING	ACRE	26	$900.00	$22,950.00
SUB-TOTAL SITE PREP				**$22,950.00**
TRAFFIC CONTROL				
MAINTENANCE AND PROTECTION OF TRAFFIC	L. SUM	1	$5,000.00	$5,000.00
FURNISH AND INSTALL TEMPORARY TRAFFIC CONTROL DEVICES	L. SUM	1	$3,500.00	$3,500.00
SUB-TOTAL TRAFFIC CONTROL				**$8,500.00**
LANDSCAPE				
DECOMPOSED GRANITE (1/2" SCREENED 'GRANDE ROSE')	TON	245	$50.00	$12,250.00
DECOMPOSED GRANITE (1/4" MINUS 'GRANDE ROSE')(STABILIZED)	TON	246	$90.00	$22,140.00
BOULDER GRANITE (GRANDE ROSE) (2'X2')	EACH	99	$95.00	$9,405.00
BOULDER GRANITE (GRANDE ROSE) (3'X3')	EACH	130	$150.00	$19,500.00
BOULDER GRANITE (GRANDE ROSE) (4'X4')	EACH	138	$350.00	$48,300.00
TURF (SOD)	SQ. FT.	41934.00	$1.00	$41,934.00
CONCRETE WALK (SALT FINISH)	SQ. FT.	48819.00	$4.50	$219,685.50
CONCRETE WALK (EXPOSED AGGREGATE)	SQ. FT.	15274.00	$5.50	$84,007.00
CONCRETE HEADER (6" X 6") (CLASS B - BROOM FINISH)	L.FT.	176.00	$9.00	$1,584.00
CONCRETE HEADER (4" X 4") (CLASS B - BROOM FINISH)	L.FT.	436.00	$7.00	$3,052.00
CONCRETE HEADER (1' X 4") (CLASS B - BROOM FINISH)	L.FT.	764.00	$5.00	$3,820.00
72" TREE GRATES	EACH	12.00	$1,600.00	$19,200.00
SEAT WALL	L.FT.	470.00	$175.00	$82,250.00
BIKE RACK SINGLE HOOP	EACH	8.00	$640.00	$5,120.00

ITEM DESCRIPTION	UNIT	PRELIMINARY CONCEPT DESIGN		
		QUANTITY	UNIT PRICE	AMOUNT
SHRUB/GROUND COVER (ONE GALLON)	EACH	197	$10.00	$1,970.00
SHRUB (FIVE GALLON)	EACH	361	$25.00	$9,025.00
SPECIALTY ACCENT SHRUB (5 GALLON)	EACH	835	$25.00	$20,875.00
TREE (15 GALLON)	EACH	87	$100.00	$8,700.00
TREE (24" BOX)	EACH	78	$275.00	$21,450.00
TRASH RECEPTACLE	EACH	20	$800.00	$16,000.00
72" BENCH	EACH	20	$1,500.00	$30,000.00
LANDSCAPING ESTABLISHMENT / MAINTENANCE PERIOD	MONTH	12	$5,500.00	$66,000.00
SUB-TOTAL LANDSCAPE				**$746,267.50**
IRRIGATION				
WATER METER (2")	EACH	1	$3,000.00	$3,000
BACKFLOW PREVENTION UNIT (REDUCED PRESSURE) (2")	EACH	1	$3,500.00	$3,500
MASTER VALVE (2")	EACH	1	$1,850.00	$1,850
FLOW METER (1 1/2")	EACH	1	$1,750.00	$1,750
PRESSURE REGULATOR RISER	EACH	10	$75.00	$750
CONTROLLER (AUTOMATIC)(TUCOR 50 STA.)	EACH	1	$5,000.00	$5,000
ELECTRICAL SERVICE	EACH	1	$2,500.00	$2,500
CONTROL VALVE (REMOTE) (ELECTRIC) (1")	EACH	10	$180.00	$1,800
CONTROL VALVE (REMOTE) (ELECTRIC) (1 1/2")	EACH	22	$250.00	$5,500
AIR/VACUUM RELEASE VALVE (1")	EACH	2	$360.00	$720
GATE VALVE (3")	EACH	8	$350.00	$2,800
TURF ROTOR SPRINKLER	EACH	60	$155.00	$9,300
TURF SPRAY SPRINKLER	EACH	294	$75.00	$22,050
EMITTER (ASSEMBLY) (MULTI-OUTLET)	EACH	787	$15.50	$12,199
EMITTER (ASSEMBLY) (SINGLE-OUTLET)	EACH	1,088	$12.00	$13,056
PIPE (PVC) (3/4") (SDR 21) (CLASS 200)	L.FT.	13,000	$1.25	$16,250

ITEM DESCRIPTION	UNIT	PRELIMINARY CONCEPT DESIGN		
		QUANTITY	UNIT PRICE	AMOUNT
PIPE (PVC) (1") (SDR 21) (CLASS 200)	L.FT.	5,015	$1.65	$8,275
PIPE (PVC) (3") (SCHEDULE 40)	L.FT.	1,925	$3.75	$7,219
PIPE (PVC) (4") (SLEEVE) (SCHEDULE 40 DWV)	L.FT.	445	$7.50	$3,338
PIPE (PVC) (6") (SLEEVE) (SCHEDULE 40 DWV)	L.FT.	665	$10.00	$6,650
SUB TOTAL IRRIGATION				**$127,505.50**
SITE FEATURES				
WALL	L. FT.	70	$165.00	$11,550
ARCHED BRIDGE	L. FT.	116	$700.00	$81,200
RIVER EXPERIENCE PLAYAREA	L. FT.	115	$450.00	$51,750
KIOSKS	EACH	10	$1,000.00	$10,000
WATER JETS	EACH	20	$425.00	$8,500
BUBBLERS	EACH	17	$225.00	$3,825
ARTWORK/WATER FEATURE 'A' (JETS)	EACH	1	$5,000.00	$5,000
ARTWORK/WATER FEATURE 'B' (AGRICULTURAL ART)	EACH	1	$7,500.00	$7,500
WATER FEATURE 'C' (N/W ENTRANCE)	EACH	1	$8,500.00	$8,500
SHADE STRUCTURES	EACH	4	$15,000.00	$60,000
ENTRY FEATURE/SHADE STRUCTURE	EACH	3	$25,000.00	$75,000
SLUICE GATES	EACH	2	$3,200.00	$6,400
8' X 6' GRATE CROSSINGS	EACH	3	$5,700.00	$17,100
4.5' X 8' GRATE CROSSINGS	EACH	4	$4,700.00	$18,800
4.5' X 12' GRATE CROSSINGS	EACH	2	$8,550.00	$17,100
30' X 4.5' GRATE CROSSINGS	EACH	1	$21,000.00	$21,000
8' X 6' CONCRETE BRIDGES	EACH	3	$5,600.00	$16,800
SIPHON HOSES (POWDERCOAT)	EACH	12	$500.00	$6,000
SIGNAGE (DIRECTIONAL)	EACH	12	$15,000.00	$180,000
SIGNAGE (EDUCATIONAL)	EACH	12	$20,000.00	$240,000

ITEM DESCRIPTION	UNIT	PRELIMINARY CONCEPT DESIGN		
		QUANTITY	UNIT PRICE	AMOUNT
SUB TOTAL SITE FEATURE ITEMS				**$846,025.00**
HYDRAULIC ELEMENTS				
12 INCH DUCTILE IRON PIPE	L. FT.	1,442	$33.00	$47,586
8 INCH DUCTILE IRON PIPE	L. FT.	2,940	$25.00	$73,500
12 INCH HDPE	L. FT.	200	$28.00	$5,600
BACK FLOW PREVENTERS	EACH	1	$10,000.00	$10,000
GATE VALVES	EACH	1	$800.00	$800
PUMP/MOTOR	EACH	1	$15,000.00	$15,000
SUB TOTAL HYDRAULIC ITEMS				**$152,486.00**
PEDESTRIAN CROSSING				
TRAFFIC SIGNAL	L. SUM	1	$200,000.00	$200,000.00
SUB TOTAL PEDESTRIAN CROSSING ITEMS				**$200,000.00**
MISCELLANEOUS ITEMS				
MOBILIZATION	L. SUM	1	$100,000.00	$100,000.00
FORCE ACCOUNT WORK (STORM WATER POLLUTION PREVENTION)	L. SUM	1	$7,500.00	$7,500.00
CONSTRUCTION SURVEYING AND LAYOUT	L. SUM	1	$7,500.00	$7,500.00
AS-BUILT DRAWINGS	L. SUM	1	$3,500.00	$3,500.00
SUB TOTAL MISCELLANEOUS ITEMS				**$118,500.00**
TOTAL DIRECT CONSTRUCTION COST				**$2,222,234.00**
OVERHEAD AND INDIRECT COSTS				
GENERAL CONDITIONS (INCLUDES CONTRACTOR FIELD OFFICE, YARD, SUPERVISION, PROJECT MANAGEMENT)	L. SUM	1	$333,335.10	$333,335.10
ENGINEERING AND CONSTRUCTION CONTINGENCY	L. SUM	1	$333,335.10	$333,335.10

ITEM DESCRIPTION	UNIT	PRELIMINARY CONCEPT DESIGN		
		QUANTITY	UNIT PRICE	AMOUNT
CONSTRUCTION MANAGEMENT FEE	L. SUM	1	$16,590.00	$16,590.00
INSURANCE	L. SUM	1	$22,222.34	$22,222.34
BOND	L. SUM	1	$33,333.51	$33,333.51
SALES TAX FOR PHOENIX 7.8% x .65	L. SUM	1	$173,334.25	$173,334.25
QUANTITY VARIATION ALLOWANCE (3.0%)	L. SUM	1	$66,667.02	$66,667.02
TOTAL-OVERHEAD AND INDIRECT COSTS				$978,817.32
TOTAL CONSTRUCTION COST				**$3,201,501.32**