Exhibit 14 - Master Drainage Report

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

MASTER DRAINAGE REPORT
FOR
HAWES CROSSING

MESA, ARIZONA

Prepared For:
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59301
BRIAN
BROCKMAN
10/9/19

October 2019
HILGARTWILSON Project No. 1833

HILGARTWILSON
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MASTER DRAINAGE REPORT
FOR
HAWES CROSSING

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
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BRIAN
BROCKMAN
DATE SIGNED 10/9/17
ARIZONA U.S.A.

HILGARTWILSON
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1.0 INTRODUCTION

1.1 PROJECT NAME, LOCATION AND TOPOGRAPHY

Hawes Crossing (the Project) is located in the City of Mesa (the City) within portions of Sections 8, 16, 17, 20, and 21 of Township 1 South, Range 7 East of the Gila and Salt River Base and Meridian. The Project is comprised of a 1,132-acre master planned mixed use development. The Project is generally bound by the Villages of Eastridge and Elliot Road to the north, the Loop 202 San Tan Freeway to the south, Ellsworth Road to the east and Sossaman Road to the west, as illustrated on Figure 1 (Vicinity Map) of Appendix A.

The Project is planned as a mixed-use development, which will include technology, office, and commercial areas, along with medium density, medium/high density, and urban residential areas, and parks and open space. The land use plan for the Project is presented on Figure 2 (Proposed Land Use Plan) of Appendix A. The site currently consists of existing dairies, light industrial and agricultural districts as well as estate residential properties (RU-43). The site generally slopes from east to west at approximately 0.4 percent. Portions of the Project are within the City limits, with the remaining area under the jurisdiction of Maricopa County. It is assumed the areas within Maricopa County will be annexed into the City of Mesa and a General Plan Amendment and PAD Rezone will be processed and approved by the City.

The Project Villages are anticipated to be developed at different times in which the order are not known at this time. The drainage infrastructure will also need to be constructed such that Villages are protected during interim conditions from stormwater impacts. The planned Villages for the Project can be seen on Figure 3 (Village Exhibit) of Appendix A. It should be noted that the Village numbering does not represent the actual sequential phasing of the Project. The development considerations for the various Villages of the Project are further discussed further in Section 3.3.

1.2 PURPOSE

This Master Drainage Report (MDR) has been prepared in support of the General Plan Amendment for Hawes Crossing. The purpose of this MDR is to provide conceptual hydrologic and hydraulic analyses of the Project property, including existing and proposed drainage systems, and address potential drainage related constraints relative to project development. In addition to identifying the drainage constraints, this report is intended to identify overall drainage management concepts and establish design guidelines for future improvement plans for the property. This MDR will become the basis for more detailed hydrologic and hydraulic designs, performed during the preliminary and final plat submittals. Site specific drainage reports will be prepared to address internal drainage at the parcel level, and will be submitted in conjunction with the site plan and subdivision plat stages of development of the property as required by the City.

This MDR has been prepared in accordance with the City's Engineering and Design Standards (EDS) (City of Mesa 2017) and the Flood Control District of Maricopa County's (FCDMC) current versions of the Drainage Policies and Standards (DPSM) (FCDMC 2016), Drainage Design Manuals (DDM) for Maricopa County, Volume 1 - Hydrology (FCDMC 2013a) and Volume 2 - Hydraulics (FCDMC 2013b).

1.3 SITE LOCATION RELATIVE TO KNOWN FEMA FLOOD HAZARD ZONES

The property is located within the Federal Emergency Management Agency's (FEMA) Zone X (Shaded) as shown on the FEMA Flood Insurance Rate Map (FIRM) panel number 04013C2760L, revised October 16th, 2013 which is presented on Figure 4 (FEMA Flood Map) of Appendix A. The Zones associated with this Project are defined below.

Zone X (Shaded):

> The flood insurance rate zone that corresponds to areas between the 100-year and 500-year floodplains, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

2.0 PREVIOUS REGIONAL STUDIES

2.1 FCDMC OUTFALL CHANNEL DESIGN REPORT

In July 2004, the FCDMC prepared the *Outfall Channel Design Report* (FCDMC 2004) detailing the design of the large earthen channel traversing the Project, east of the freeway, routing offsite flows to the Loop 202 channel. The report details the channel's configuration and specifies a design flow of 1,100 cfs referenced from the East Mesa Area Drainage Master Plan. Excerpts of the report are included in Appendix B.

2.2 EAST MESA AREA DRAINAGE MASTER PLAN UPDATE

In March 2014, the FCDMC completed the *East Mesa Area Drainage Master Plan Update* (ADMPU, FCDMC 2014) which provided an updated hydrologic analysis of the East Mesa Area Drainage Master Plan adjacent to the Project. The analysis detailed the methodology and results of revised HEC-1 models referencing updated parameters including NOAA 14 rainfall precipitation depths. The ADMPU did not detail flows impacting the property as flows are either diverted away or the study area is not inclusive of the Project. As such, the ADMPU was not referenced in this report.

3.0 MANAGEMENT OF OFFSITE DRAINAGE

3.1 EXISTING PATTERNS

As previously mentioned, tributary drainage areas to the Project generally slope west and southwest, approaching as sheet flow and shallow concentrated flows originating from undeveloped desert rangeland and sparsely developed agricultural operations from the east, west of the Loop 202. Flows from the development north of the Project are intercepted by a series of regional retention basins. In addition to the offsite flows from the east, the Elliot Road Channel currently conveys offsite flows traversing the proposed site and outfalls into the Loop 202 Channel. The Elliot Road Channel crosses the eastern portion of the Project, discharging beneath Ellsworth Road. The channel has been designed to convey the 100-year flow of 1,100 cfs identified in the Elliot Road Channel Design Report. Flows from the adjacent Elliot Road and Ellsworth Road frontage is captured by an existing system of catch basins that routes the flows to either the Elliot Road or Loop 202 Channels. The Loop 202 drainage channel cuts off additional upstream drainage areas where runoff is now conveyed south along the highway and away from the Project. Peak flows and contributing drainage areas are graphically displayed on Figure 5 (Master Drainage Exhibit) of Appendix A.

3.2 FINAL BUILD-OUT PROPOSED PATTERNS

Offsite flows approaching the Project will continue to be received as they do under existing conditions. Engineered channels will route the collected flows to historical outfall points within or along the downstream limits of the property. Flows will be discharged from the Project at their historical outfalls in a similar manner mimicking existing drainage conditions such that downstream properties are not impacted. The final drainage infrastructure layout can be seen on Figure 5. As the existing alignment of the Elliot Road Channel traverses the site, two alternative channel alignments are being considered to convey the 1,100 cfs runoff safely through the site to its existing ultimate outfall at the Loop 202 Channel. The proposed alignments for the alternative channels can be seen on Figure 5.

Grade control will be implemented to reduce channel velocities wherever necessary. Where steeper channels and higher velocities are unavoidable, erosion protection will be provided. Erosion protection for channels will be specified in the future in more detailed site plans. The primary channel corridors within the property will likely be designed with many natural elements including the use of native vegetation and typical desert landscaping materials. Some locations, particularly channels located in the vicinity of amenity areas, may be turf lined. Other locations, such as those that may be prone to erosion or that are located in areas of more intense land uses, may include sections that require other linings such as riprap or other robust revetment. All channel linings will be selected in accordance with the City's standards.

3.3 PROPOSED VILLAGE DEVELOPMENT

The Project will most likely develop various parcels at different times. In order to provide safe conveyance of 100-year peak flows and to minimize flood hazards during the construction of the development, the timing of construction of the proposed drainage corridors has been considered in order to safely manage offsite runoff through the site. Flows will be accepted and conveyed through the Project and discharged to their historical outfall in a similar manner similar to existing conditions. Final build-out drainage infrastructure has been sized to convey a minimum 1-foot of freeboard for either interim or final build-out conditions.

Each Village has been analyzed independently considering the drainage infrastructure required for interim or final build-out conditions. Refer to Figures 6–13 (Village 1-8 Interim Drainage Exhibit) of Appendix A. Areas where interim drainage infrastructure has been specified will likely have the option to be reclaimed or reduced once upstream villages are developed. At final design more detailed topo will be acquired and more detailed analyses will be provided quantifying offsite drainage impacts. Preliminary calculated flows and drainage infrastructure are graphically shown on Figures 6-13 with calculations included in Appendix D. Considerations for each village are discussed in detail below.

3.3.1 VILLAGE 1

The entrance road to the Village 1 parcels, west of Village 3, entering off of Elliot Road will be constructed as part of Village 1. With construction of the entrance road, offsite runoff from small drainage area to the east will be diverted south to culvert crossing running parallel with Elliot Road. Flows are conservatively assumed to freely cross over Hawes Road generated from the larger drainage area to the east. Culvert and channel capacities along Hawes Road will also be conservatively sized to convey the full flow from the tributary area north and east of the concentration point. Elliot Road has been analyzed to account for the additional flow from the undeveloped Village 3 parcels. Freeboard requirements within the channel will be met during the interim conditions and when Village 3 is fully developed, retaining the 100-year storm event.

3.3.2 VILLAGE 2

The undeveloped area east of Village 2 will have stormwater draining to the west, impacting the eastern boundary of Village 2. During interim and final build-out conditions, flows will continue to drain west along their natural flow patterns north of Elliot Road. An interim drainage channel will be required to convey the tributary flows south and then west around the Village 2 property as not to adversely impact properties to the south. The flows will drain to a spreader basin at the southwestern boundary of the Project, discharging to its historical outfall. When Village 7 is fully developed and retention within the parcel is provided, the area utilized for the interim channel can be fully recovered as offsite flows will no longer impact Village 2.

3.3.3 VILLAGE 3

As discussed in Village 1, flows are conservatively assumed to freely cross over Hawes Road generated from the tributary drainage areas to the north and east. Drainage infrastructure specified during this interim condition will also be required at final buildout.

3.3.4 VILLAGE 4

Similar to Elliot Road, Warner Road diverts flows generated from the north, west and away from Village 4. Flows generated to the east of Village 4 will be routed through the village and discharged at its historical outfall via an interim drainage channel. The flows will drain to a spreader basin at the southwestern boundary of Village 4, discharging from a spreader basin to its historical outfall. When Village 5 is developed and retention within the parcel is provided, the area utilized for the interim channel can be fully recovered.

3.3.5 VILLAGE 5

Drainage infrastructure specified during this interim condition will also be required at final buildout. As part of the final build-out conditions, conveyance channels along the southern and western boundary are proposed to be constructed conveying runoff from a small offsite drainage area to the east. Flows will discharge via an existing culvert running parallel with Warner Road matching its historical outfall location.

3.3.6 VILLAGE 6

As shown on Figure 5, a portion of the drainage infrastructure required for final buildout will be constructed along the northeastern boundary during interim conditions for Village 6 conveying offsite runoff approaching from the northeast. Interim drainage infrastructure will be required along the southeastern boundary of the Village to convey runoff generated from the tributary undeveloped area. When Village 5 is developed and retention within the parcel is provided, the area utilized for the interim channel can be fully recovered and culverts reduced if deemed necessary.

3.3.7 VILLAGE 7

There is no offsite drainage infrastructure required for Village 7 as flows from the north will be diverted west along Elliot Road and flows from the east are cut off by the Loop 202.

3.3.8 VILLAGE 8

Drainage infrastructure specified at final build-out will be required, conveying offsite flows from the Elliot Road Channel through or around Village 8.

4.0 HYDROLOGIC ANALYSIS

The amount of offsite runoff approaching the Project from the east was quantified using the Rational Method in order to conservatively size onsite drainage infrastructure. Offsite runoff impacting the Project is generated from drainage areas to the east, approaching as sheet flow and shallow concentrated flows originating from undeveloped desert rangeland as shown on Figure 5 (Master Drainage Exhibit) of Appendix A. The following sections describe the methodology used for the analysis in this report. Hydrologic equations, calculations, and results from the analyses can be found in Appendix C.

4.1 RATIONAL METHOD ANALYSIS

Rational Method calculations were performed to conservatively estimate the rainfall runoff generated from the smaller tributary drainage areas impacting the Project in order to size drainage corridors through the Project in accordance with the DDM Volume 1. Topographic contour data obtained from the FCDMC was used to reference elevations used for the delineation of offsite drainage areas. Precipitation depths were determined using NOAA 14. The Rational Method calculations can be found in Appendix C. During final design of the site, detailed grading plans for the channels will be used in conjunction with normal depth hydraulic calculations to determine water surface profiles for the proposed channels.

5.0 HYDRAULIC ANALYSIS

5.1 PRELIMINARY OPEN CHANNEL DESIGN

Figures 5-13 detail the various channel segment ID's and the associated hydrologic flows through the property along with the approximate channel footprint. Hydraflow was used to perform normal depth calculations for each channel section which have been included in Appendix D.

Channels have been sized referencing parameters from the DDM, Volume 2. Design parameters and results for the proposed channel corridors are presented in the Channel Summary Table included in Appendix D. All channels will have a minimum freeboard of 1 foot. Other pertinent design criteria for the channels are described below:

- Manning's n: A Manning's n value of 0.032 has been used to represent the proposed channel lining for the offsite flow drainage corridors. Use of a mid-range roughness coefficient allows for some flexibility in the channel lining, such as a combination of grass with native vegetation, sparsely placed shrubs, and decomposed granite.

- Side Slopes: Offsite drainage conveyance channels located throughout the property boundaries will be designed at 4H: 1V side slopes.

- Permissible velocities: A maximum permissible velocity of 5 feet per second (fps) has been used for the preliminary design of the channels, consistent with the maximum velocity specified for natural channels in the DDM.

- Longitudinal Slopes: Preliminary longitudinal slopes were determined based on existing ground slopes and were found to be approximately 0.4 %.

5.2 PRELIMINARY CULVERT DESIGN

Along with the channel configurations, Figures 5-13 also detail anticipated locations of culverts throughout the property based on preliminary roadway layouts which will be required to pass offsite 100-year peak flows under the roads assuming no overtopping. Similar to the open channel calculations, Hydraflow was utilized to quantify the approximate number and size of culverts required to convey flow beneath the roadways with no overtopping. Hydraflow cross sections are included in Appendix D.

6.0 ONSITE DRAINAGE

The proposed drainage infrastructure to manage stormwater for the Hawes Crossing development consists of manmade channels, culverts, street drainage networks and retention basins. This section describes the proposed concepts and future design of the required Project drainage infrastructure.

6.1 LOT DRAINAGE

Lots are to be graded to drain from the rear to the front and into the street. A minimum lot drainage time of concentration of 10-minutes for residential and commercial will be used to determine rainfall intensities in accordance with the EDS.

6.2 ONSITE STREET DRAINAGE

The Rational Method will be used to calculate 10- and 100-year onsite flows for pavement drainage design. For local streets, the onsite system will be designed to convey the peak 10-year flow between curbs and 100-year flow within the street right-of-way or drainage easements. Where possible, this will be accomplished with the use of 4-inch roll curb. 6-inch vertical curb will be constructed where a 4-inch curb cannot meet the above requirements. Arterial and major collector streets shall be designed utilizing 6-inch vertical curbs and will convey peak flows generated by the 10-year event such that the flows will be limited to a spread of one traffic lane in each direction and 100-year flow within the street right-of-way or drainage easements. Furthermore, an underground storm drain network will be utilized in design where a 6-inch curb cannot meet the aforementioned requirements.

6.3 DRAINAGE STRUCTURES

The drainage design for the Project outlines a system in which street flows will be directed to concentration points throughout the site where catch basins and storm drains will be placed to collect and convey the street runoff to retention basins. Underground storage basins may also be utilized for non-residential developments within the site in accordance with the EDS. Calculations to determine storm drain locations and sizes will be provided with the final drainage plans for each parcel of the development.

Erosion revetment such as riprap aprons, will be designed downstream of all concentrated discharge points, including storm drain pipe outlets, to protect against scour around these areas, facilitate uniform spreading of flows and decrease flow velocities. These structures will be designed in accordance with the design guidelines.

6.4 ONSITE STORMWATER STORAGE REQUIREMENTS

The onsite rainfall runoff from the site will be routed via in-street flow and storm drains, where necessary. The City requires 100-year, 2-hour retention be provided for new developments. The equations to calculate the 100-year, 2-hour required retention volumes are detailed below:

100-Year, 2-Hour

$$V_R = P/12*(C)*A$$

Where:

V_R is the 100-year, 2-hour retention volume (ft^3)
C is the runoff coefficient
P is the 100-year, 2-hour rainfall depth (inches)
A is the drainage area (ft^2).

The NOAA Atlas 14 100-year, 2-hour rainfall depth of 2.17 inches was used as the precipitation depth. The NOAA 14 report for the Project has been included in Appendix C. Runoff coefficients for onsite drainage sub-basins were taken from Table 6.3 of the DPSM and Table 3.2 of the DDM, Volume 1, detailed in Table 1 below. The applicable runoff coefficients from this table were weighted based on the land uses and gross areas and are presented in Appendix E. Regional retention basins may be employed, in lieu of individual basins or underground storage, combining one or more parcels in order to make the most efficient use of the property. Onsite retention solutions will be determined as the Project is developed which will be detailed in subsequent parcel drainage reports.

Table 1:
Land Use Summary Table

Land Use	**"C" Coefficient**
Medium Density Residential (3.5-5.0 DU/AC)	0.75
Medium/High Density Residential (5.5-10 DU/AC)	0.80
Urban Density Residential (10.5-25.0 DU/AC)	0.85
Urban/ Mixed-Use (6-12 DU/AC)	0.80
Technology/ Mixed Use	0.90
Commercial	0.90
Office	0.90
Park/ Open Space	0.65
Undeveloped Desert	0.50

Excess flows generated from major storm events (those events exceeding the design storm event) will overtop the basins and be routed downstream via channels, in-street flows, storm drain pipes, and other retention basins to historical outfalls. The resulting peak flows discharging from the site will not be increased as a result of development.

6.4.1 RETENTION BASIN DEWATERING

Outlet facilities will generally consist of natural infiltration and gravity bleed-off pipes wherever possible, in accordance with the EDS. Retention basins will be placed at strategic locations to allow retained runoff to discharge to historical outfall locations. It should be noted that there are currently no existing stromdrain networks in the vicinity in which the development can drain via gravity bleed-off. To the extent possible, existing washes and other onsite and offsite drainage infrastructure will be utilized such that retention basins can bleed-off by gravity. However, due to the relatively flat terrain, gravity bleed-off may not be feasible for all portions of the site. If gravity bleed-off is not deemed feasible for portions of the Project, other alternatives for dewatering will be considered at final design in accordance with Section 806.21.2.1 of the EDS. Post construction geotechnical tests will be performed in order to determine the natural infiltration rate of each basin.

7.0 FINISHED FLOOR ELEVATIONS

In the event of a storm where retention volumes are exceeded, the Project will be designed with a means to outfall at a number of locations throughout the site. Finished floor elevations within the Project will be set a minimum of 12-inches above the high adjacent 100-year water surface elevation.

8.0 SUMMARY AND CONCLUSIONS

The proposed development will comply with the City of Mesa's required drainage standards as well as Maricopa County Planning and Development Design guidelines and regulations. Hawes Crossing will meet the specified retention requirements such that flows generated from the 100-year event will not be anticipated to result in adverse impacts to either downstream existing properties or drainage ways from the Project. This report has determined that:

- The design of the hydraulic facilities is in accordance with the City's and the FCDMC's requirements.
- Channels will be designed to convey offsite 100-year peak flows through the Project with a minimum 1-foot of freeboard. Maximum flow velocities in the channels will be less than permissible velocities for the selected linings.
- Streets will be designed to adequately convey the calculated peak 10-year flows between curbs and 100-year flows within the street right-of-ways or drainage easements.
- Onsite flows will be conveyed to stormwater storage basins or underground storage near low points via surface flow and, when necessary, storm drain pipes.
- Riprap aprons will be placed downstream of all storm drain outlets and other points of concentrated flow to protect against scour.
- Onsite retention basins and underground storage will provide, at a minimum, a storage volume equivalent to the 100-year, 2-hour runoff.
- Basins will be drained within 36 hours. The dewatering of the retention basins will be accomplished by the combination of natural infiltration and bleed-off pipes wherever possible.
- All finished floor elevations will be set a minimum of 12 inches above the retention basin overflow elevations and 100-year water surface elevations in the adjacent drainage corridors.
- Individual parcel drainage reports will be prepared based on the future development of the Project. These reports will contain final calculations and design for the following:
    - In-street flow capacities;
    - Scupper and catch basin sizing;
    - Storm drain pipe system design capacities;
    - Retention basin geometries and volumes;
    - Retention basin high-water outlet structures;
    - Retention bleed-off structures.

9.0 REFERENCES

City of Mesa, 2017. *Engineering and Design Standards*. City of Mesa, Arizona. July, 2017.

Flood Control District of Maricopa County, July, 2004. *Elliot Outfall Channel Design Report.* Phoenix, Arizona.

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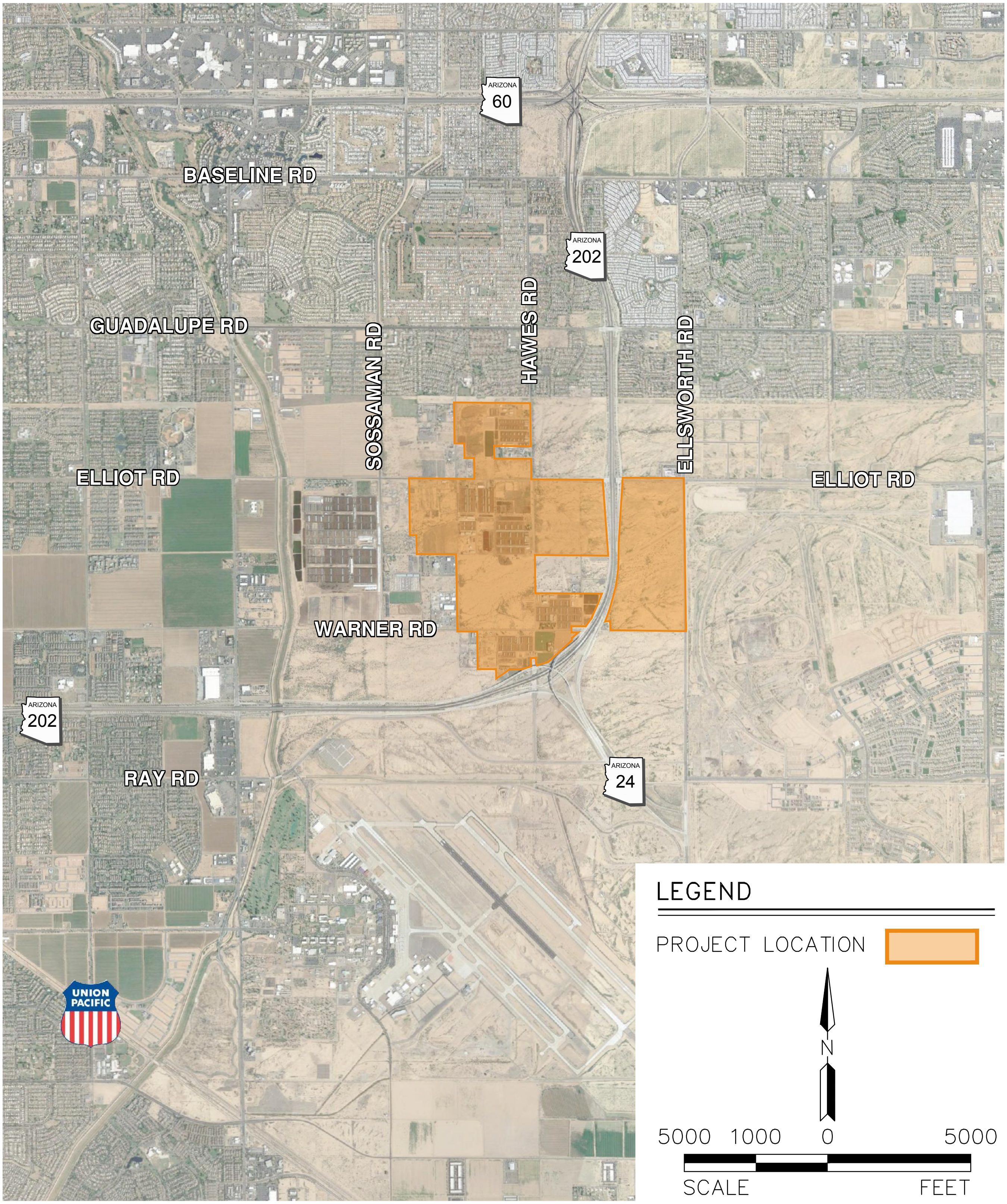
APPENDIX A

FIGURES



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DATE:	MAR 2019
SCALE:	1" = 5,000'
DRAWN BY:	SL
CHECKED BY:	AT

HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 1: VICINITY MAP

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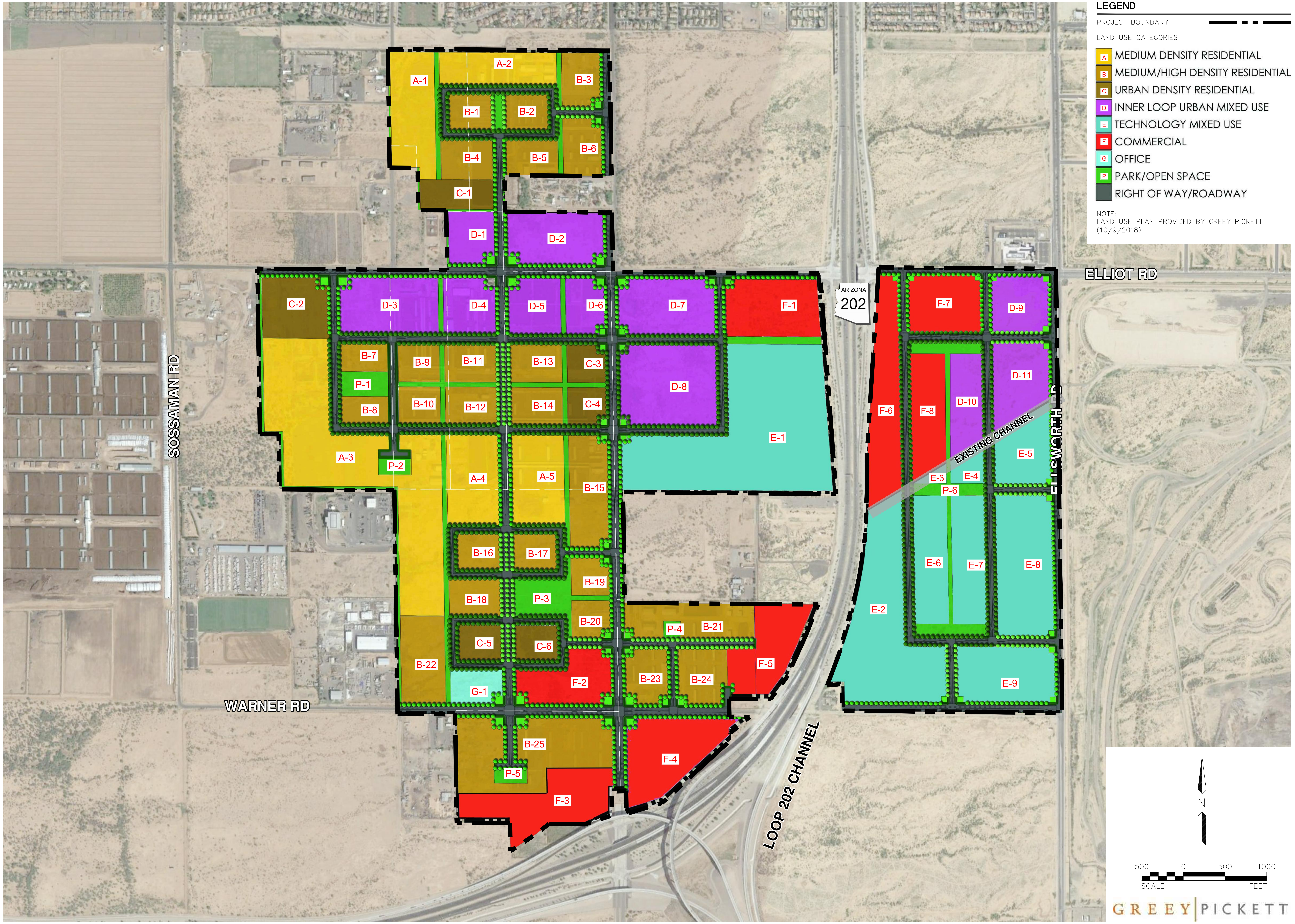

LEGEND

PROJECT BOUNDARY ▬ ▪ ▬

LAND USE CATEGORIES

- A MEDIUM DENSITY RESIDENTIAL
- B MEDIUM/HIGH DENSITY RESIDENTIAL
- C URBAN DENSITY RESIDENTIAL
- D INNER LOOP URBAN MIXED USE
- E TECHNOLOGY MIXED USE
- F COMMERCIAL
- G OFFICE
- P PARK/OPEN SPACE
- ■ RIGHT OF WAY/ROADWAY

NOTE:
LAND USE PLAN PROVIDED BY GREEY PICKETT (10/9/2018).

GREEY | PICKETT

REV.:

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HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 2: PROPOSED LAND USE PLAN

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APPROVED: AT

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SHT. 2 OF 13

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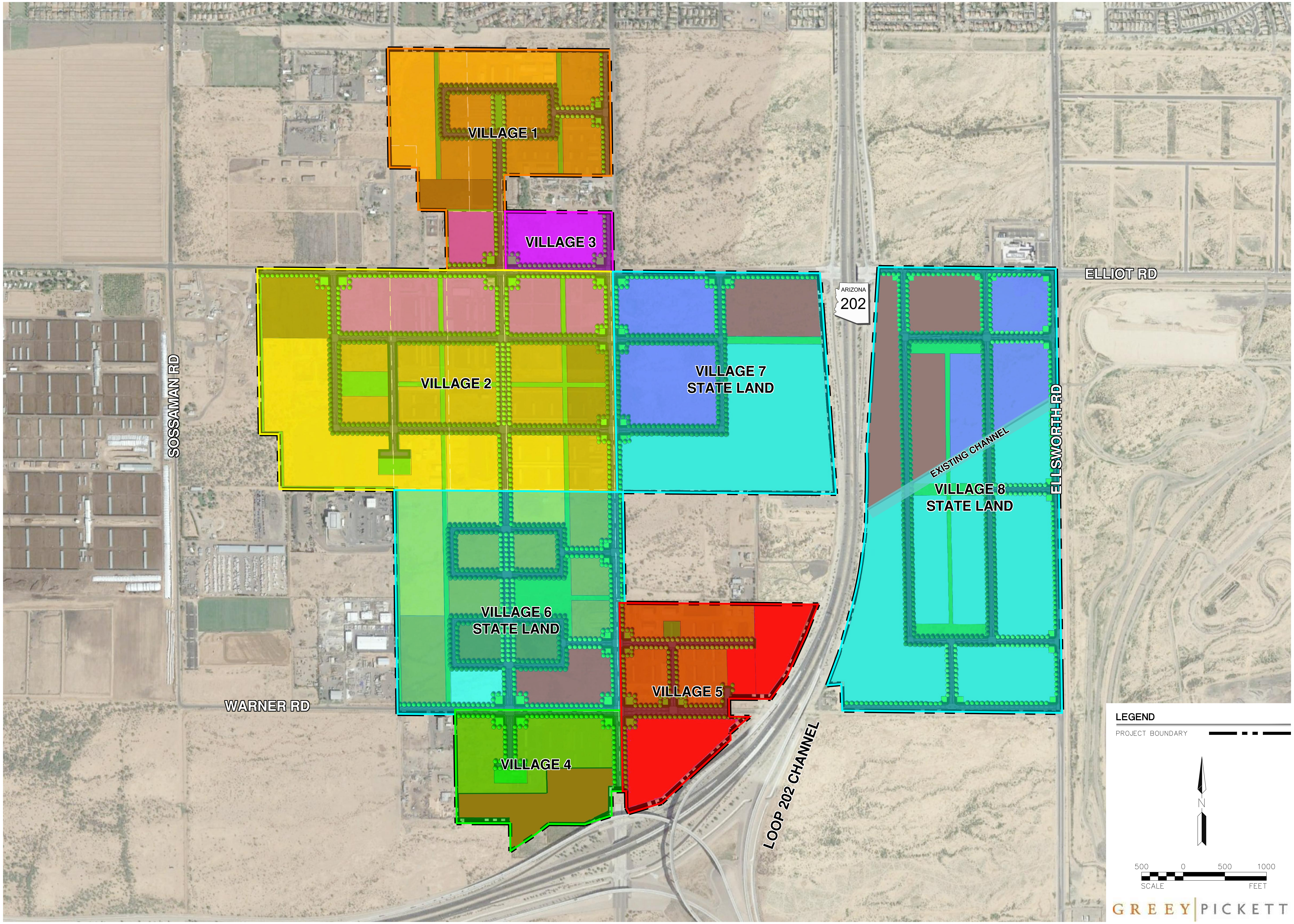

GREEY | PICKETT

REV.:

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HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 3: VILLAGE EXHIBIT

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APPROVED: AT

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SHT. 3 OF 13

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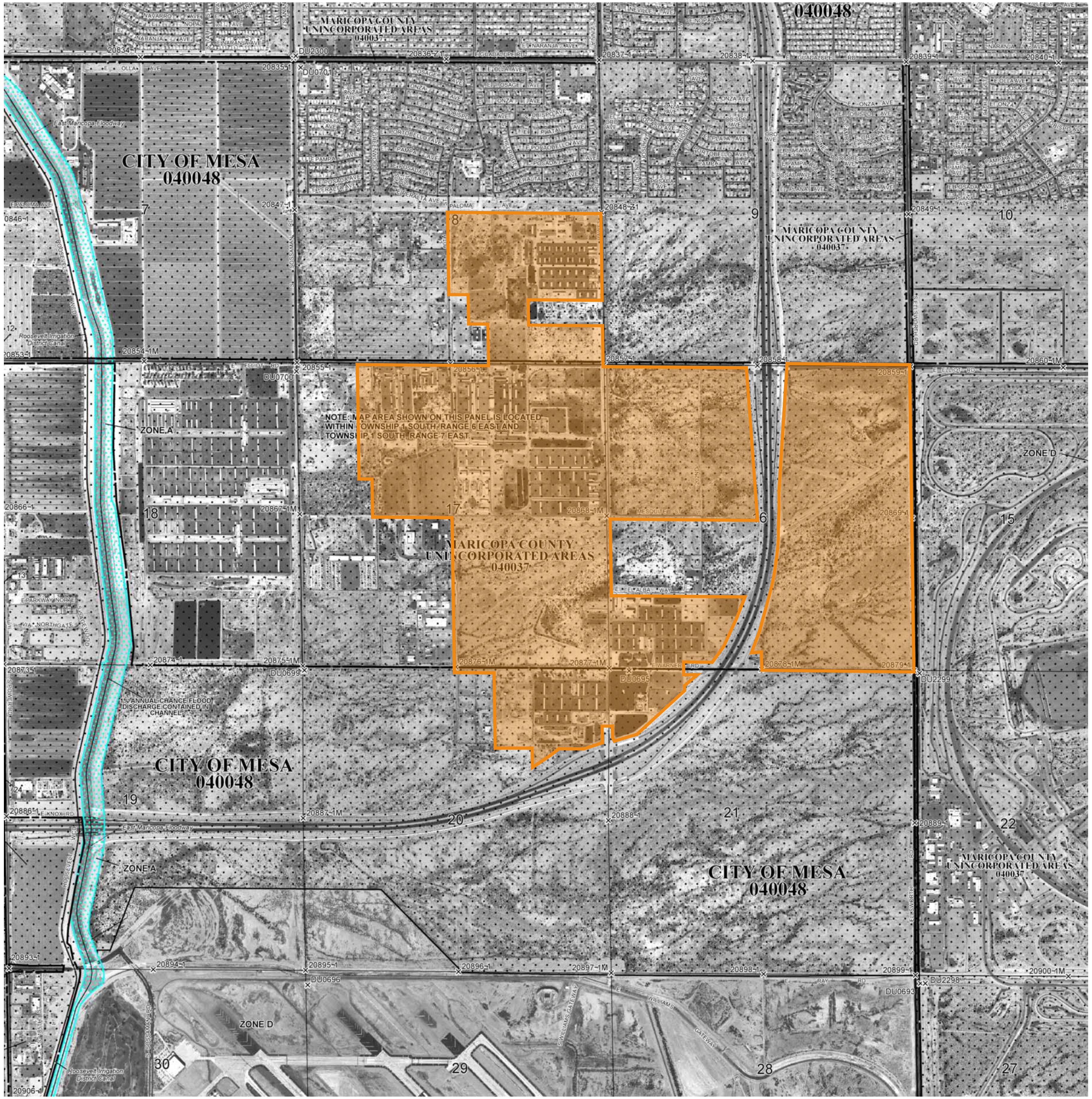

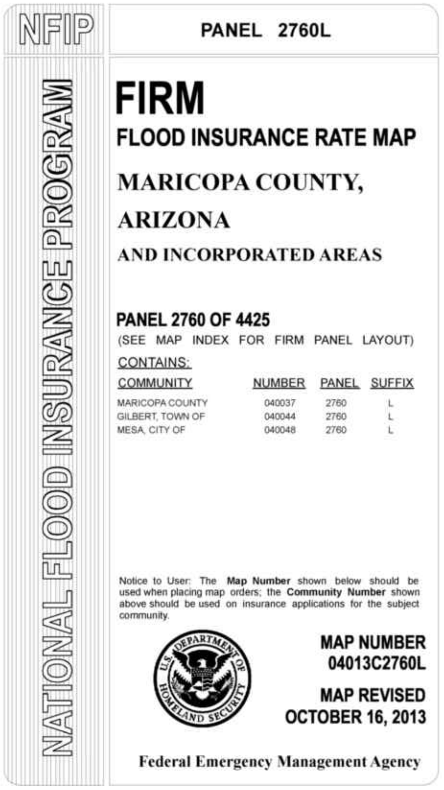

NFIP

PANEL 2760L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,
ARIZONA
AND INCORPORATED AREAS

PANEL 2760 OF 4425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2760	L
GILBERT, TOWN OF	040044	2760	L
MESA, CITY OF	040048	2760	L

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2760L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

LEGEND

PROJECT BOUNDARY	▨

N

2000 1000 0 2000
SCALE FEET

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HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 4: FEMA FLOOD MAP

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DATE: MAR 2019
SCALE: 1" = 2,000'
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CHECKED BY: AT

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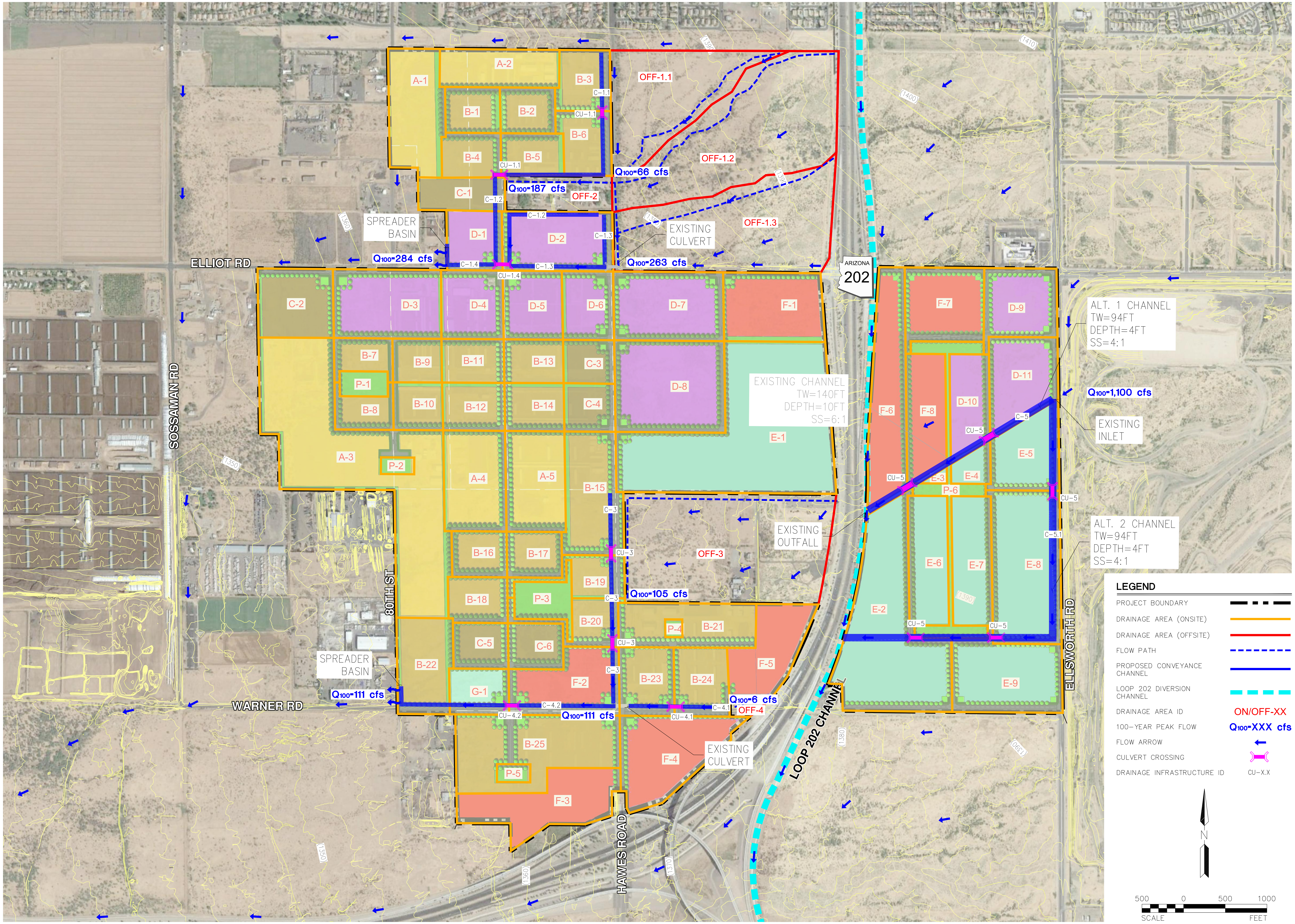
U:\1800\1833\1833.0101 – Mesa-Casa Grande\REPORTS\DRAINAGE\Exhibits\1833 Fig 4 – FEMA Flood Map.dwg 3/25/2019 2:37 PM



LEGEND

PROJECT BOUNDARY	▬ ▪ ▪ ▬
DRAINAGE AREA (ONSITE)	▬
DRAINAGE AREA (OFFSITE)	▬
FLOW PATH	- - - -
PROPOSED CONVEYANCE CHANNEL	▬
LOOP 202 DIVERSION CHANNEL	▬ ▬ ▬ ▬
DRAINAGE AREA ID	ON/OFF-XX
100-YEAR PEAK FLOW	Q100=XXX cfs
FLOW ARROW	←
CULVERT CROSSING	⊢⊣
DRAINAGE INFRASTRUCTURE ID	CU-X.X

N

500 0 500 1000
SCALE FEET

REV.:

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436
www.hilgartwilson.com

HAWES CROSSING

CITY OF MESA, ARIZONA

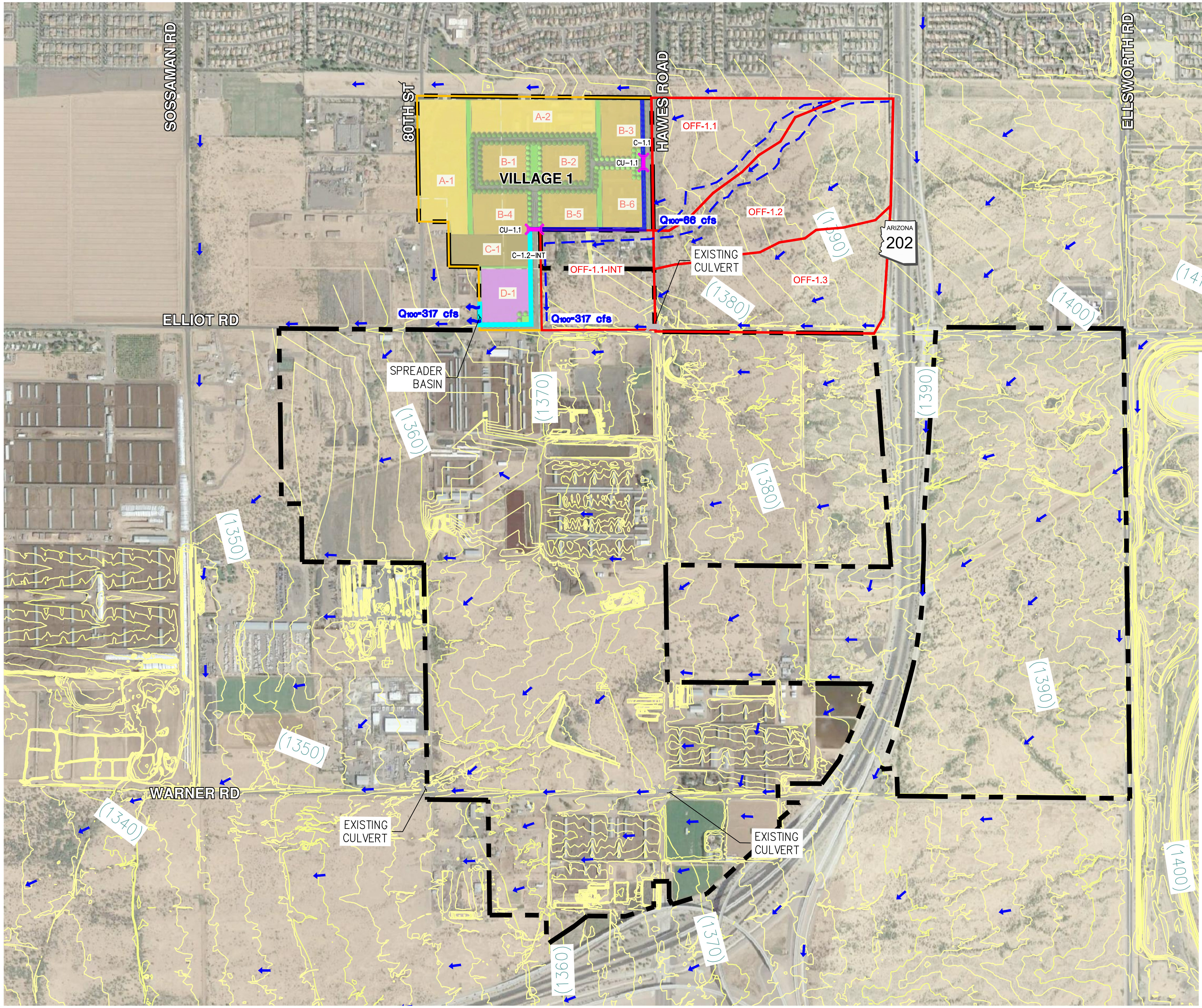
FIG 5: MASTER DRAINAGE EXHIBIT

HILGARTWILSON
PROJ NO.: 1833
DATE: OCT 2019
SCALE: 1" = 500'
DRAWN: SL
DESIGNED: HW
APPROVED: AT

DWG. NO.
5
SHT. OF

Copyright, HILGARTWILSON 2019 – This plan document set is the sole property of HILGARTWILSON. No alterations to these plans, other than adding "as-built" information, are allowed by anyone other than authorized HILGARTWILSON employees.

U:\1800\1833\1833.0101 – Mesa–Casa Grande\REPORTS\DRAINAGE\Exhibits\1833 Fig 5 – Master Drainage Exhibit.dwg 10/9/2019 11:17 AM



LEGEND

PROJECT BOUNDARY	▬ ▬ ▬
VILLAGE BOUNDARY	─
PERMANENT CHANNEL	─
INTERIM CHANNEL	─
CULVERT	⋈

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

N

1200 600 0 1200
SCALE FEET

GREEY|PICKETT

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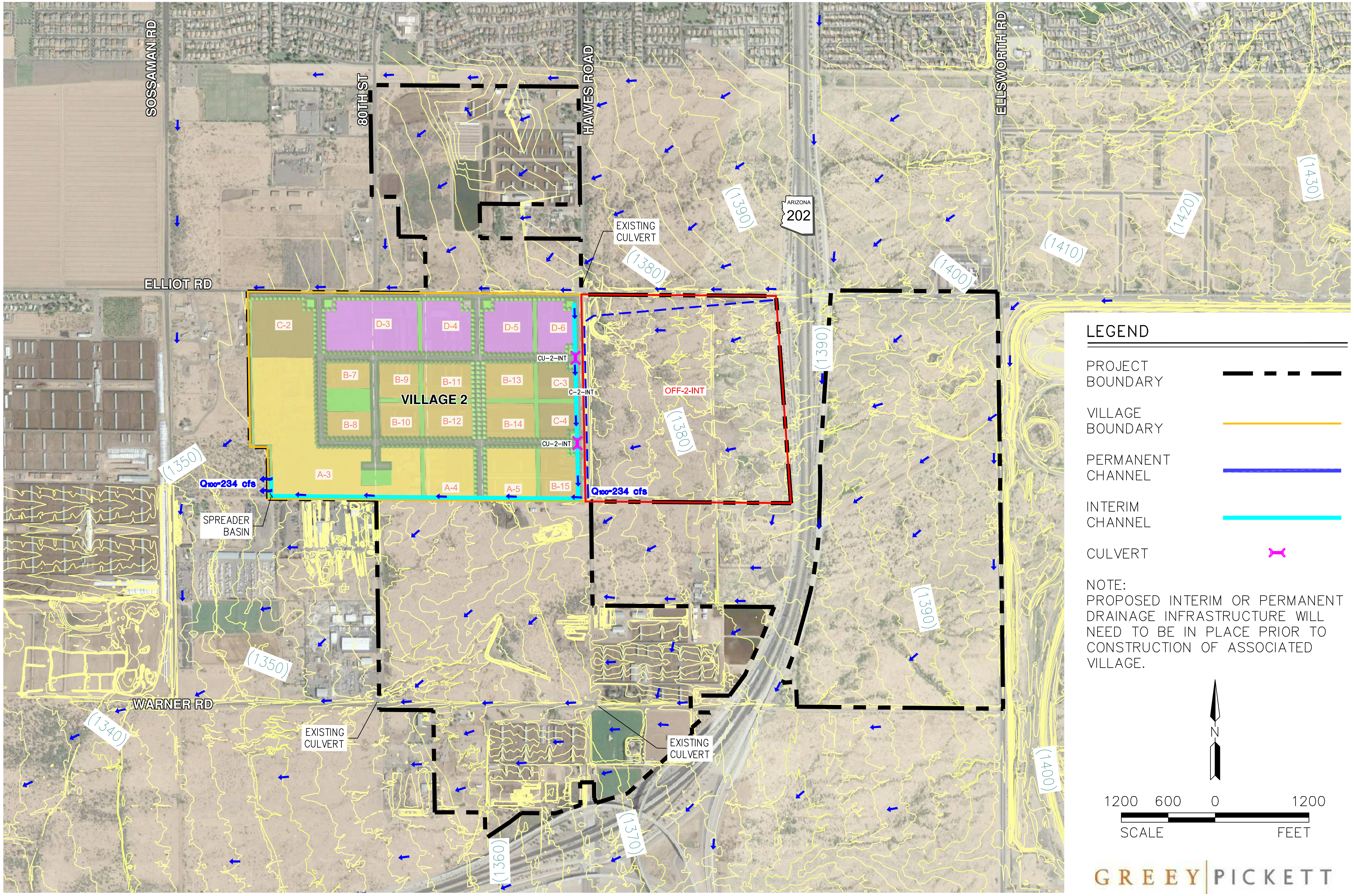
CITY OF MESA, ARIZONA

FIG 6: VILLAGE 1 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB



LEGEND

PROJECT BOUNDARY — ▬ ▬ ▬

VILLAGE BOUNDARY — ▬

PERMANENT CHANNEL — ▬

INTERIM CHANNEL — ▬

CULVERT — ⋈

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

GREEY|PICKETT

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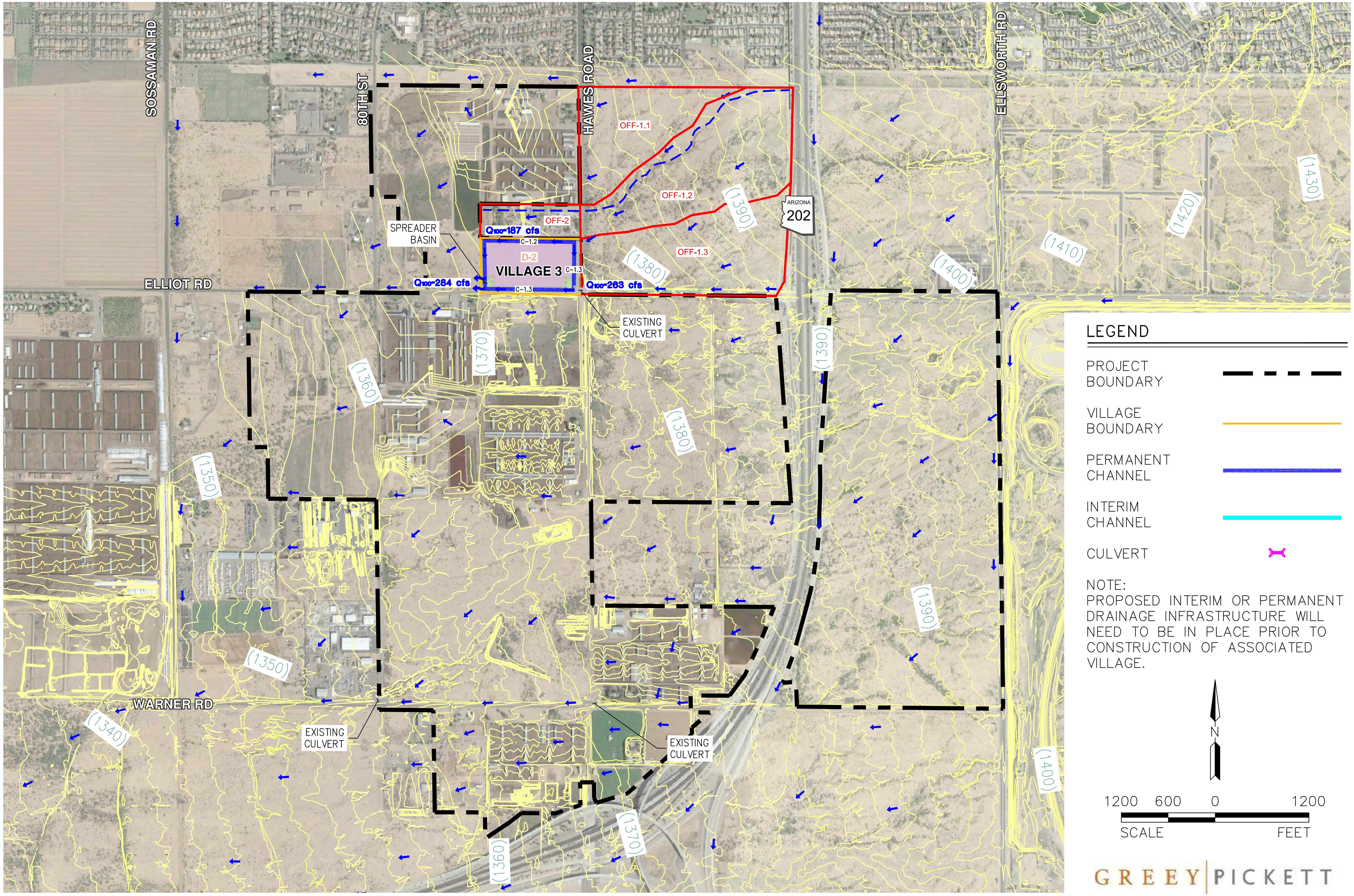
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 7: VILLAGE 2 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB



LEGEND

PROJECT BOUNDARY	━ ━ ━
VILLAGE BOUNDARY	━
PERMANENT CHANNEL	━
INTERIM CHANNEL	━
CULVERT	⋈

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

N

1200 600 0 1200
SCALE FEET

GREEY|PICKETT

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PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

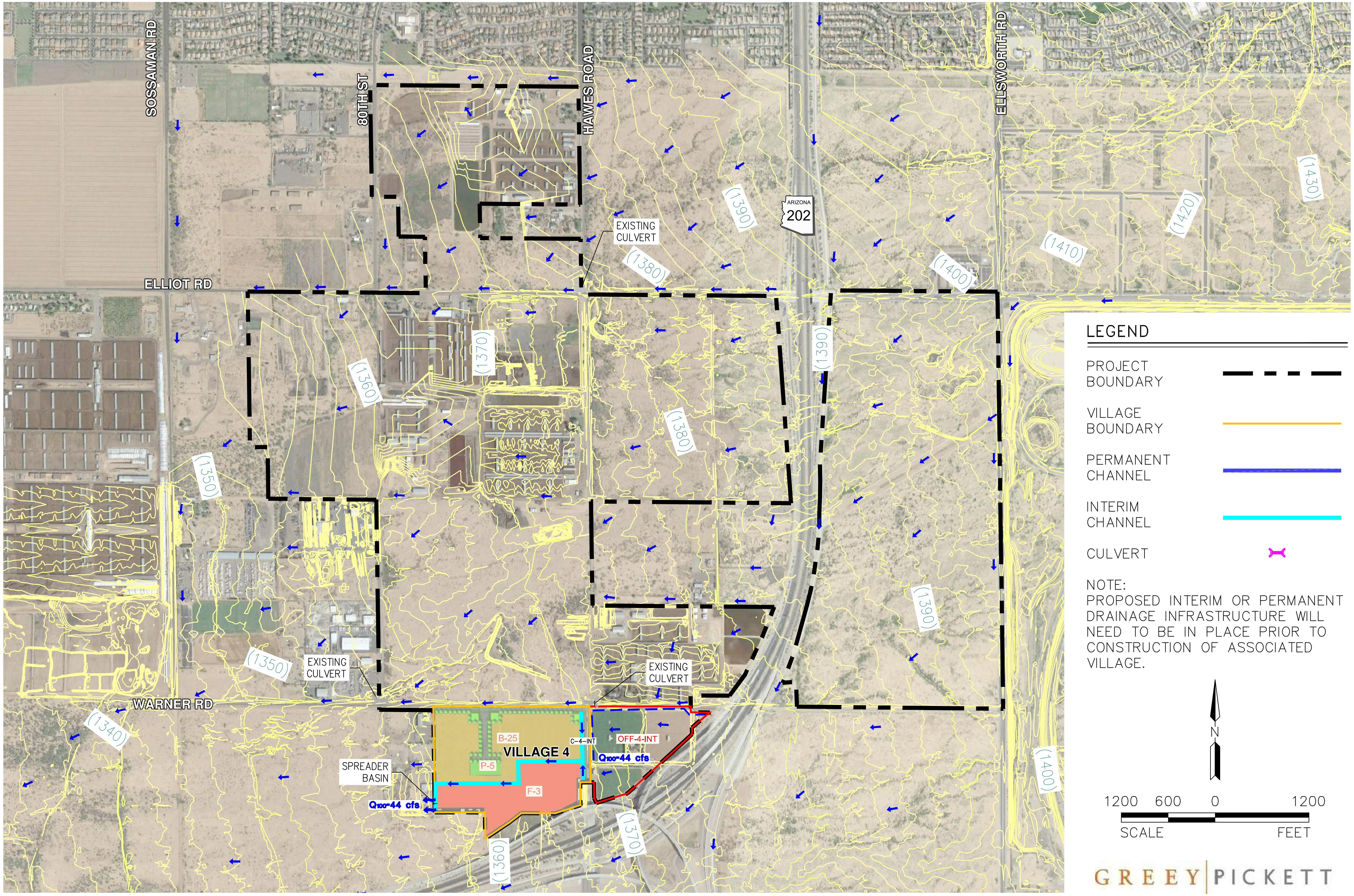
HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 8: VILLAGE 3 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB

U:\1800\1833\1833.0101 – Mesa–Casa Grande\REPORTS\DRAINAGE\Exhibits\1833 Fig 8 – Village 3 Drainage Exhibit.dwg 10/9/2019 11:01 AM



LEGEND

PROJECT BOUNDARY	▬ ▬ ▬
VILLAGE BOUNDARY	━
PERMANENT CHANNEL	━
INTERIM CHANNEL	━
CULVERT	⟷

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

1200 600 0 1200
SCALE FEET

GREEY | PICKETT

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PHOENIX, AZ 85016
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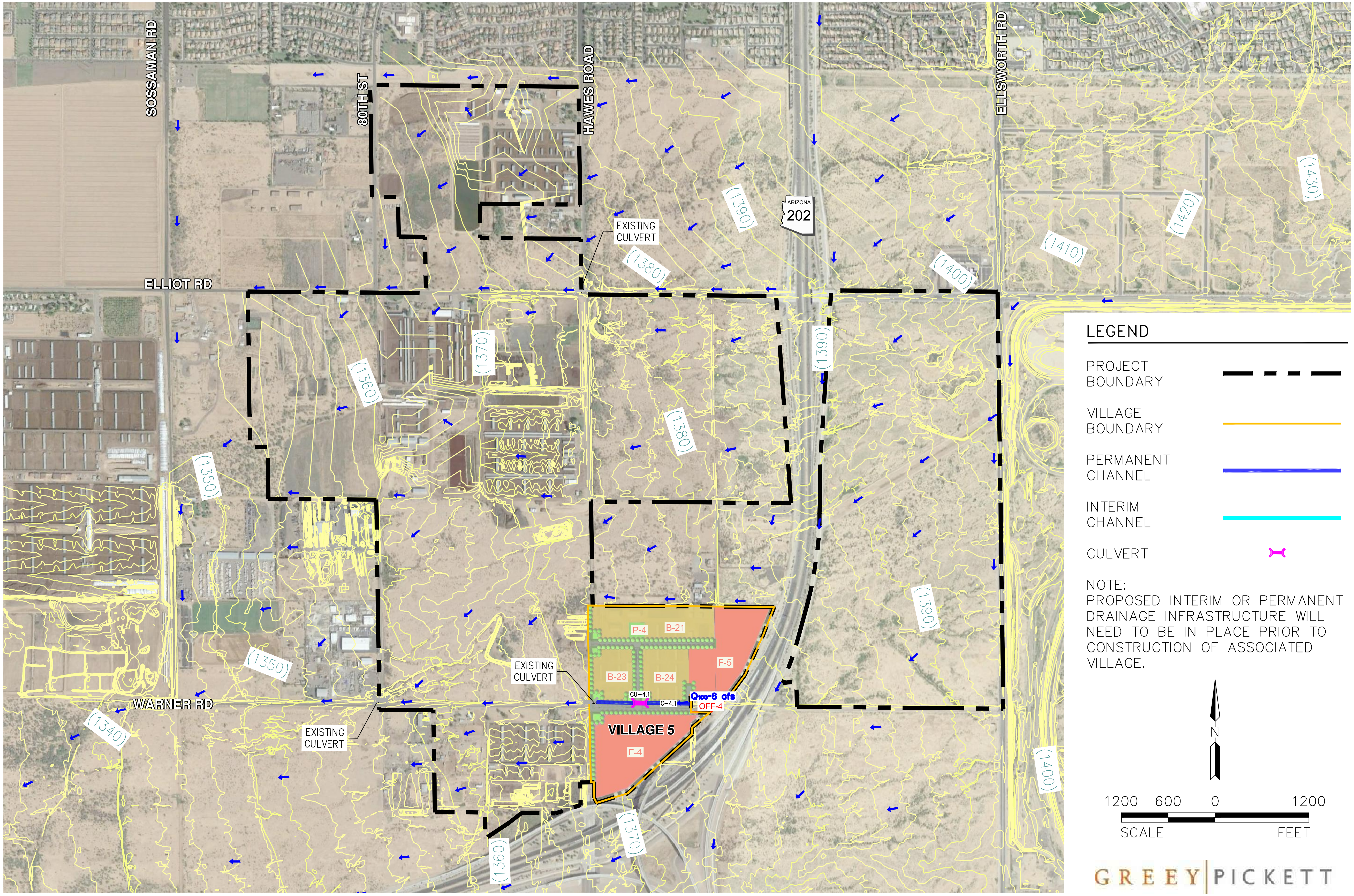
HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 9: VILLAGE 4 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB



LEGEND

PROJECT BOUNDARY	▬ ▬ ▬
VILLAGE BOUNDARY	▬
PERMANENT CHANNEL	▬
INTERIM CHANNEL	▬
CULVERT	⤫

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

N

1200 600 0 1200
SCALE FEET

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PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

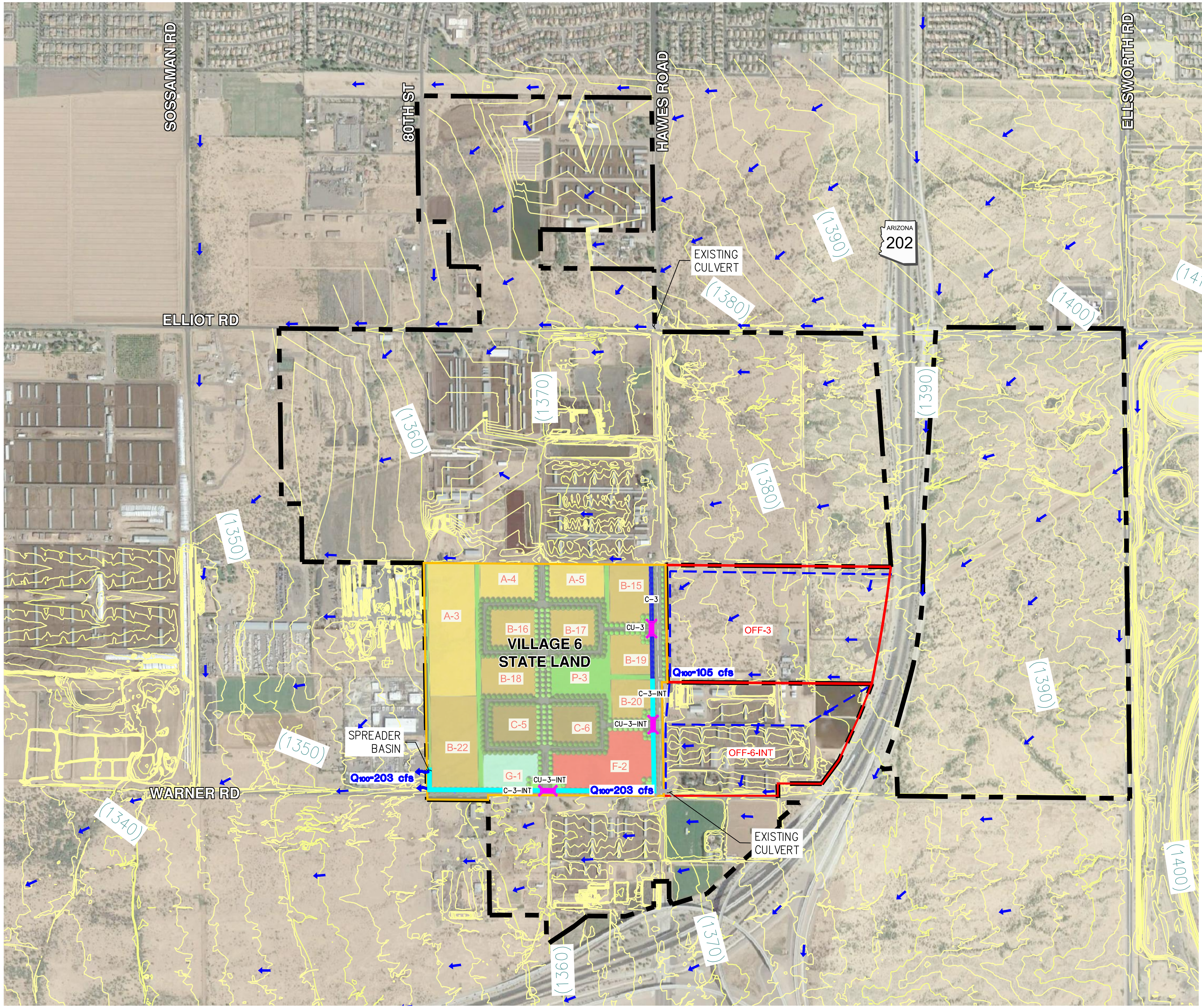
HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 10: VILLAGE 5 INTERIM DRAINAGE EXHIBIT

PROJ. NO.:	1833
DATE:	OCT 2019
SCALE:	1" = 1,200'
DRAWN BY:	SL
CHECKED BY:	BB

U:\1800\1833\1833.0101 – Mesa-Casa Grande\REPORTS\DRAINAGE\Exhibits\1833 Fig 10 – Village 5 Drainage Exhibit.dwg 10/9/2019 11:02 AM



LEGEND

PROJECT BOUNDARY	▬ ▬ ▬
VILLAGE BOUNDARY	―
PERMANENT CHANNEL	―
INTERIM CHANNEL	―
CULVERT	⋈

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

N

1200 600 0 1200

SCALE FEET

GREEY|PICKETT

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2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

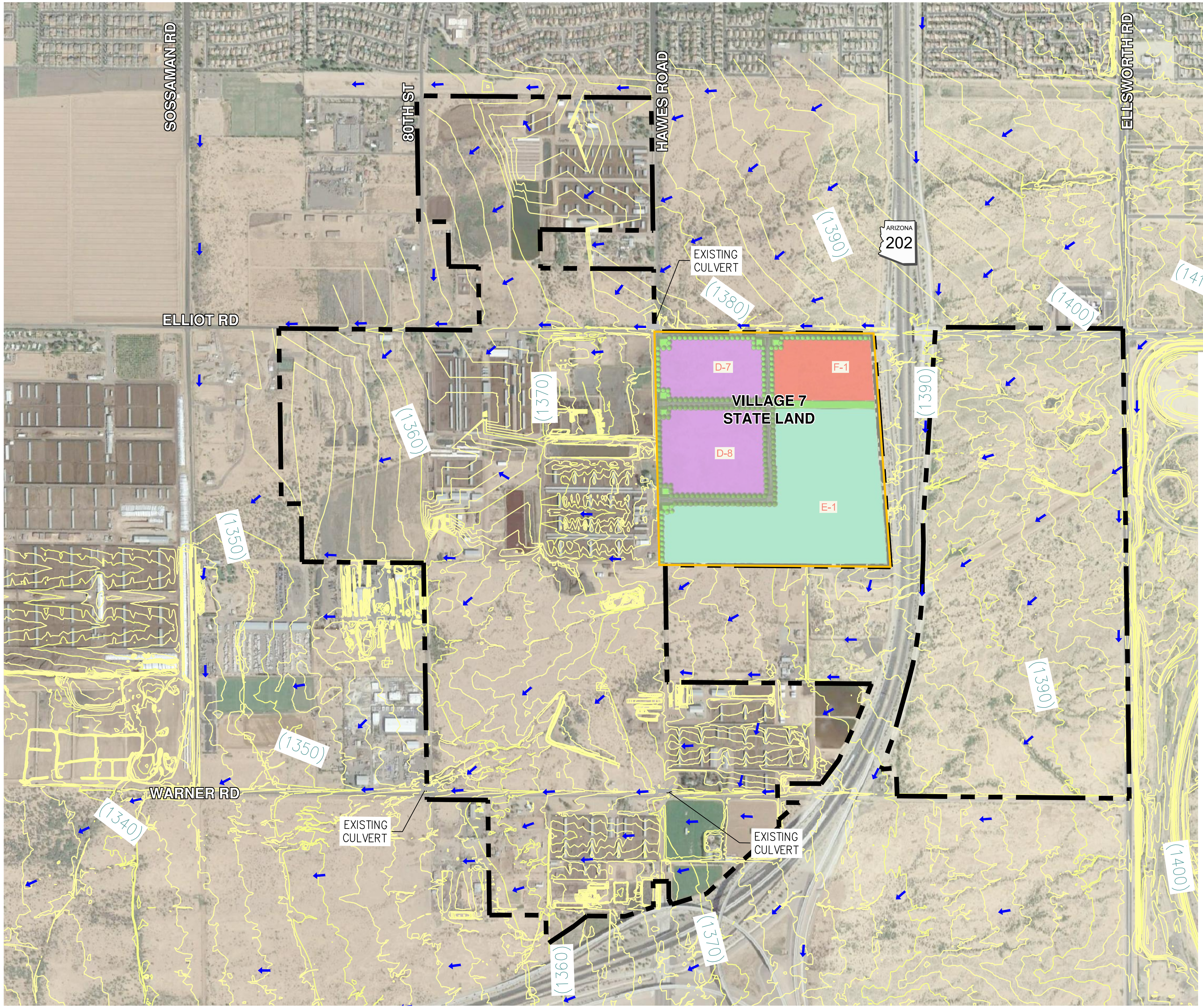
HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 11: VILLAGE 6 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB

U:\1800\1833\1833.0101 - Mesa-Casa Grande\REPORTS\DRAINAGE\Exhibits\1833 Fig 11 - Village 6 Drainage Exhibit.dwg 10/9/2019 11:02 AM



LEGEND

PROJECT BOUNDARY	━ ━ ━
VILLAGE BOUNDARY	━
PERMANENT CHANNEL	━
INTERIM CHANNEL	━
CULVERT	⌶

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

N

1200 600 0 1200

SCALE FEET

GREEY|PICKETT

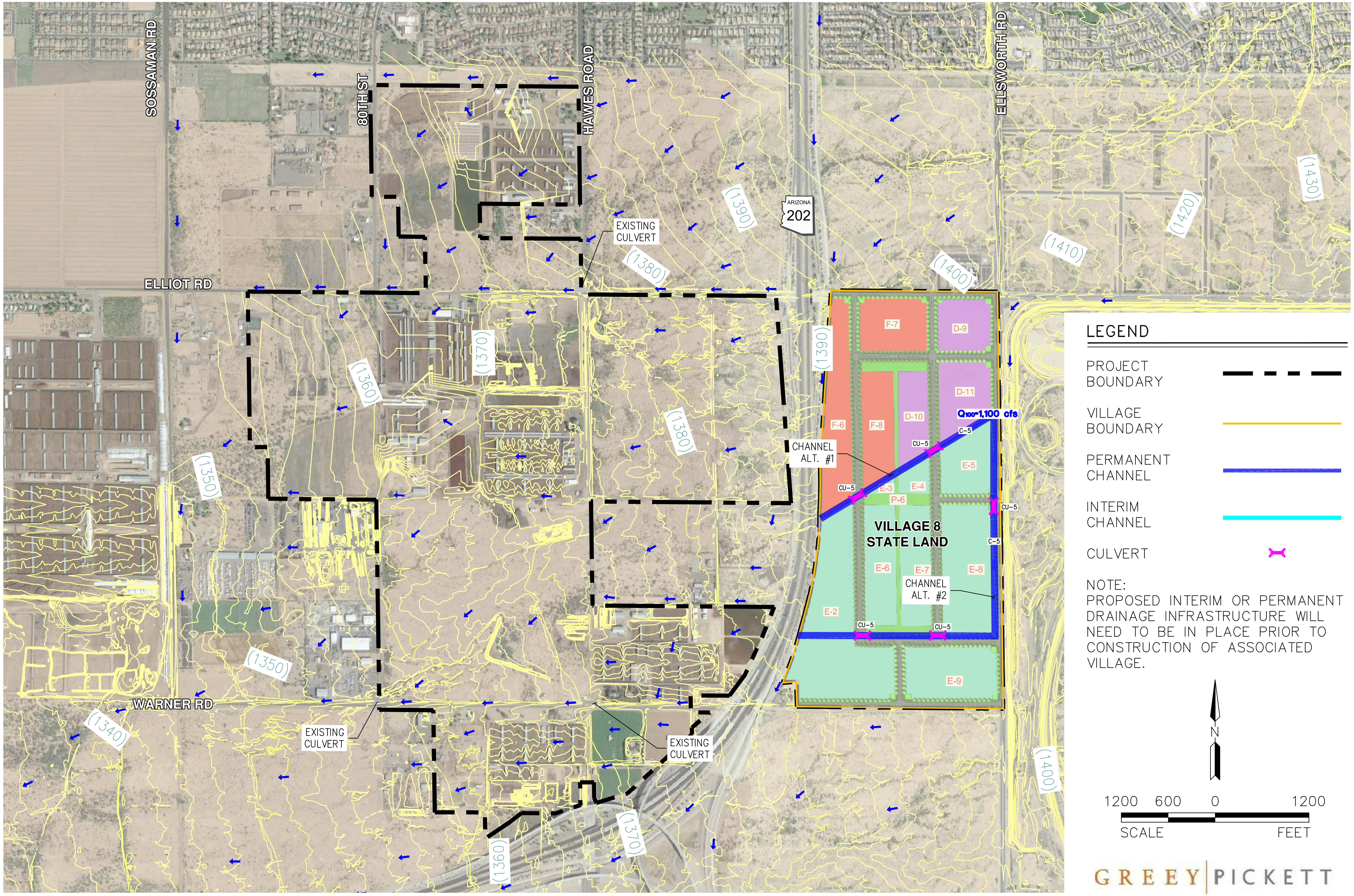
HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 12: VILLAGE 7 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB



LEGEND

PROJECT BOUNDARY	▬ ▬ ▬
VILLAGE BOUNDARY	▬
PERMANENT CHANNEL	▬
INTERIM CHANNEL	▬
CULVERT	⋈

NOTE:
PROPOSED INTERIM OR PERMANENT DRAINAGE INFRASTRUCTURE WILL NEED TO BE IN PLACE PRIOR TO CONSTRUCTION OF ASSOCIATED VILLAGE.

GREEY | PICKETT

HILGARTWILSON
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PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

HAWES CROSSING

CITY OF MESA, ARIZONA

FIG 13: VILLAGE 8 INTERIM DRAINAGE EXHIBIT

PROJ. NO.: 1833
DATE: OCT 2019
SCALE: 1" = 1,200'
DRAWN BY: SL
CHECKED BY: BB

APPENDIX B

PREVIOUS DRAINAGE STUDIES

ELLIOT OUTFALL CHANNEL

DESIGN REPORT

July, 2004

Prepared For:
Flood Control District of Maricopa County
Chief Engineer & General Manager

Prepared by:
Engineering Division
Flood Control District of Maricopa County

FCD Project No. 442-04-31

Registered Professional Engineer Civil
CERTIFICATE NO.
15608
JEFFREY R.
RIDDLE
Date Signed 7/15/04
ARIZONA, U.S.A.

Jeffrey R. Riddle

Elliot Outfall Channel

Design Report

July, 2004

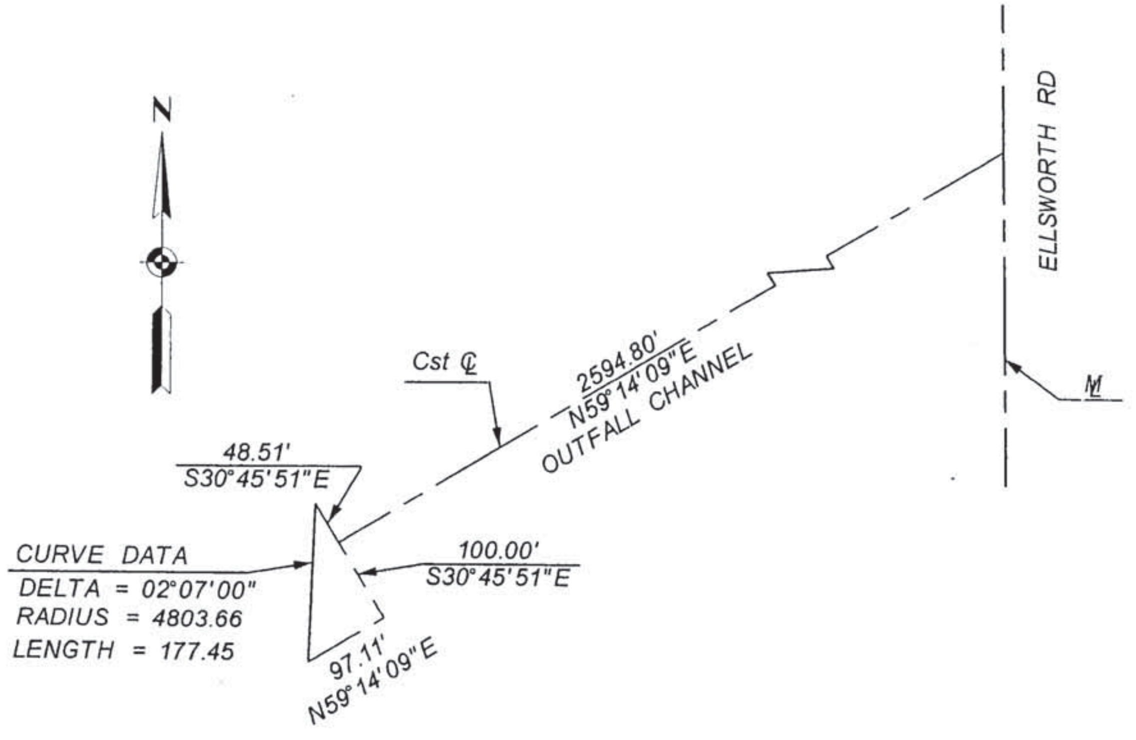

N
ELLSWORTH RD
2594.80'
N59° 14' 09"E
OUTFALL CHANNEL
Cst ℄
M℄
48.51'
S30° 45' 51"E
CURVE DATA
DELTA = 02°07'00"
RADIUS = 4803.66
LENGTH = 177.45
100.00'
S30° 45' 51"E
97.11'
N59° 14' 09"E

Figure 2

2.0 SELECTED CHANNEL ALTERNATIVE

The selected cross section for this project is an 10-foot deep trapezoidal section with a 20-foot bottom and 6:1 side slopes. The bottom and sides will be planted with native grass. This conforms with the channel on the west side of Ellsworth Road. This section is shown in Figure 3.

3.0 HYDROLOGIC ANALYSIS

The Project will be designed to convey the 100-year flow identified in the East Mesa Area Drainage Master Plan, which is 1100 cfs. No significant inflow locations exist along the Project length. Therefore, no additional field investigation of the HEC-1 is required to refine inflow values.

4.0 HYDRAULIC ANALYSIS

The proposed channel improvements have been analysed using HECRAS and the output is shown in Appendix I.

5.0 CONSTRUCTION COST ESTIMATE

The estimated constructed cost for this project is $502.247.96. A complete construction cost estimate is shown in Appendix II.

6.0 CONSTRUCTION SPECIAL PROVISIONS

The Construction Special Provisions are shown in Appendix III.

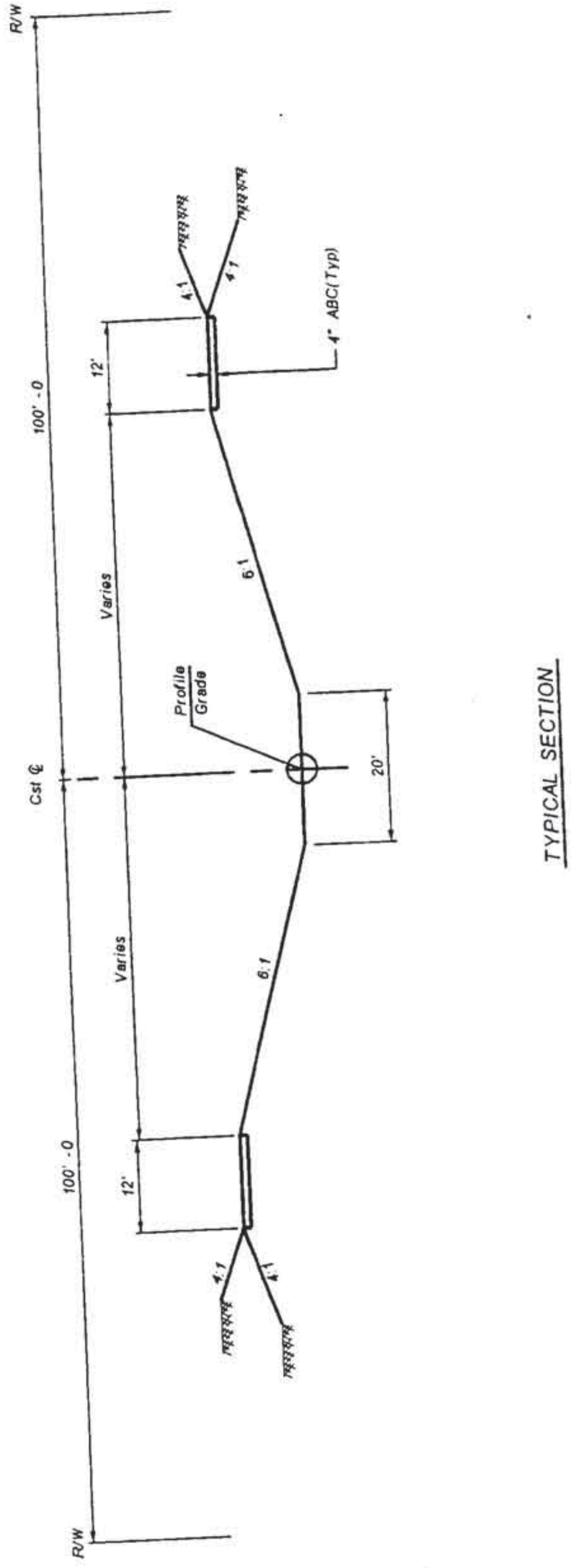

R/W
100' - 0
12'
4:1
4:1
4" ABC(Typ)
Varies
6:1
Profile
Grade
Cst ℄
20'
Varies
6:1
100' - 0
12'
4:1
4:1
R/W
TYPICAL SECTION

Figure 3

7.0 SUPPLEMENTARY GENERAL CONDITIONS

The Supplementary General Conditions Provisions are included in Appendix IV.

8.0 CONSTRUCTION PLANS

The Construction Plans are included in Appendix V.

APPENDIX I

HECRAS OUTPUT

HEC-RAS Plan: Plan 01 River: Stream Reach: Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
Reach	2700	PF 1	1100.00	1389.00	1392.57	1392.28	1393.43	0.016456	7.45	147.72	62.78	0.86	1397.00	1397.00
Reach	2612.280	PF 1	1100.00	1386.91	1392.53		1392.74	0.002373	3.65	301.59	87.38	0.35	1394.91	1394.91
Reach	2512.280	PF 1	1100.00	1386.81	1392.25		1392.48	0.002733	3.84	286.21	85.25	0.37	1394.81	1394.81
Reach	2412.280	PF 1	1100.00	1386.71	1391.91		1392.18	0.003334	4.14	265.88	82.33	0.41	1394.71	1394.71
Reach	2312.280	PF 1	1100.00	1386.61	1391.45		1391.78	0.004566	4.65	236.77	78.00	0.47	1394.61	1394.61
Reach	2212.280	PF 1	1100.00	1386.51	1390.06	1389.79	1390.94	0.016779	7.50	146.68	62.59	0.86	1394.51	1394.51
Reach	2112.280	PF 1	1100.00	1384.41	1390.03		1390.24	0.002371	3.65	301.69	87.41	0.35	1392.41	1392.41
Reach	2012.280	PF 1	1100.00	1384.31	1389.75		1389.98	0.002734	3.84	286.14	85.24	0.37	1392.31	1392.31
Reach	1912.280	PF 1	1100.00	1384.21	1389.41		1389.67	0.003337	4.14	265.83	82.33	0.41	1392.21	1392.21
Reach	1812.280	PF 1	1100.00	1384.11	1388.94		1389.28	0.004572	4.65	236.60	77.94	0.47	1392.11	1392.11
Reach	1712.280	PF 1	1100.00	1384.01	1387.56	1387.29	1388.44	0.016738	7.49	146.82	62.63	0.86	1392.01	1392.01
Reach	1612.280	PF 1	1100.00	1381.91	1387.53		1387.74	0.002372	3.65	301.63	87.39	0.35	1389.91	1389.91
Reach	1512.280	PF 1	1100.00	1381.81	1387.25		1387.48	0.002740	3.85	285.93	85.21	0.37	1389.81	1389.81
Reach	1412.280	PF 1	1100.00	1381.71	1386.91		1387.17	0.003335	4.14	265.87	82.32	0.41	1389.71	1389.71
Reach	1312.280	PF 1	1100.00	1381.61	1386.44		1386.78	0.004582	4.65	236.42	77.92	0.47	1389.61	1389.61
Reach	1212.280	PF 1	1100.00	1381.51	1385.09	1384.79	1385.94	0.016344	7.43	148.10	62.87	0.85	1389.51	1389.51
Reach	1112.280	PF 1	1100.00	1379.41	1385.05		1385.25	0.002330	3.62	303.58	87.65	0.34	1387.41	1387.41
Reach	1012.280	PF 1	1100.00	1379.31	1384.78		1385.00	0.002680	3.82	288.31	85.56	0.37	1387.31	1387.31
Reach	912.2800	PF 1	1100.00	1379.21	1384.45		1384.71	0.003231	4.09	269.01	82.79	0.40	1387.21	1387.21
Reach	812.2800	PF 1	1100.00	1379.11	1384.30		1384.33	0.004333	4.56	241.36	78.68	0.46	1387.11	1387.11
Reach	712.2800	PF 1	1100.00	1379.01	1382.29	1382.29	1383.40	0.023321	8.46	130.05	59.33	1.01	1387.01	1387.01
Reach	612.2800	PF 1	1100.00	1376.77	1381.67		1381.99	0.004322	4.55	241.59	78.72	0.46	1384.77	1384.77
Reach	512.2800	PF 1	1100.00	1376.67	1379.95	1379.95	1381.06	0.023432	8.47	129.81	59.26	1.01	1384.67	1384.67
Reach	412.2800	PF 1	1100.00	1376.57	273.40	57.68	273.43	0.001002		809.99	5.93	0.00	1384.69	1376.57

APPENDIX V

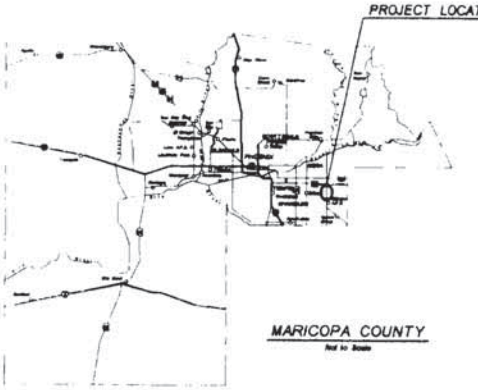
CONSTRUCTION PLANS

TRIAL VERSION of TIFF

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

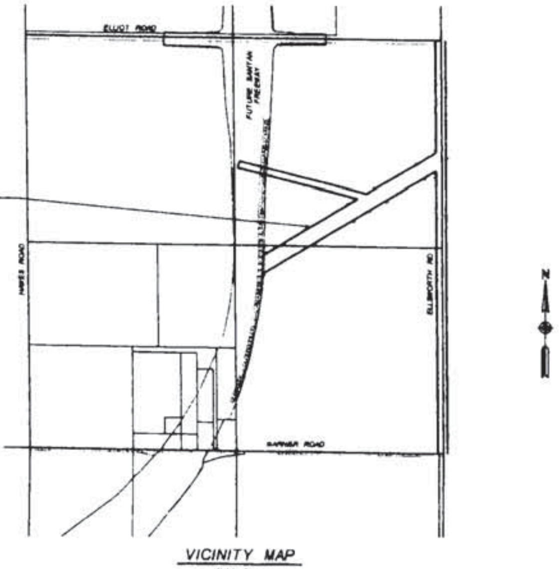
IN COOPERATION WITH THE CITY OF MESA
AND MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

PLANS FOR THE CONSTRUCTION OF
ELLIOT OUTFALL CHANNEL
FCD PROJECT CONTROL NO. 4420431
FCD CONTRACT NO. 2004CO38



MARICOPA COUNTY

Not to Scale



VICINITY MAP

Not to Scale

CITY OF MESA — DATE

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION — DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ISSUED FOR PUBLIC BIDDING BY

CHIEF ENGINEER AND GENERAL MANAGER

THE FLOOD CONTROL DISTRICT

ANDY KUNASEK - CHAIRMAN

DISTRICT 1	FULTON BROCK
DISTRICT 2	DON STAPLEY
DISTRICT 3	ANDY KUNASEK
DISTRICT 4	MAX WILSON
DISTRICT 5	MARY ROSE WILCOX

TRIAL VERSION of TIFFDLL

GENERAL NOTES

1. ALL CONSTRUCTION TO BE PERFORMED ACCORDING TO APPLICABLE MAG STANDARD DETAILS AND MAG SPECIFICATIONS, DATED 1998 AND REVISIONS THROUGH 2003
2. FACILITIES WHICH ARE NOT SPECIFICALLY LOCATED WITH ACTUAL HORIZONTAL AND VERTICAL CONTROLS ARE APPROXIMATE AND TO THE BEST AVAILABLE INFORMATION
3. EXISTING UTILITIES AND OTHER FACILITIES HAVE BEEN PLACED ON THE PLANS FROM FIELD SURVEYS, EXISTING MAPS AND OTHER CURRENT PLANS WITHIN THE AREA OF THIS PROJECT. THE CONTRACTOR WILL DETERMINE THE EXACT LOCATION AND/OR ELEVATION OF EXISTING UTILITIES WHICH PERTAIN TO AND AFFECT THE CONSTRUCTION OF THIS PROJECT
4. TWO (2) WORKING DAYS PRIOR TO EXCAVATING, THE CONTRACTOR SHALL CALL FOR BLUE STAKE AT THE BLUE STAKE CENTER CENTER (PHONE 1800-STAKEIT)
5. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS PRIOR TO CONSTRUCTION
6. THE FLOOD CONTROL DISTRICT OR CITY OF MESA IS NOT RESPONSIBLE FOR LIABILITY ACCRUED DUE TO DELAYS AND/OR DAMAGE TO UTILITIES IN CONJUNCTION WITH THIS CONSTRUCTION
7. ANY WORK PERFORMED WITHOUT THE APPROVAL OF THE FLOOD CONTROL DISTRICT AND/OR THE ENGINEER AND ALL WORK AND MATERIALS NOT IN CONFORMANCE WITH THE SPECIFICATIONS IS SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE
8. THE ENGINEER WILL DETERMINE THE NUMBER AND LOCATION OF THE REQUIRED COMPACTION TESTS FOR STRUCTURAL BACKFILL
9. TRAFFIC CONTROL SHALL BE MAINTAINED IN ACCORDANCE WITH MAG SPECIFICATION 401, PART VI OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (1988 EDITION) INCLUDING REVISION 3 DATED SEPTEMBER 3, 1993
10. CONTRACTOR SHALL REPLACE PAVEMENT TO THE EXISTING GRADES SHOWN ON THE PLANS
11. EXACT POINT OF MATCHING TERMINATION AND OVERLAY WILL BE DETERMINED IN THE FIELD BY THE ENGINEER
12. NO JOB WILL BE CONSIDERED COMPLETED UNTIL CURBS, PAVEMENT AND SIDEWALKS HAVE BEEN SWEPT CLEAN OF ALL DIRT AND DEBRIS
13. PRIOR TO FINAL APPROVAL AND ACCEPTANCE OF THE WORK, THE CONTRACTOR WILL BE REQUIRED TO CLEAN ADJACENT (OFF-PROJECT) ROADWAYS USED DURING THE COURSE OF CONSTRUCTION
14. ALL COMPACTION AND BACKFILL WITHIN COUNTY RIGHT-OF-WAY SHALL CONFORM TO THE SPECIAL PROVISIONS FOR CONSTRUCTION OF STREET IMPROVEMENTS AND INSTALLATION OF UNDERGROUND UTILITIES. BACKFILL UNDER ANY EXISTING OR PROPOSED PAVEMENT, CURB, GUTTER OR WITHIN TWO FEET (2') OR LESS FROM THE EDGE OF PAVEMENT SHALL CONSIST OF AGGREGATE BASE COURSE (ABC) MATERIAL

STRUCTURAL NOTES

1. ALL CONSTRUCTION SHALL CONFORM TO MAG STANDARDS DETAILS, SPECIFICATIONS, DATED 1998, INCLUDING ALL REVISIONS THRU 2003
2. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, DIVISION 1, 17TH EDITION, 2002
3. REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A615 GRADE 60
4. STRESSES - fs = 24,000 PSI - GRADE 60 REINFORCING STEEL
5. ALL REINFORCING STEEL PLACEMENT DIMENSIONS SHALL BE TO THE CENTER OF BARS UNLESS OTHERWISE NOTED
6. ALL REINFORCING STEEL SHALL HAVE 2" CLEAR COVER UNLESS OTHERWISE NOTED
7. STRUCTURAL STEEL SHALL CONFORM TO ASTM SPECIFICATION A36
8. ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF THE AMERICAN WELDING SOCIETY, STRUCTURAL WELDING CODE, REVISION 1996
9. DIMENSIONS SHALL NOT BE SCALED FROM DRAWING
10. CHAMFER ALL EXPOSED CORNERS 3/4" UNLESS OTHERWISE NOTED
11. CONCRETE COMPRESSIVE STRENGTH SHALL BE 3,000 PSI MAG, UNLESS OTHERWISE NOTED

INDEX OF SHEETS

ABBREVIATIONS

CST	CONSTRUCTION
DBL	DOUBLE
DESC	DESCRIPTION
EQ	EQUAL
FOC	FIBER OPTIC CABLE
G	GUTTER ELEVATION
OP	OVERHEAD ELECTRIC
P	PAVEMENT ELEVATION
PG	PAGE
P/L	PROPERTY LINE
PRV	PRIVATE
SPG	SPACING
STR	STRUCTURE
UGT	UNDERGROUND TELE CABLE
TBM	TEMPORARY BENCHMARK
TC	TOP OF CURB ELEVATION
TW	TOP OF WALL ELEVATION
TG	TOP OF GRATE ELEVATION

PROJECT BENCHMARKS

FD BC IN HH
℄ Elliot Rd & Ellsworth Rd
EL 1403.08

DESIGN DISCHARGES

Design Q = 1,100 CFS

NO	REVISION	BY	DATE

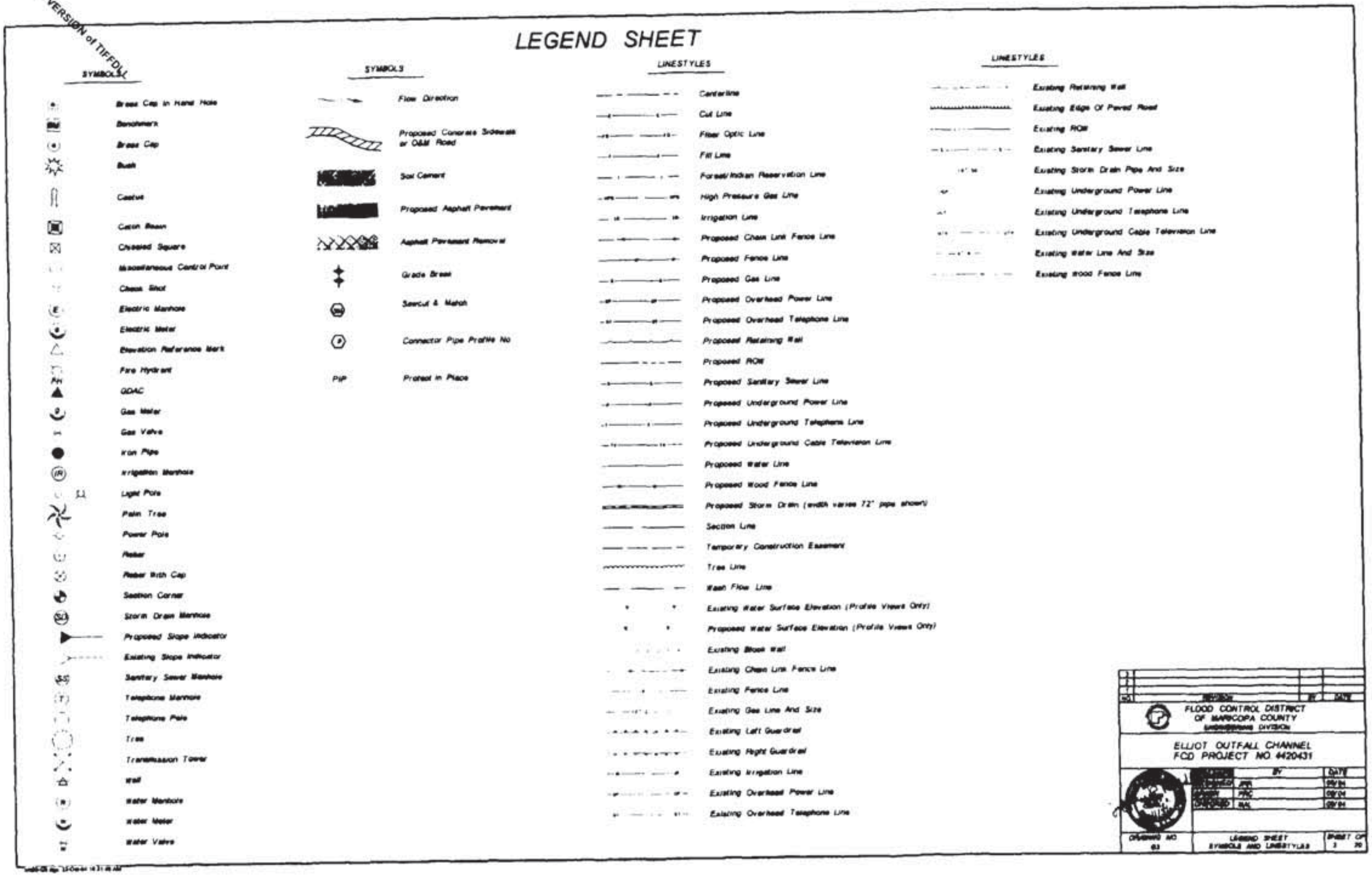
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4420431

	BY	DATE
DESIGNED	JRR	09/04
DRAWN	PRC	09/04
CHECKED	[illegible]	09/04

DRAWING NO		SHEET OF
G2	GENERAL NOTES INDEX OF SHEETS	2 20

TRIAL VERSION of TIFFDLL



TRIAL VERSION of TIFFDLL

NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
7	865,026.14	788,425.07	1414.30	Railroad Spike Centerline Elliot Rd & 96th St Alignment
▲ 12	865,042.58	785,786.34	1403.09	BC in HH Centerline Elliot Road & Ellsworth Rd
13	867,678.33	785,746.56	--	BC in HH Centerline Ellsworth Rd & Paloma Ave Alignment
14	865,058.36	783,130.65	--	BC in HH Centerline Elliot Road & 96th St Alignment
15	852,420.00	785,758.70	--	BC in HH Centerline Ellsworth Rd & Mesquite St Alignment
100	863,542.87	785,771.10	--	Control Point
101	862,216.42	783,041.48	--	Control Point
102	863,196.73	782,751.40	--	Control Point
103	862,776.41	784,482.19	--	Control Point

NOTES

Elevations are on City of Mesa Datum

▲ Project Benchmark

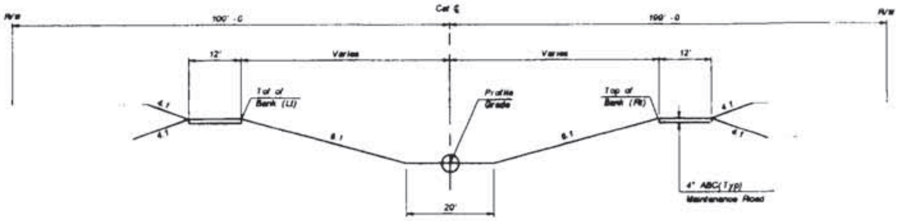
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4430431

	BY	DATE
DESIGNED	JRR	08/04
DRAWN	PRC	08/04
CHECKED	MAL	08/04

DRAWING NO.		SHEET OF
04	GEOMETRIC LAYOUT	4 38

TRIAL VERSION of TIFFDLL



TYPICAL SECTION
NTS

REVISION	BY	DATE

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4420431

	BY	DATE
DESIGNED	JBR	[illegible]
DRAWN	FRC	[illegible]
CHECKED	WSL	[illegible]

DRAWING NO.		SHEET OF
06	TYPICAL SECTION	6 36

TRIAL VERSION of TIFFDLL

QUANTITY SUMMARY

ELLIOT OUTFALL CHANNEL

NO.	DESCRIPTION	UNIT	SHEET NUMBERS																			QTY
			C1	C2	C3	C4	C5															
211-1	Channel Fill	CY				2,340	7,898															10,238
216-2	Channel Excavation	CY	10,013	20,268	8,919																	39,200
310-1	ABC Maintenance Road (4")	SY	2,380	2,367	2,060																	6,807
420-1	6' Chain Link Fence	LF	280																			280
420-2	24' Chain Link Fence Gate	EA	2		2																	4
420-3	6' Break Away Fence	LS	1																			1
430-3	Native Seed Mix	SY	8,999	16,884	6,444	4,096	16,800															52,984
505-5	Concrete Grade Control Structure	EA	4	4	2																	10
505-8	Concrete Sediment Trap	EA	1																			1
505-7	Concrete Channel Lining	SY	2,086																			2,086

NO.	REVISION	BY	DATE
1			
2			
3			

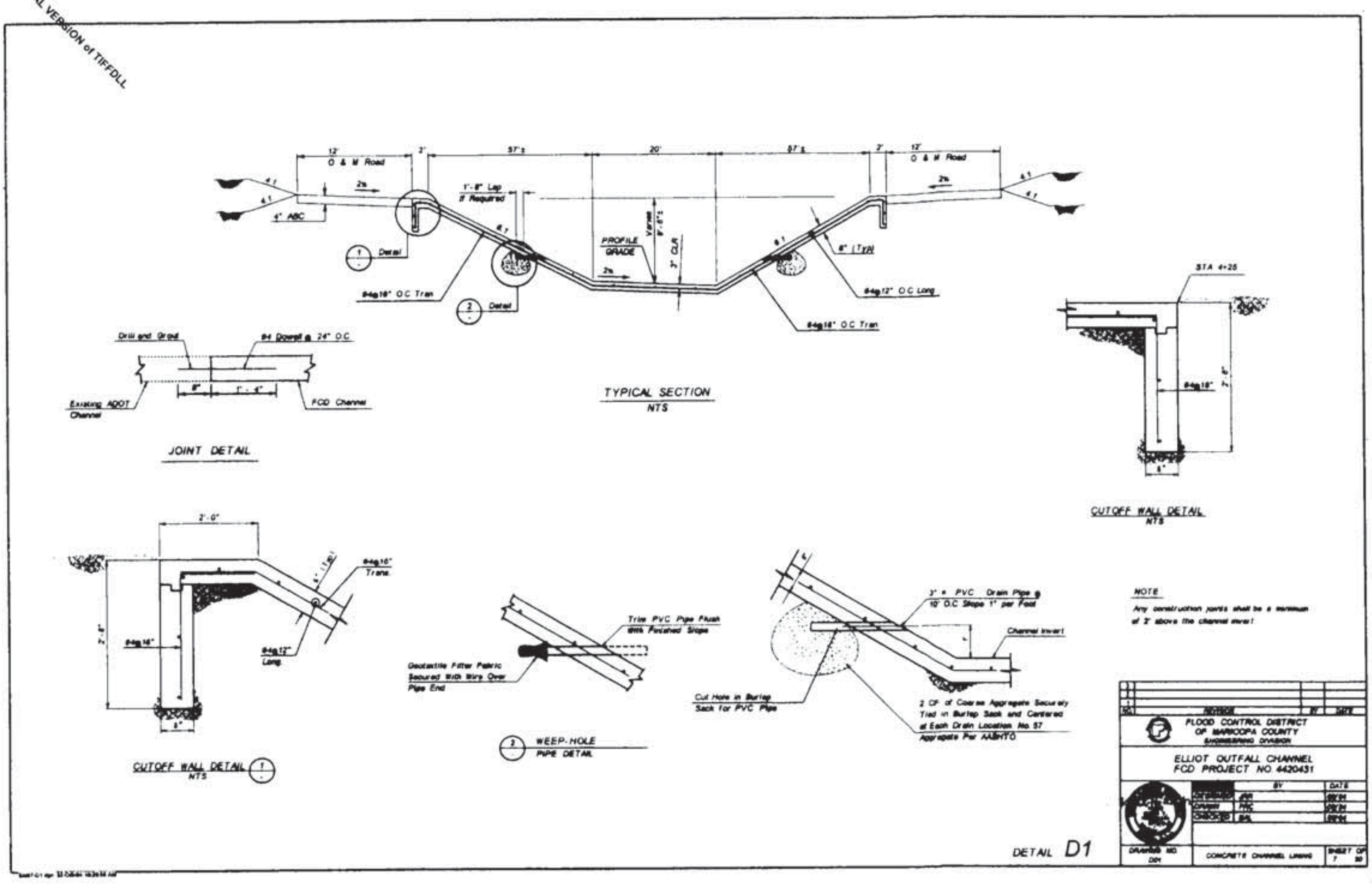
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4420431

	BY	DATE
DESIGNED	JPR	11/92
DRAWN	FRC	11/92
CHECKED	WAL	11/92

DRAWING NO.		SHEET OF
Q001	QUANTITY SUMMARY SHEET	4 20

TRIAL VERSION of TIFFDLL



NOTE

Any construction joints shall be a minimum of 2' above the channel invert

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO 4420431

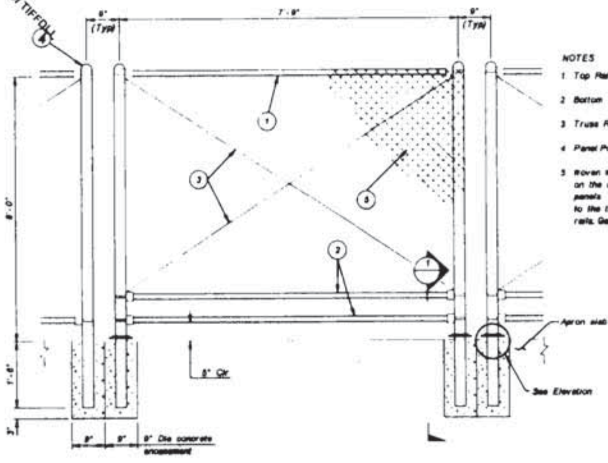
	BY	DATE
DESIGNED	[illegible]	[illegible]
DRAWN	[illegible]	[illegible]
CHECKED	[illegible]	[illegible]

DRAWING NO. D01

CONCRETE CHANNEL LINING

SHEET 7 OF 30

TRIAL VERSION of TIFFDLL



COLLAPSIBLE FENCE PANEL

(2 REQUIRED - Centered Across Spillway)
NTS

NOTES

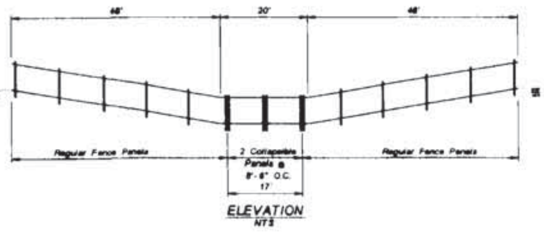
1 Top Rail - 1 1/2" ⌀ Std

2 Bottom Rail - 1 1/2" ⌀ Std

3 Truss Rods - 1/2" ⌀

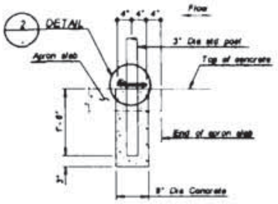
4 Panel Posts - 3" ⌀ Std

5 Woven Wire Fabric - To be placed on the upstream side of the fence panels. The fabric shall be tied to the truss rods, panel posts and rails. Galvanize all elements

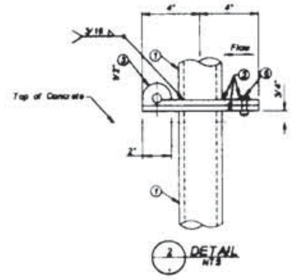


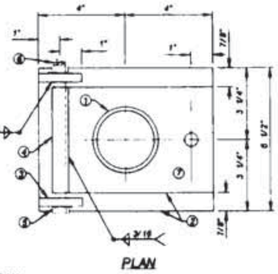
ELEVATION

NTS



ELEVATION





HINGE PLATE DETAIL

NTS

PLAN

NOTES:

1 3" ⌀ Std Pipe

2 ℄ - 3/8" w/ 3/16" ⌀ x 1" Long Machine Bolt w/ Hex Nut and Medium Split Lock Washer. Zinc-Plated Finish on Bolt Washer and Nut

3 ℄ - 3/8" w/ 9/16" ⌀ Hole

4 1/2" ⌀ Std Pipe x 4 5/8" Long

5 1/2" ⌀ Bolt w/ Nut and Washers

6 Jam threads after nut is in place

7 All Plates, Bolts, & Nuts shall be galvanized

DETAIL D2

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO 4420431

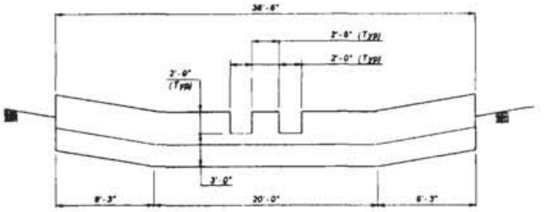
	BY	DATE
DESIGNED	KVN	08/94
DRAWN	RRC	08/94
CHECKED	JRR	08/94

DRAWING NO. D88

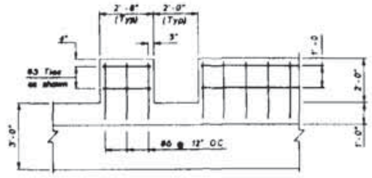
COLLAPSIBLE FENCE DETAILS

SHEET 8 OF 39

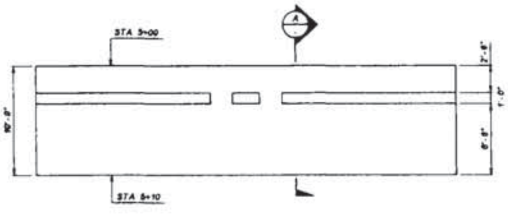
TRIAL VERSION of TIFFDLL



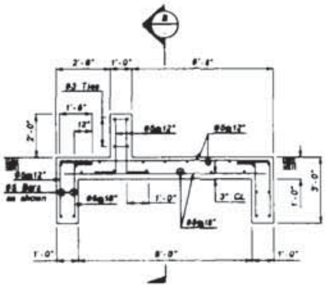
ELEVATION - SEDIMENT TRAP
NTS



B TYPICAL REINFORCING
Scale 1/2" = 1'-0"



PLAN
NTS



A SECTION
Scale 1/2" = 1'-0"

DETAIL D3

NO.	REVISION	BY	DATE
3			
2			
1			

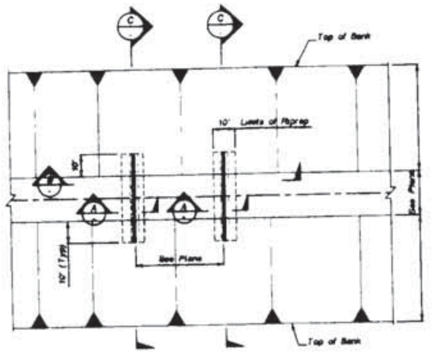
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4420431

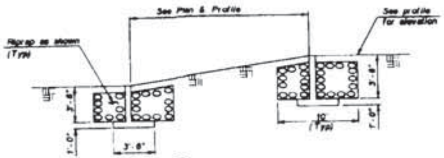
	BY	DATE
DESIGNED	KVH	05/94
DRAWN	RRC	05/94
CHECKED	JBR	05/94

DRAWING NO.		SHEET OF
D03	SEDIMENT TRAP DETAIL	9 36

TRIAL VERSION of TIFFDLL



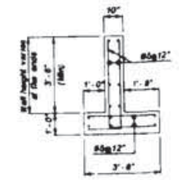
PLAN
NTS



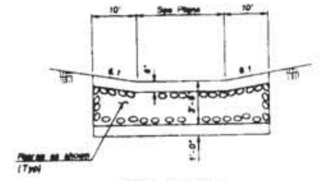
(B) SECTION
NTS

NOTES

D_{50} = 18 INCHES



(A) DETAIL
NTS



(C) SECTION
NTS

CHANNEL GRADE CONTROL STRUCTURE

DETAIL D4

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4420431

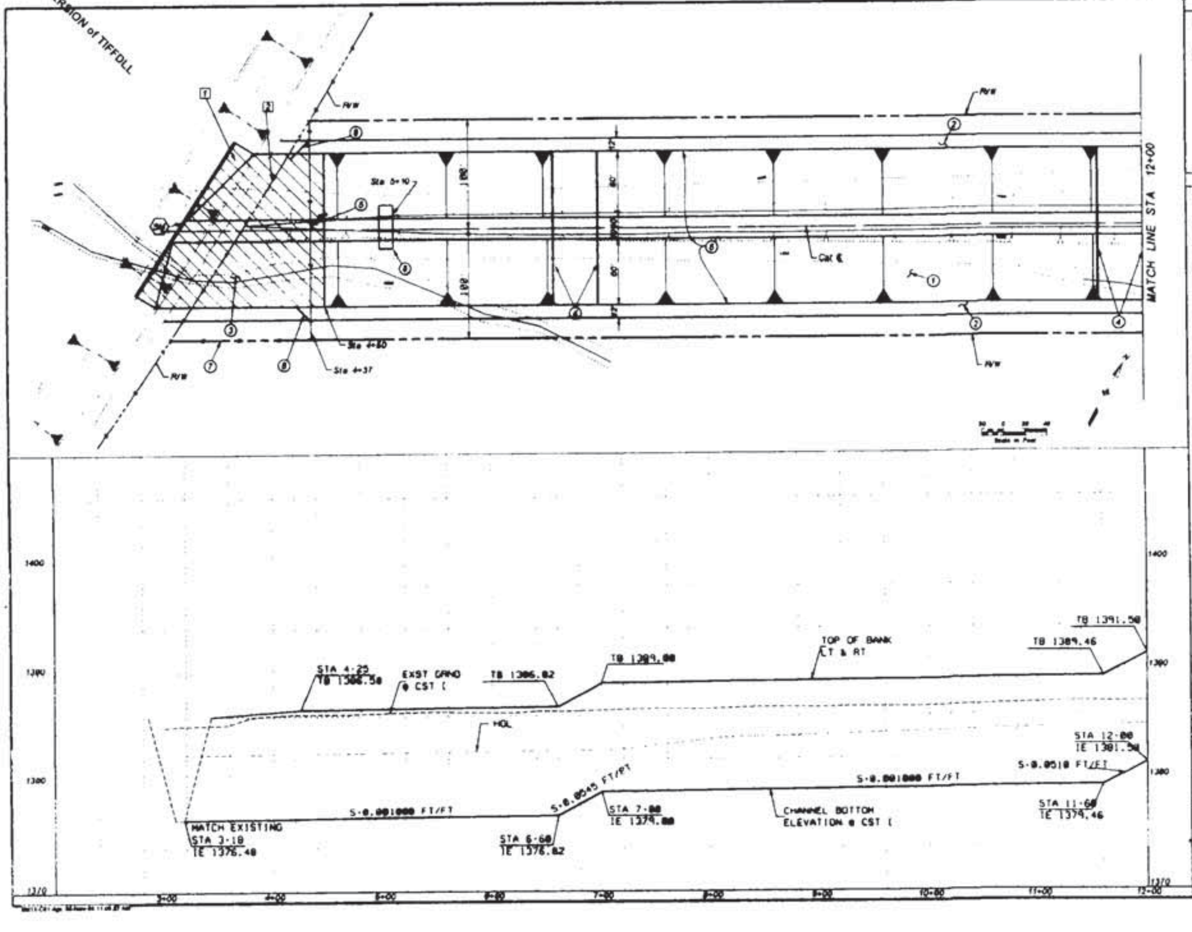
	BY	DATE
DESIGNED	KVH	08/04
DRAWN	PRC	08/04
CHECKED	JRR	08/04

DRAWING NO. D04

GRADE CONTROL STRUCTURE

SHEET 10 OF 30

TRIAL VERSION of TIFFDLL



☐ REMOVE ☐

1	SAWCUT AND REMOVE CONCRETE CHANNEL LINING	464 SY
2	REMOVE EXISTING CHAIN LINK FENCE	200 LF

○ CONSTRUCT ○

①	CONSTRUCT EARTHEN CHANNEL	10,013 CY
②	CONSTRUCT 4" ABC MAINTENANCE ROAD	2,260 SY
③	CONSTRUCT CONCRETE CHANNEL LINING	2,098 SY
④	CONSTRUCT GRADE CONTROL STRUCTURE	4 EA
⑤	CONSTRUCT BREAK AWAY FENCE	1 LS
⑥	NATIVE SEED MIX	9,989 SY
⑦	INSTALL 6' CHAIN LINK FENCE	260 LF
⑧	INSTALL 24' CHAIN LINK FENCE GATE	2 EA
⑨	CONSTRUCT SEDIMENT TRAP	1 EA

NO	REVISION	BY	DATE
3			
2			
1			

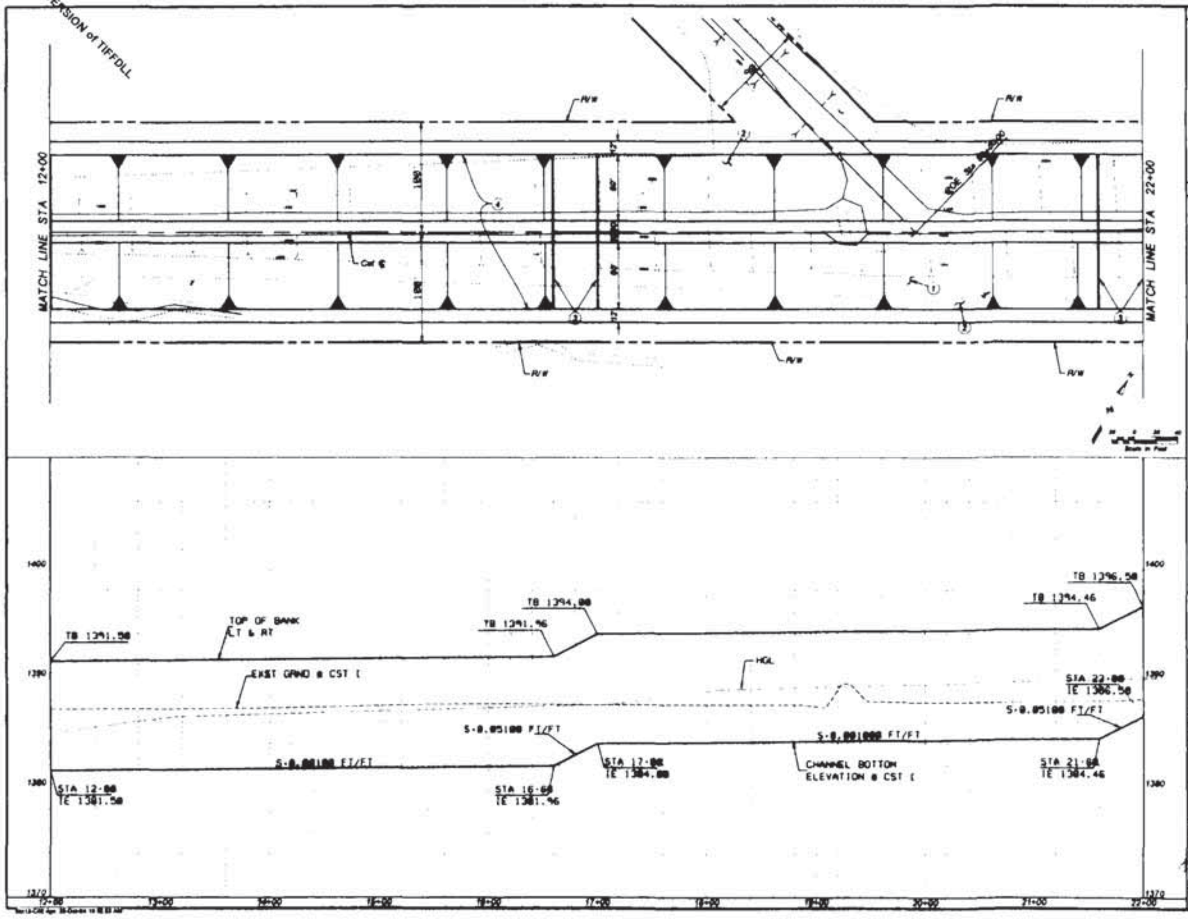
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO 4420431

	BY	DATE
DESIGNED	JAR	08/04
DRAWN	FC	08/04
CHECKED	BAL	08/04

DRAWING NO		SHEET OF
C1	PLAN AND PROFILE STA 4+00 TO STA 17+00	11 20

TRIAL VERSION of TIFFDLL



☐ REMOVE ☐

○ CONSTRUCT ○

①	CONSTRUCT EARTHEN CHANNEL	20,268 CY
②	CONSTRUCT 4" ABC MAINTENANCE ROAD	2,287 SY
③	CONSTRUCT GRADE CONTROL STRUCTURE	4 EA
④	NATIVE SEED MIX	15,556 SY

NO	REVISION	BY	DATE
3			
2			
1			

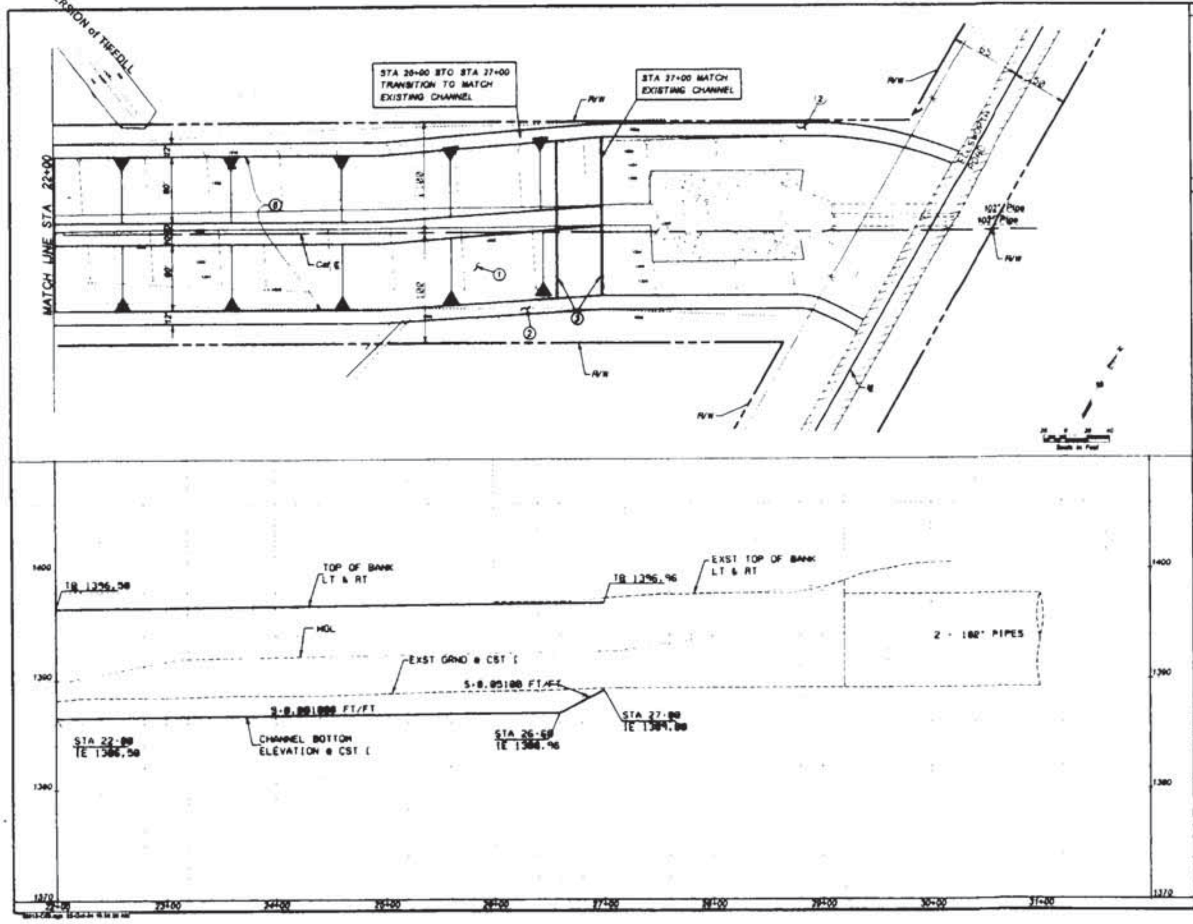
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO 4420431

	BY	DATE
DESIGNED	JRR	09/04
DRAWN	FC	09/04
CHECKED	MRL	09/04

DRAWING NO		SHEET OF
C3	PLAN AND PROFILE STA 12+00 TO STA 22+00	12 20

TRIAL VERSION of TIFFDLL



☐ REMOVE ☐

○ CONSTRUCT ○

① CONSTRUCT EARTHEN CHANNEL
8,919 CY

② CONSTRUCT 4" ABC MAINTENANCE ROAD
2,080 SY

③ CONSTRUCT GRADE CONTROL STRUCTURE
2 EA

④ NATIVE SEED MIX
8,444 SY

NO.	REVISION	BY	DATE
3			
2			
1			

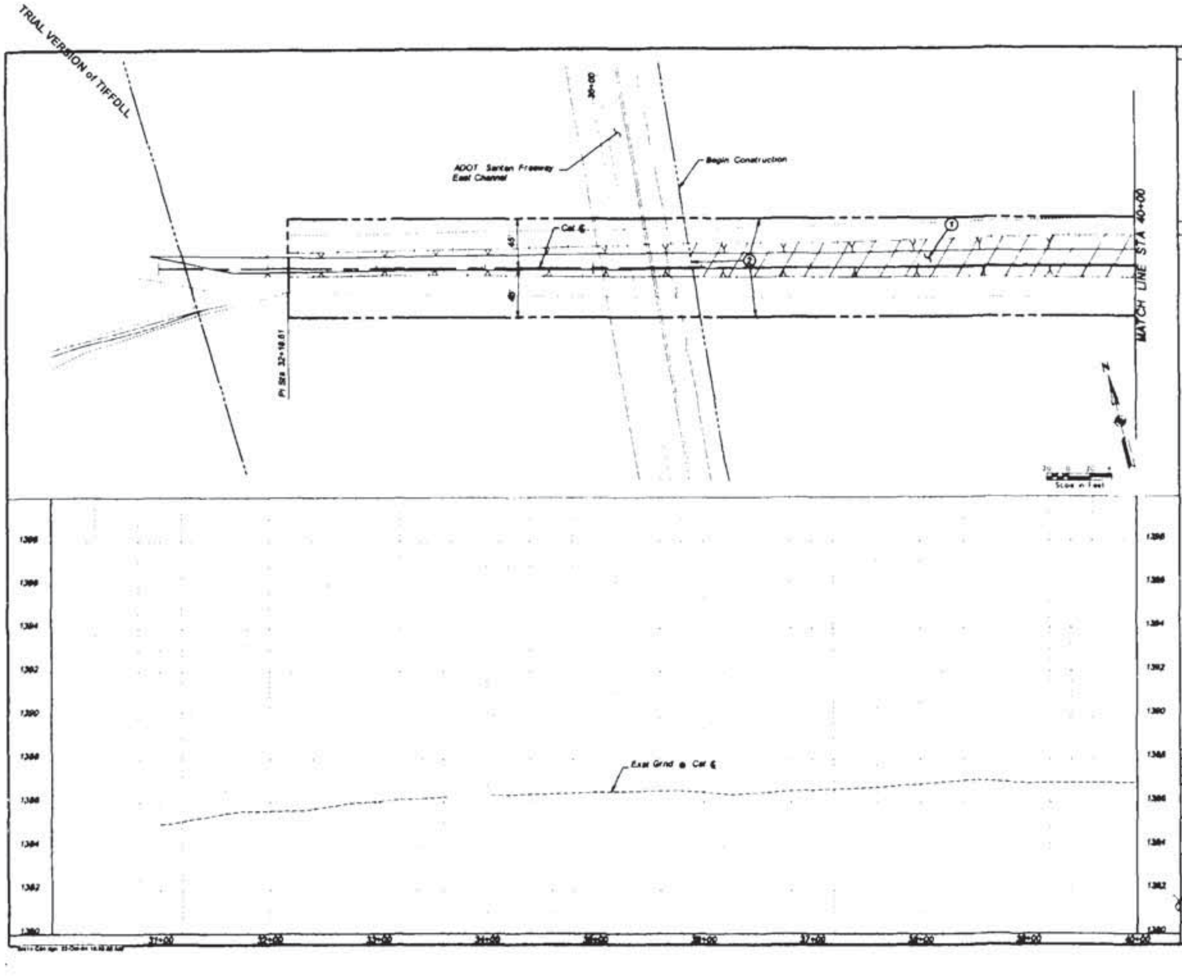
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4430431

	BY	DATE
DESIGNED	JPR	09/04
DRAWN	PC	09/04
CHECKED	BAL	09/04

DRAWING NO.		SHEET OF
C3	PLAN AND PROFILE STA 22+00 TO STA 30+00	13 20

TRIAL VERSION of TIFFDLL



☐ REMOVE ☐

○ CONSTRUCT ○

① BACKFILL & COMPACT EARTHEN CHANNEL	2,349 CY
② NATIVE SEED MIX	4,096 SY

NO.	REVISION	BY	DATE
3			
2			
1			

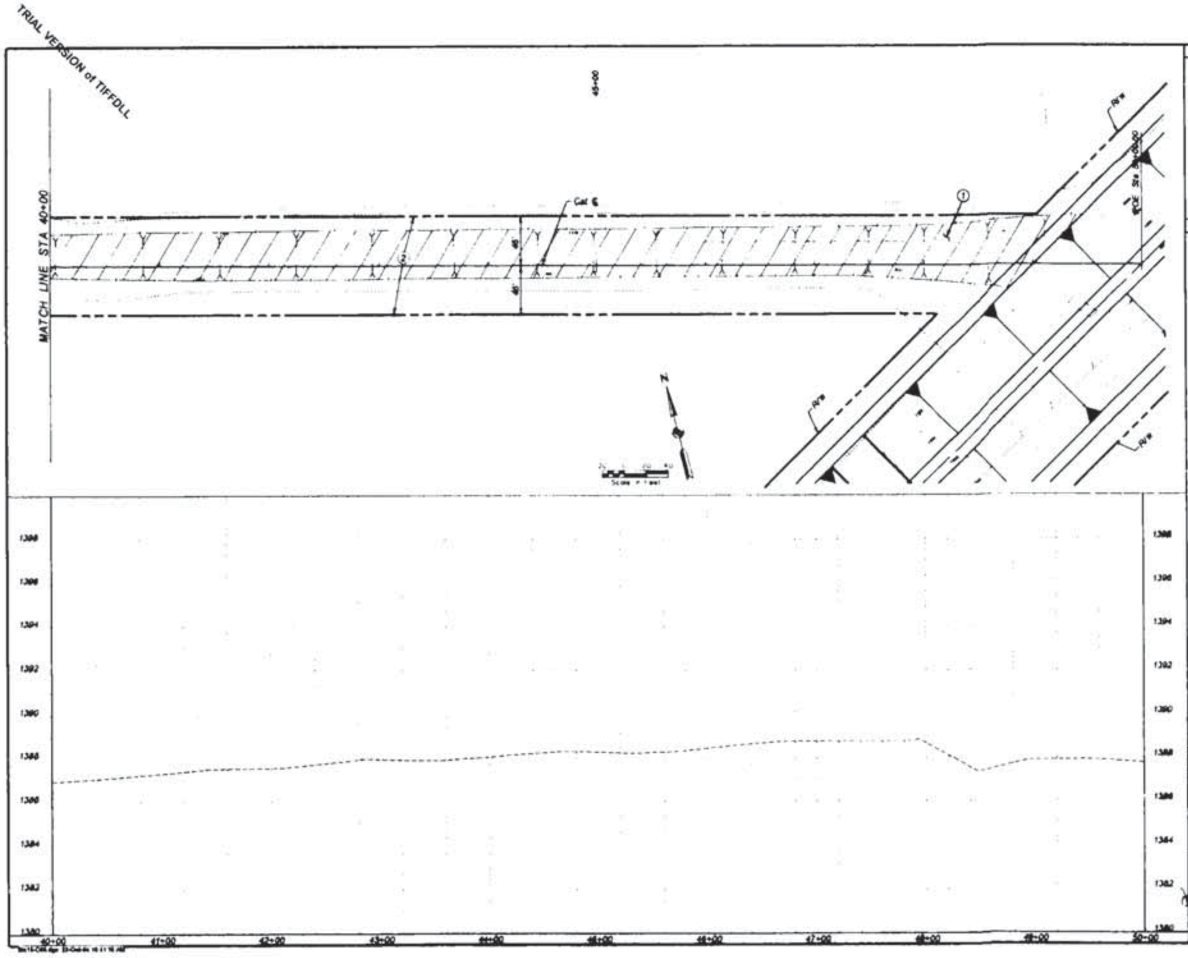
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO. 4420431

	BY	DATE
DESIGNED	JRR	09/04
DRAWN	PC	09/04
CHECKED	MAL	09/04

DRAWING NO.	PLAN AND PROFILE	SHEET OF
C04	30+00 TO 40+00	14 20

TRIAL VERSION of TIFFDLL



☐ REMOVE ☐

○ CONSTRUCT ○

① BACKFILL & COMPACT EARTHEN CHANNEL

7 800 CY

② NATIVE SEED MIX

16,900 SY

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ELLIOT OUTFALL CHANNEL
FCD PROJECT NO 4420431

	BY	DATE
DESIGNED	JRR	08/04
DRAWN	FC	08/04
CHECKED	NAL	08/04

DRAWING NO		SHEET OF
C08	PLAN AND PROFILE STA 40+00 TO 50+00	15 20

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

APPENDIX C

PRELIMINARY HYDROLOGIC CALCULATIONS

RATIONAL METHOD ANALYSIS

DRAINAGE SUBAREA SUMMARY TABLE

Project: Hawes Crossing

Prepared by: BB

Date: Oct, 2019

Drainage Subarea ID(s)	Concentration Point	Land Use Category									Total Area	Total Area	Total Area	Length of Longest Flowpath	Length of Longest Flowpath	Top Elevation	Bottom Elevation	Change in Elevation	Slope	Slope
		Medium Density Residential [ft^2]	Medium/High Density Residential [ft^2]	Urban Density Residential [ft^2]	Urban/ Mixed Use [ft^2]	Technology/ Mixed Use [ft^2]	Commercial [ft^2]	Office [ft^2]	Park/Open Space [ft^2]	Undeveloped Desert [ft^2]	[ft^2]	[ac]	[sq mi]	[ft]	[mi]	[ft]	[ft]	[ft]	[ft/ft]	[ft/mi]
OFFSITE DRAINAGE AREAS																				
OFF-1.1	C-1.1	0	0	0	0	0	0	0	0	1,656,641	1,656,641	38.0	0.0594	2,627	0.498	1,394	1,379	15	0.006	30
OFF-1.2	C-1.2	0	0	0	0	0	0	0	0	2,832,596	2,832,596	65.0	0.102	3,644	0.690	1,397	1,379	18	0.005	26
OFF-1.3	C-1.3	0	0	0	0	0	0	0	0	2,612,001	2,612,001	60.0	0.094	4,978	0.943	1,394	1,376	18	0.004	19
OFF-2	C-1.2	0	0	0	0	0	0	0	0	522,617	522,617	12.0	0.019	4,286	0.812	1,379	1,371	8	0.002	10
OFF-1.1+OFF-1.2+OFF-2	C-1.2	0	0	0	0	0	0	0	0	5,063,316	5,063,316	116.2	0.1816	4,567	0.865	1,394	1,371	23	0.005	27
OFF-1.1+OFF-1.2+OFF-1.3	C-1.3	0	0	0	0	0	0	0	0	7,112,847	7,112,847	163.3	0.2551	4,286	0.812	1,394	1,376	18	0.004	22
OFF-1.1+OFF-1.2+OFF-1.3+OFF-2	C-1.4/CU-1.4	0	0	0	0	0	0	0	0	7,676,152	7,676,152	176.2	0.2753	4,286	0.812	1,394	1,376	18	0.004	22
OFF-3	C-3	0	0	0	0	0	0	0	0	3,257,283	3,257,283	74.8	0.117	4,978	0.943	1,388	1,374	14	0.003	15
OFF-4	C-4.1	0	0	0	0	0	0	0	0	86,481	86,481	2.0	0.003	436	0.083	1,378	1,374	4	0.009	48
OFF-5	CP-4	0	0	0	0	0	0	0	0	645,894	645,894	14.8	0.023	1,295	0.245	1,366	1,364	2	0.002	8
OFF-1.1-INT	CU-1.2	0	0	0	0	0	0	0	0	1,457,821	1,457,821	33.5	0.052	2,077	0.393	1,379	1,368	11	0.005	28
FF-1.1+OFF-1.2+OFF-1.3+OFF-1.1-IN	C-1.2-INT	0	0	0	0	0	0	0	0	8,570,669	8,570,669	196.8	0.307	5,445	1.031	1,397	1,368	29	0.005	28
OFF-2-INT	C-2-INT	0	0	0	0	0	0	0	0	6,771,436	6,771,436	155.5	0.243	4,702	0.890	1,387	1,374	13	0.003	15
OFF-4-INT	C-4-INT	0	0	0	0	0	0	0	0	1,180,104	1,180,104	27.1	0.042	2,120	0.401	1,374	1,370	4	0.002	10
OFF-6-INT	C-3-INT	0	0	0	0	0	0	0	0	2,611,350	2,611,350	59.9	0.094	4,978	0.943	1,381	1,368	13	0.003	14
OFF-3+OFF-6-INT	C-3-INT/CU-3-INT	0	0	0	0	0	0	0	0	5,868,633	5,868,633	134.7	0.211	5,032	0.953	1,388	1,368	20	0.004	21

WEIGHTED RUNOFF COEFFICIENT CALCULATIONS

HILGARTWILSON

Project:	Hawes Crossing
Prepared by:	BB
Date:	Oct, 2019

Land Use[(1)]	Land Use Code	C Coefficient
Medium Density Residential	A	0.75
Medium/High Density Residential	B	0.80
Urban Density Residential	C	0.85
Urban/ Mixed Use[(2)]	D	0.80
Technology/ Mixed Use	E	0.90
Commercial	F	0.90
Office	G	0.90
Park/Open Space	P	0.65
Undeveloped Desert	--	0.50

NOTES:

(1) From Table 6.3 of the FCDMC Drainage Policies and Standards, Arizona (August, 2018)

(2) Assumes average of Urban and Commercial density coefficients

Drainage Subarea ID(s)	Concentration Point	Subarea Surface Types & Areas											Weighted C Coefficient
		Medium Density Residential [ft^2]	Medium/High Density Residential [ft^2]	Urban Density Residential [ft^2]	Urban/ Mixed Use [ft^2]	Technology/ Mixed Use [ft^2]	Commercial [ft^2]	Office [ft^2]	Park/Open Space [ft^2]	Undeveloped Desert [ft^2]	Total [ft^2]	Total [ac]	C_w - 100 Year
OFFSITE DRAINAGE AREAS													
OFF-1.1	C-1.1	0	0	0	0	0	0	0	0	1,656,641	1,656,641	38.0	0.50
OFF-1.2	C-1.2	0	0	0	0	0	0	0	0	2,832,596	2,832,596	65.0	0.50
OFF-1.3	C-1.3	0	0	0	0	0	0	0	0	2,612,001	2,612,001	60.0	0.50
OFF-2	C-1.2	0	0	0	0	0	0	0	0	522,617	522,617	12.0	0.50
OFF-1.1+OFF-1.2+OFF-2	C-1.2	0	0	0	0	0	0	0	0	5,063,316	5,063,316	116.2	0.50
OFF-1.1+OFF-1.2+OFF-1.3	C-1.3	0	0	0	0	0	0	0	0	7,112,847	7,112,847	163.3	0.50
OFF-1.1+OFF-1.2+OFF-1.3+OFF-2	C-1.4/CU-1.4	0	0	0	0	0	0	0	0	7,676,152	7,676,152	176.2	0.50
OFF-3	C-3	0	0	0	0	0	0	0	0	3,257,283	3,257,283	74.8	0.50
OFF-4	C-4.1	0	0	0	0	0	0	0	0	86,481	86,481	2.0	0.50
OFF-5	CP-4	0	0	0	0	0	0	0	0	645,894	645,894	14.8	0.50
OFF-1.1-INT	CU-1.2	0	0	0	0	0	0	0	0	1,457,821	1,457,821	33.5	0.50
OFF-1.1+OFF-1.2+OFF-1.3+OFF-1.1-INT	C-1.2-INT	0	0	0	0	0	0	0	0	8,570,669	8,570,669	196.8	0.50
OFF-2-INT	C-2-INT	0	0	0	0	0	0	0	0	6,771,436	6,771,436	155.5	0.50
OFF-4-INT	C-4-INT	0	0	0	0	0	0	0	0	1,180,104	1,180,104	27.1	0.50
OFF-6-INT	C-3-INT	0	0	0	0	0	0	0	0	2,611,350	2,611,350	59.9	0.50
OFF-3+OFF-6-INT	C-3-INT/CU-3-INT	0	0	0	0	0	0	0	0	5,868,633	5,868,633	134.7	0.50

TIME OF CONCENTRATION CALCULATIONS

Project: Hawes Crossing

Prepared by: BB

Date: Oct, 2019

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										100-year storm		
Drainage Subarea ID(s)	Concentration Point	Length of Longest Flowpath [mi]	Area [ac]	Slope [ft/mi]	Adjusted Slope [ft/mi]	$m_{weighted}$	$b_{weighted}$	K_b	$11.4 \times L^{0.5} \times K_b^{0.52} \times S^{-0.31}$	Assumed T_c [min]	i_{100} [in/hr]	T_c [min]
Offsite Drainage Sub-Basins												
OFF-1.1	C-1.1	0.498	38.0	30	30	-0.01375	0.08000	0.0516	0.599	22.4	3.47	22.4
OFF-1.2	C-1.2	0.690	65.0	26	26	-0.01375	0.08000	0.0496	0.723	27.5	3.31	27.5
OFF-1.3	C-1.3	0.943	60.0	19	19	-0.01375	0.08000	0.0542	0.975	38.5	3.02	38.5
OFF-2	C-1.2	0.812	12.0	10	10	-0.01375	0.08000	0.0759	1.322	58.8	2.20	58.8
OFF-1.1+OFF-1.2+OFF-2	C-1.2	0.865	116.2	27	27	-0.01375	0.08000	0.0590	0.881	33.9	3.22	33.9
OFF-1.1+OFF-1.2+OFF-1.3	C-1.3	0.812	163.3	22	22	-0.01375	0.08000	0.0485	0.814	31.3	3.22	31.3
OFF-1.1+OFF-1.2+OFF-1.3+OFF-2	C-1.4/CU-1.4	0.812	176.2	22	22	-0.01375	0.08000	0.0499	0.826	31.8	3.22	31.8
OFF-3	C-3	0.943	74.8	15	15	-0.01375	0.08000	0.0542	1.054	42.7	2.81	42.7
OFF-4	C-4.1	0.083	2.0	48	48	-0.01375	0.08000	0.0759	0.257	10.0	5.77	7.9
OFF-5	C-4.2	0.245	14.8	8	8	-0.01375	0.08000	0.0590	0.676	25.6	3.37	25.6
OFF-1.1-INT	C-4.2	0.393	33.5	28	28	-0.01375	0.08000	0.0590	0.585	21.8	3.50	21.8
OFF-1.1+OFF-1.2+OFF-1.3+OFF-1.1-INT	C-4.3	1.031	196.8	28	28	-0.01375	0.08000	0.0485	0.853	32.8	3.22	32.8
OFF-2-INT	C-4.3	0.890	155.5	15	15	-0.01375	0.08000	0.0499	0.985	38.9	3.02	38.9
OFF-4-INT	C-4.4	0.401	27.1	10	10	-0.01375	0.08000	0.0603	0.822	31.6	3.22	31.6
OFF-6-INT	C-4.5	0.943	59.9	14	14	-0.01375	0.08000	0.0556	1.092	44.2	2.81	44.2
OFF-3+OFF-6-INT	C-4.6	0.953	134.7	21	21	-0.01375	0.08000	0.0507	0.919	36.3	3.02	36.3

From Equation 3.2 of the Flood Control District of Maricopa County (FCDMC)

Drainage Design Manual for Maricopa County, Arizona, Hydrology (December, 2018)

$T_c = 11.4 * L^{0.5} * K_b^{0.52} * S^{-0.31} * i^{-0.38}$

Where:

T_c = The time of concentration in hours

L = The length of the longest flow path in miles

K_b = The watershed resitance coefficient (Kb = m * log(A) + b)

S = The watercourse slope in ft/ mi

i = The rainfall intensity in in/ hr

m & b = Equation parameter from Table 2-2: Watershed Resistance Coefficients

A = Drainage area in acres

Peak Flow Rate Calculations

Project: Hawes Crossing
Prepared by: BB
Date: Oct, 2019

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				100-year storm		
Drainage Subarea ID(s)	**Concentration Point**	**Slope [ft/ft]**	**Total Area [ac]**	**Weighted C**	**Rainfall Intensity [in/hr]**	**Flow Rate (1) [cfs]**
Offsite Drainage Sub-Basins						
OFF-1.1	C-1.1	0.0057	38.0	0.50	3.47	66
OFF-1.2	C-1.2	0.0049	65.0	0.50	3.31	108
OFF-1.3	C-1.3	0.0036	60.0	0.50	3.02	90
OFF-2	C-1.2	0.0019	12.0	0.50	2.20	13
OFF-1.1+OFF-1.2+OFF-2	C-1.2	0.0050	116.2	0.50	3.22	187
OFF-1.1+OFF-1.2+OFF-1.3	C-1.3	0.0042	163.3	0.50	3.22	263
OFF-1.1+OFF-1.2+OFF-1.3+OFF-2	C-1.4/CU-1.4	0.0042	176.2	0.50	3.22	284
OFF-3	C-3	0.0028	74.8	0.50	2.81	105
OFF-4	C-4.1	0.0092	2.0	0.50	5.77	6
OFF-5	C-4.2	0.0015	14.8	0.50	3.37	25
OFF-1.1-INT	CU-1.2	0.0053	33.5	0.50	3.50	59
OFF-1.1+OFF-1.2+OFF-1.3+OFF-1.1-INT	C-1.2-INT	0.0053	196.8	0.50	3.22	317
OFF-2-INT	C-2-INT	0.0028	155.5	0.50	3.02	234
OFF-4-INT	C-4-INT	0.0019	27.1	0.50	3.22	44
OFF-6-INT	C-3-INT	0.0026	59.9	0.50	2.81	84
OFF-3+OFF-6-INT	C-3-INT/CU-3-INT	0.0040	134.7	0.50	3.02	203

NOTES:

(1) The flow rate values shown were calculated using the following process:

From Equation 3.1 of the Flood Control District of Maricopa County (FCDMC) *Drainage Design Manual for Maricopa County, Arizona, Hydrology* (December, 2018)

$Q = CiA$

Where

Q = The the peak discharge (cfs) from a given area.

C = A coefficient relating the runoff to rainfall.

i= The average rainfall intensity (inches/ hour), lasting for a T_c

T_c = The time of concentration (hours)

A= The drainage area (acres)

In order to solve for the flow rate (Q), the Rational Method equation shown above was used to calculate the peak discharge at each concentration point.

DDF/IDF TABLES

Project: Hawes Crossing
Prepared by: BB
Date: Oct, 2019

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Rainfall Depth (inches)										
Frequency (years)	Duration									
	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
2	0.25	0.37	0.46	0.62	0.77	0.87	0.92	1.10	1.23	1.50
5	0.33	0.51	0.63	0.84	1.04	1.16	1.21	1.40	1.56	1.93
10	0.40	0.61	0.75	1.01	1.25	1.39	1.44	1.64	1.81	2.27
25	0.49	0.75	0.92	1.24	1.54	1.69	1.76	1.98	2.16	2.73
50	0.56	0.85	1.06	1.42	1.76	1.93	2.01	2.24	2.42	3.10
100	0.63	0.96	1.19	1.61	1.99	2.17	2.28	2.51	2.69	3.48

1) Rainfall depths are referneced from NOAA Atlas 14 Precipitation Frequency Data Server.
(http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=az)

Rainfall Intensity (inches/hour)		
Duration	Frequency (years)	
	10	100
5-min	2.94	7.58
10-min	2.24	5.77
15-min	1.85	4.76
30-min	1.25	3.22
1-hr	0.77	1.99
2-hr	0.44	1.09
3-hr	0.31	0.76
6-hr	0.18	0.42
12-hr	0.10	0.22
24-hr	0.06	0.15

1) intensity = Rainfall Depth / Duration

IDF CURVE TABLE

Project: Hawes Crossing
Prepared by: BB
Date: Dec, 2017

	10-year storm	100-year storm
Assumed Tc	I	I
[min]	[in/hr]	[in/hr]
10.000	2.24	5.77
10.125	2.23	5.75
10.250	2.22	5.72
10.375	2.21	5.70
10.500	2.20	5.67
10.625	2.19	5.65
10.750	2.18	5.62
10.875	2.17	5.59
11.000	2.16	5.57
11.125	2.15	5.54
11.250	2.14	5.52
11.375	2.13	5.49
11.500	2.12	5.47
11.625	2.11	5.44
11.750	2.10	5.42
11.875	2.09	5.39
12.000	2.08	5.37
12.125	2.07	5.34
12.250	2.06	5.32
12.375	2.05	5.29
12.500	2.05	5.27
12.625	2.04	5.24
12.750	2.03	5.22
12.875	2.02	5.19
13.000	2.01	5.16
13.125	2.00	5.14
13.250	1.99	5.11
13.375	1.98	5.09
13.500	1.97	5.06
13.625	1.96	5.04
13.750	1.95	5.01
13.875	1.94	4.99
14.000	1.93	4.96
14.125	1.92	4.94
14.250	1.91	4.91
14.375	1.90	4.89
14.500	1.89	4.86
14.625	1.88	4.84
14.750	1.87	4.81
14.875	1.86	4.79
15.000	1.85	4.76
15.125	1.84	4.73

	10-year storm	100-year storm
Assumed Tc	I	I
[min]	[in/hr]	[in/hr]
15.250	1.83	4.70
15.375	1.82	4.67
15.500	1.80	4.64
15.625	1.79	4.61
15.750	1.78	4.58
15.875	1.77	4.54
16.000	1.76	4.51
16.125	1.74	4.48
16.250	1.73	4.45
16.375	1.72	4.42
16.500	1.71	4.39
16.625	1.69	4.36
16.750	1.68	4.33
16.875	1.67	4.30
17.000	1.66	4.27
17.125	1.65	4.24
17.250	1.63	4.21
17.375	1.62	4.17
17.500	1.61	4.14
17.625	1.60	4.11
17.750	1.59	4.08
17.875	1.57	4.05
18.000	1.56	4.02
18.125	1.55	3.99
18.250	1.54	3.96
18.375	1.52	3.93
18.500	1.51	3.90
18.625	1.50	3.87
18.750	1.49	3.84
18.875	1.48	3.81
19.000	1.46	3.77
19.125	1.45	3.74
19.250	1.44	3.71
19.375	1.43	3.68
19.500	1.42	3.65
19.625	1.40	3.62
19.750	1.39	3.59
19.875	1.38	3.56
20.000	1.37	3.53
21.000	1.36	3.50
22.000	1.34	3.47
23.000	1.33	3.44
24.000	1.32	3.40
25.000	1.31	3.37
26.000	1.29	3.34
27.000	1.28	3.31
28.000	1.27	3.28
29.000	1.26	3.25

	10-year storm	100-year storm
Assumed Tc	I	I
[min]	[in/hr]	[in/hr]
30.000	1.25	3.22
35.000	1.17	3.02
40.000	1.09	2.81
45.000	1.01	2.61
50.000	0.93	2.40
55.000	0.85	2.20
60.000	0.77	1.99
90.000	0.60	1.54
120.000	0.44	1.09
150.000	0.37	0.92
180.000	0.31	0.76
270.000	0.25	0.59
360.000	0.18	0.42
540.000	0.14	0.32
720.000	0.10	0.22
1080.000	0.08	0.18
1440.000	0.06	0.15

NOAA 14 REPORT

NOAA Atlas 14, Volume 1, Version 5
Location name: Mesa, Arizona, USA*
Latitude: 33.3499°, Longitude: -111.6469°
Elevation: 1386.53 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.188** (0.158-0.231)	**0.245** (0.207-0.302)	**0.332** (0.277-0.407)	**0.399** (0.331-0.486)	**0.490** (0.400-0.594)	**0.560** (0.452-0.677)	**0.632** (0.500-0.763)	**0.706** (0.549-0.850)	**0.805** (0.609-0.969)	**0.880** (0.653-1.06)
10-min	**0.286** (0.240-0.351)	**0.373** (0.315-0.459)	**0.505** (0.422-0.619)	**0.607** (0.504-0.740)	**0.745** (0.608-0.905)	**0.853** (0.687-1.03)	**0.962** (0.761-1.16)	**1.07** (0.835-1.29)	**1.23** (0.927-1.48)	**1.34** (0.993-1.62)
15-min	**0.354** (0.297-0.435)	**0.463** (0.390-0.569)	**0.626** (0.523-0.767)	**0.752** (0.624-0.917)	**0.924** (0.754-1.12)	**1.06** (0.852-1.28)	**1.19** (0.944-1.44)	**1.33** (1.03-1.60)	**1.52** (1.15-1.83)	**1.66** (1.23-2.00)
30-min	**0.477** (0.401-0.586)	**0.623** (0.525-0.767)	**0.844** (0.705-1.03)	**1.01** (0.841-1.24)	**1.24** (1.02-1.51)	**1.42** (1.15-1.72)	**1.61** (1.27-1.94)	**1.79** (1.39-2.16)	**2.04** (1.55-2.46)	**2.24** (1.66-2.70)
60-min	**0.591** (0.496-0.725)	**0.771** (0.650-0.949)	**1.04** (0.872-1.28)	**1.25** (1.04-1.53)	**1.54** (1.26-1.87)	**1.76** (1.42-2.13)	**1.99** (1.57-2.40)	**2.22** (1.73-2.67)	**2.53** (1.92-3.05)	**2.77** (2.05-3.34)
2-hr	**0.675** (0.570-0.811)	**0.874** (0.739-1.05)	**1.16** (0.979-1.40)	**1.39** (1.16-1.67)	**1.69** (1.39-2.02)	**1.93** (1.56-2.30)	**2.17** (1.73-2.59)	**2.42** (1.89-2.87)	**2.75** (2.10-3.27)	**3.01** (2.25-3.60)
3-hr	**0.719** (0.607-0.875)	**0.921** (0.780-1.13)	**1.21** (1.02-1.47)	**1.44** (1.20-1.74)	**1.76** (1.44-2.11)	**2.01** (1.62-2.41)	**2.28** (1.81-2.73)	**2.56** (1.99-3.06)	**2.94** (2.23-3.52)	**3.26** (2.40-3.90)
6-hr	**0.864** (0.747-1.02)	**1.10** (0.947-1.29)	**1.40** (1.21-1.65)	**1.64** (1.40-1.93)	**1.98** (1.67-2.31)	**2.24** (1.86-2.60)	**2.51** (2.05-2.92)	**2.79** (2.24-3.25)	**3.18** (2.48-3.70)	**3.49** (2.66-4.07)
12-hr	**0.979** (0.858-1.12)	**1.23** (1.08-1.42)	**1.56** (1.36-1.79)	**1.81** (1.57-2.07)	**2.16** (1.85-2.46)	**2.42** (2.06-2.75)	**2.69** (2.25-3.07)	**2.97** (2.44-3.38)	**3.34** (2.69-3.83)	**3.63** (2.86-4.19)
24-hr	**1.19** (1.07-1.34)	**1.50** (1.35-1.69)	**1.93** (1.72-2.16)	**2.27** (2.02-2.54)	**2.73** (2.41-3.05)	**3.10** (2.71-3.45)	**3.48** (3.02-3.88)	**3.87** (3.33-4.33)	**4.42** (3.73-4.96)	**4.85** (4.03-5.47)
2-day	**1.25** (1.12-1.41)	**1.59** (1.43-1.79)	**2.06** (1.84-2.31)	**2.43** (2.16-2.72)	**2.94** (2.60-3.29)	**3.34** (2.93-3.73)	**3.76** (3.27-4.21)	**4.20** (3.60-4.70)	**4.79** (4.04-5.39)	**5.26** (4.38-5.95)
3-day	**1.34** (1.21-1.50)	**1.71** (1.54-1.90)	**2.22** (2.01-2.47)	**2.64** (2.37-2.93)	**3.22** (2.87-3.57)	**3.68** (3.26-4.07)	**4.17** (3.66-4.62)	**4.68** (4.07-5.20)	**5.40** (4.62-6.01)	**5.97** (5.05-6.68)
4-day	**1.43** (1.30-1.58)	**1.83** (1.66-2.02)	**2.39** (2.17-2.64)	**2.85** (2.57-3.14)	**3.49** (3.14-3.85)	**4.02** (3.59-4.42)	**4.58** (4.06-5.04)	**5.17** (4.54-5.70)	**6.00** (5.19-6.64)	**6.67** (5.72-7.41)
7-day	**1.58** (1.44-1.75)	**2.01** (1.83-2.23)	**2.64** (2.39-2.91)	**3.15** (2.85-3.47)	**3.87** (3.48-4.26)	**4.45** (3.98-4.90)	**5.07** (4.50-5.59)	**5.73** (5.04-6.32)	**6.67** (5.77-7.37)	**7.42** (6.35-8.24)
10-day	**1.72** (1.57-1.90)	**2.20** (2.00-2.42)	**2.88** (2.62-3.17)	**3.43** (3.11-3.76)	**4.20** (3.79-4.60)	**4.82** (4.32-5.28)	**5.47** (4.87-6.01)	**6.16** (5.44-6.77)	**7.14** (6.21-7.87)	**7.91** (6.82-8.75)
20-day	**2.13** (1.93-2.36)	**2.74** (2.48-3.02)	**3.59** (3.25-3.95)	**4.23** (3.83-4.66)	**5.11** (4.60-5.62)	**5.78** (5.18-6.37)	**6.47** (5.77-7.13)	**7.16** (6.35-7.91)	**8.10** (7.12-8.98)	**8.82** (7.69-9.81)
30-day	**2.49** (2.27-2.73)	**3.19** (2.90-3.50)	**4.17** (3.79-4.57)	**4.92** (4.47-5.39)	**5.93** (5.36-6.49)	**6.71** (6.04-7.34)	**7.50** (6.72-8.23)	**8.31** (7.40-9.13)	**9.40** (8.28-10.4)	**10.2** (8.95-11.3)
45-day	**2.91** (2.64-3.20)	**3.73** (3.39-4.10)	**4.87** (4.43-5.36)	**5.72** (5.19-6.29)	**6.84** (6.18-7.52)	**7.68** (6.92-8.45)	**8.53** (7.65-9.38)	**9.37** (8.35-10.3)	**10.5** (9.25-11.6)	**11.3** (9.92-12.5)
60-day	**3.23** (2.95-3.54)	**4.15** (3.78-4.55)	**5.40** (4.92-5.93)	**6.32** (5.74-6.94)	**7.52** (6.81-8.24)	**8.40** (7.58-9.22)	**9.28** (8.35-10.2)	**10.1** (9.07-11.2)	**11.3** (10.0-12.4)	**12.1** (10.7-13.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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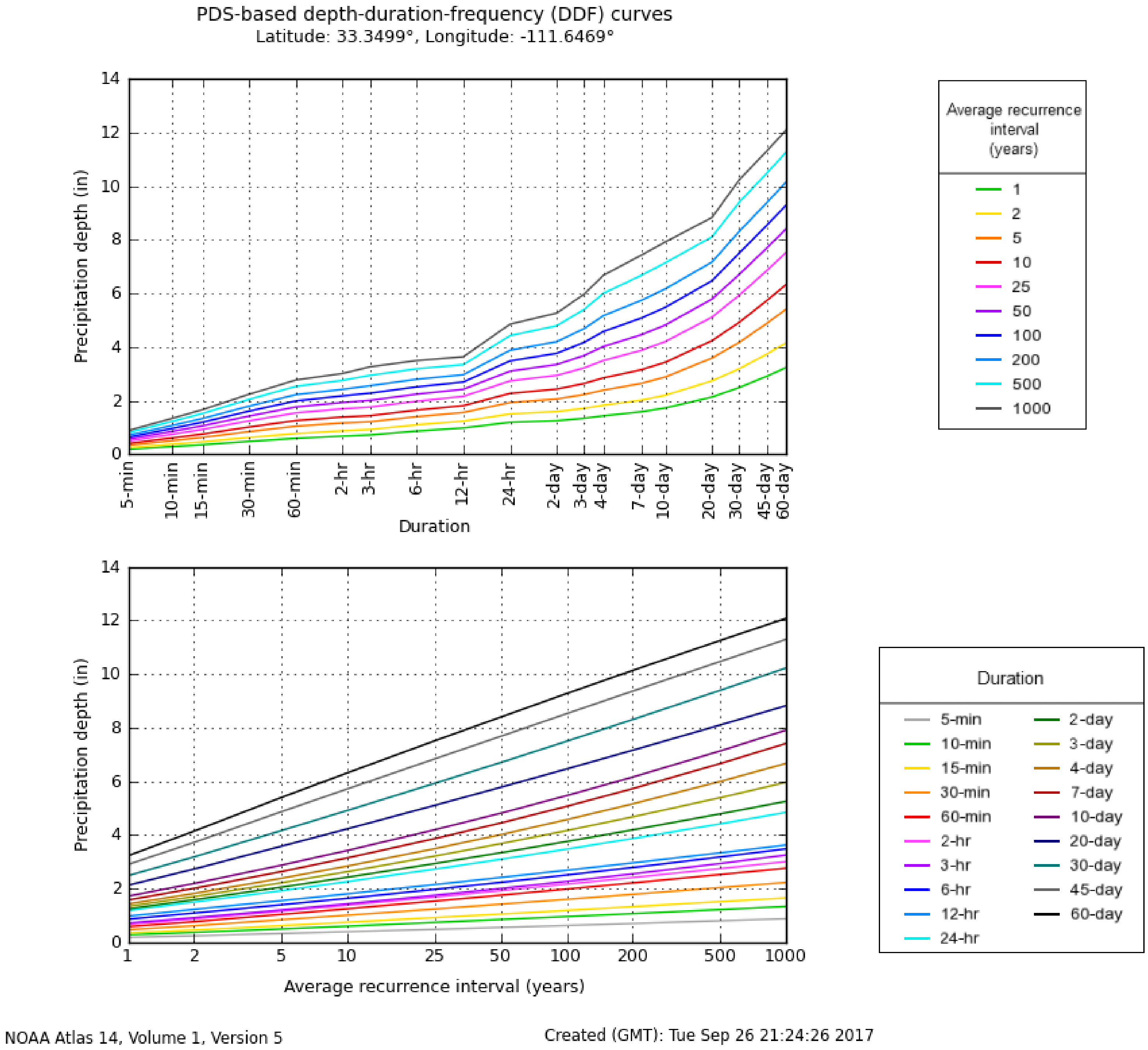
PF graphical


PDS-based depth-duration-frequency (DDF) curves
Latitude: 33.3499°, Longitude: -111.6469°

NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Tue Sep 26 21:24:26 2017

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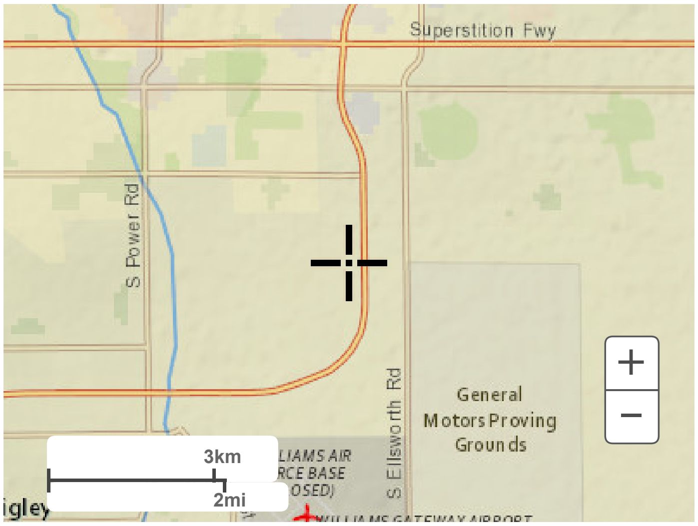
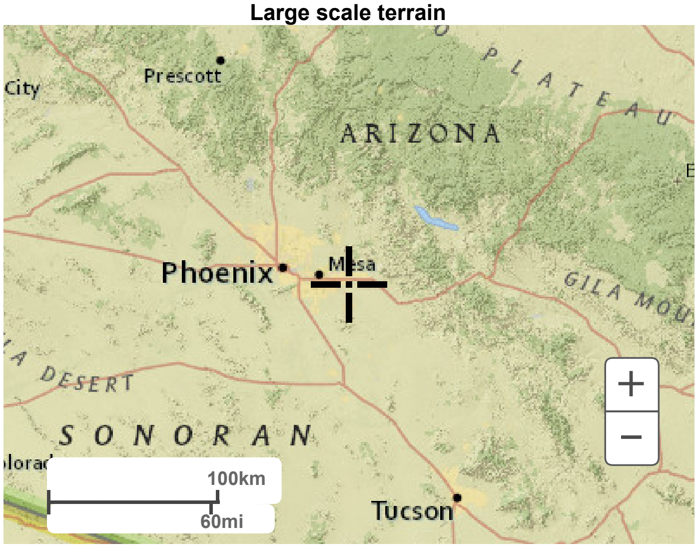
Maps & aerials

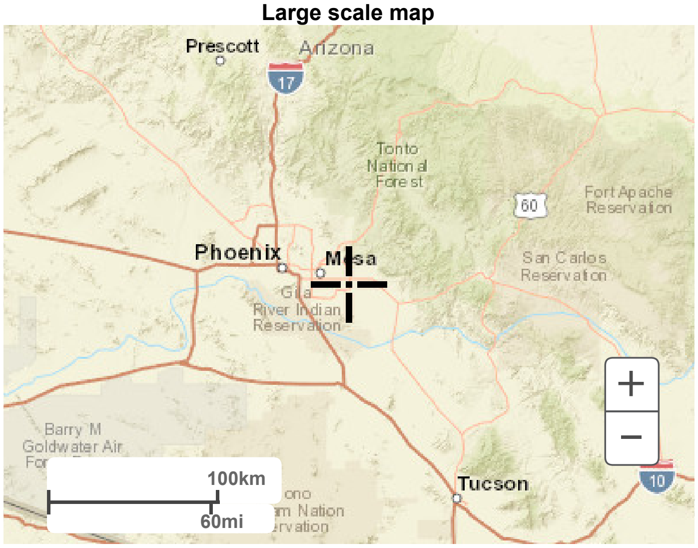
Small scale terrain



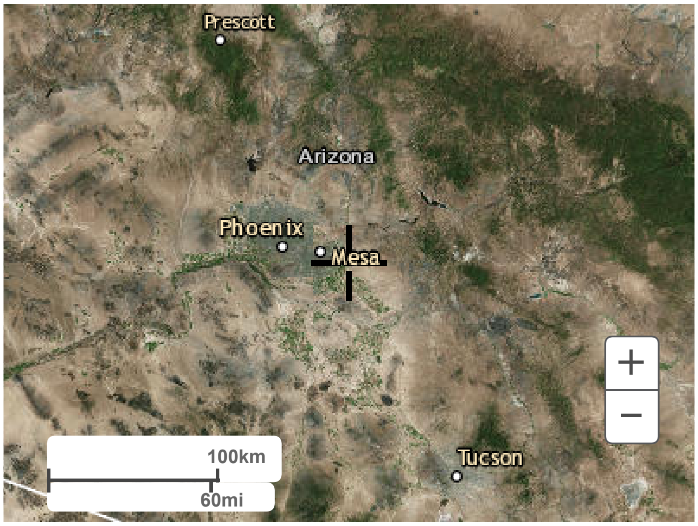
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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APPENDIX D

PRELIMINARY HYDRAULIC CALCULATIONS

PRELIMINARY CHANNEL CALCULATIONS

CHANNEL PARAMETER SUMMARY

Project: Hawes Crossing

Prepared by: BB

Date: Oct, 2019

Channel ID	Model Q(1) [ft^3/sec]	Side Slopes [H:V]	Minimum Channel Bottom Width [ft]	Channel Top Width [ft]	Total Channel Depth [ft]	Manning's n(2)	Slope [%]	Velocity(3) [ft/sec]	Water Surface Depth(4) [ft]	Freeboard Provided(5) [ft]	Top Width of Flow [ft]	Cross-Sectional Area of Flow [ft^2]	Froude Number(6,7)
C-1.1	66	4:1	9	29	2.50	0.032	0.40	2.99	1.48	1.02	20.84	22.08	0.51
C-1.2	187	4:1	9	37	3.50	0.032	0.40	3.99	2.48	1.02	28.84	46.92	0.55
C-1.3	263	4:1	10	42	4.00	0.032	0.40	4.36	2.83	1.17	32.64	60.34	0.57
C-1.4	284	4:1	10	42	4.00	0.032	0.40	4.44	2.94	1.06	33.52	63.97	0.57
C-3	105	4:1	8	32	3.00	0.032	0.40	3.43	1.94	1.06	23.52	30.57	0.53
C-4.1	6	4:1	-	16	2.00	0.032	0.40	1.70	0.94	1.06	7.52	3.53	0.44
C-4.2	111	4:1	8	32	3.00	0.032	0.40	3.49	1.99	1.01	23.92	31.76	0.53
C-5	1,100	4:1	65	97	4.00	0.032	0.33	4.76	3.00	1.00	89.00	231.00	0.52
C-1.2-INT	317	4:1	12	44	4.00	0.032	0.40	4.54	2.94	1.06	35.52	69.85	0.57
C-2-INT	234	4:1	7	39	4.00	0.032	0.40	4.27	2.93	1.07	30.44	54.85	0.56
C-3-INT	203	4:1	6	38	4.00	0.032	0.40	4.26	2.91	1.09	30.28	54.24	0.56
C--4-INT	47	4:1	6	26	2.50	0.032	0.40	2.57	1.45	1.05	17.60	17.11	0.46

NOTES:

(1) Model Q is peak flow determined in DDMSW/HEC-1.

(2) Channels are currently modeled as having a composite channel lining that may consist of desert landscaping, turf, riprap or a combination thereof.

(3) Maximum allowable velocity of 5ft/sec from Table 6.2 of the Drainage Design Manual of Maricopa County, Hydraulics: Rational Method, Chapter 3 (December, 2018).

(4) Maximum flow depth of 3 ft from Section 1.4.3 of the Drainage Design Manual of Maricopa County, Hydraulics: Safety, Chapter 1 (December, 2018).

(5) Minimum 1 ft of freeboard required from Section 6.5.4 of the Drainage Design Manual of Maricopa County, Hydraulics: Feeboard, Chapter 6 (December, 2018).

(6) $Fr=V/(g*D)^{0.5}$ where V=velocity, g=32.2 ft/s^2, and D=(Cross-sectional area)/(Top width)

(7) Fr<0.86 indicates subcritical flow and Fr>0.86 indicates supercritical flow

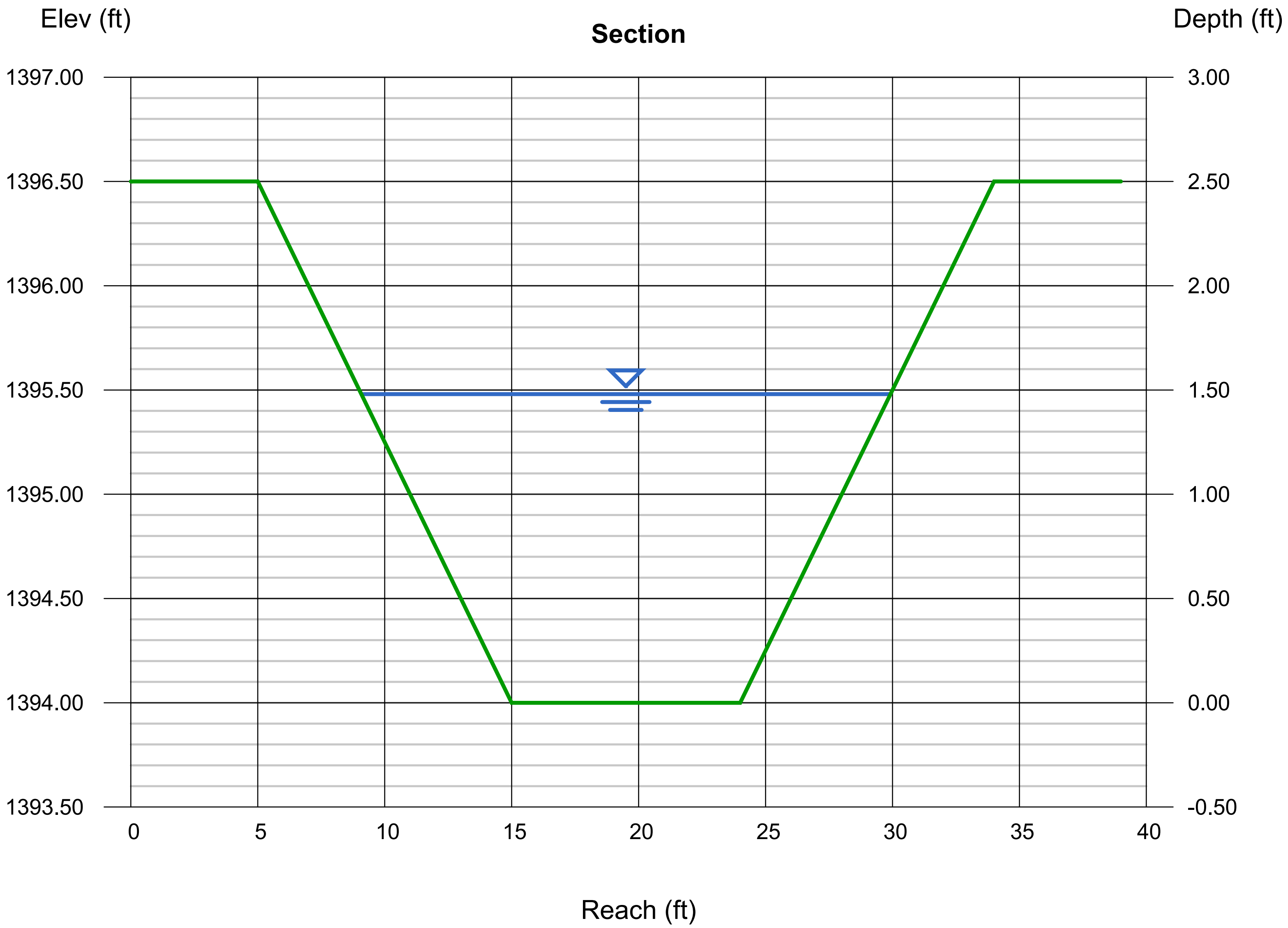
Channel Report

C-1.1 (TW=29FT)

Trapezoidal
Bottom Width (ft) = 9.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.50
Invert Elev (ft) = 1394.00
Slope (%) = 0.40
N-Value = 0.032

Calculations
Compute by: Known Q
Known Q (cfs) = 66.00

Highlighted
Depth (ft) = 1.48
Q (cfs) = 66.00
Area (sqft) = 22.08
Velocity (ft/s) = 2.99
Wetted Perim (ft) = 21.20
Crit Depth, Yc (ft) = 1.02
Top Width (ft) = 20.84
EGL (ft) = 1.62



Channel Report

C-1.2 (TW=37FT)

Trapezoidal

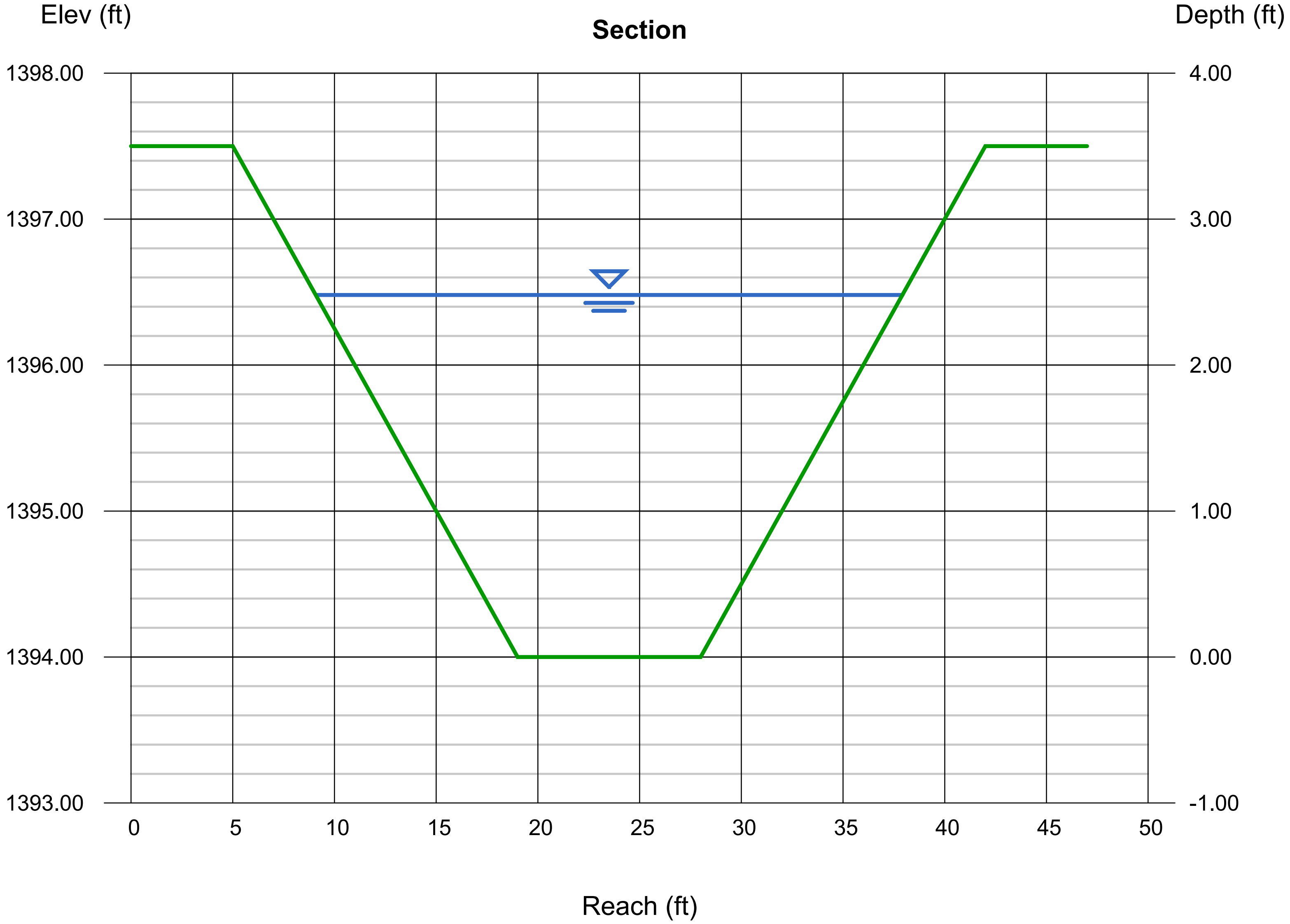
Bottom Width (ft)	= 9.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 1394.00
Slope (%)	= 0.40
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 187.00

Highlighted

Depth (ft)	= 2.48
Q (cfs)	= 187.00
Area (sqft)	= 46.92
Velocity (ft/s)	= 3.99
Wetted Perim (ft)	= 29.45
Crit Depth, Yc (ft)	= 1.82
Top Width (ft)	= 28.84
EGL (ft)	= 2.73



Channel Report

C-1.2-INT (TW=44FT) INTERIM

Trapezoidal

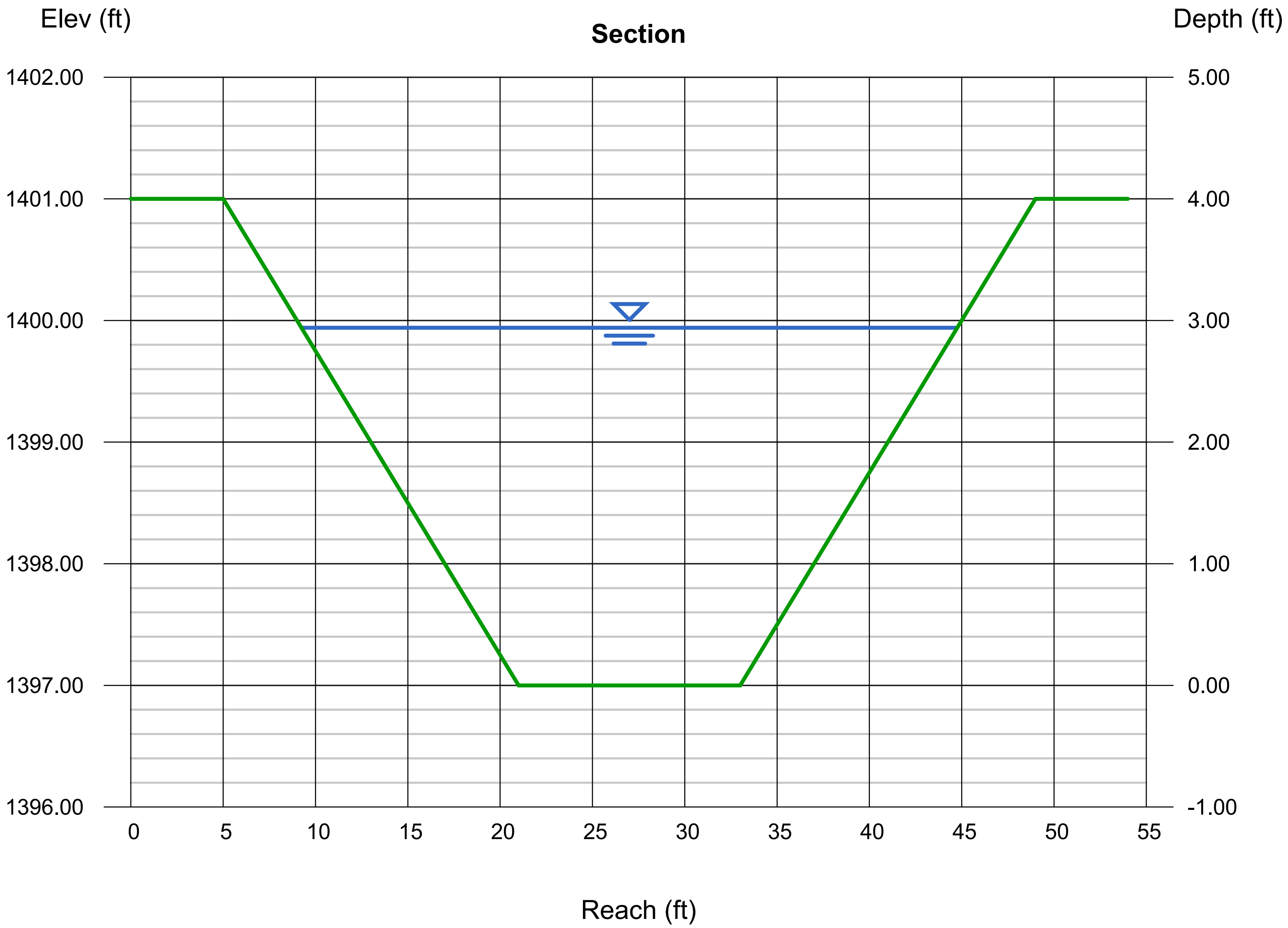
Bottom Width (ft)	= 12.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 1397.00
Slope (%)	= 0.40
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 317.00

Highlighted

Depth (ft)	= 2.94
Q (cfs)	= 317.00
Area (sqft)	= 69.85
Velocity (ft/s)	= 4.54
Wetted Perim (ft)	= 36.24
Crit Depth, Yc (ft)	= 2.18
Top Width (ft)	= 35.52
EGL (ft)	= 3.26



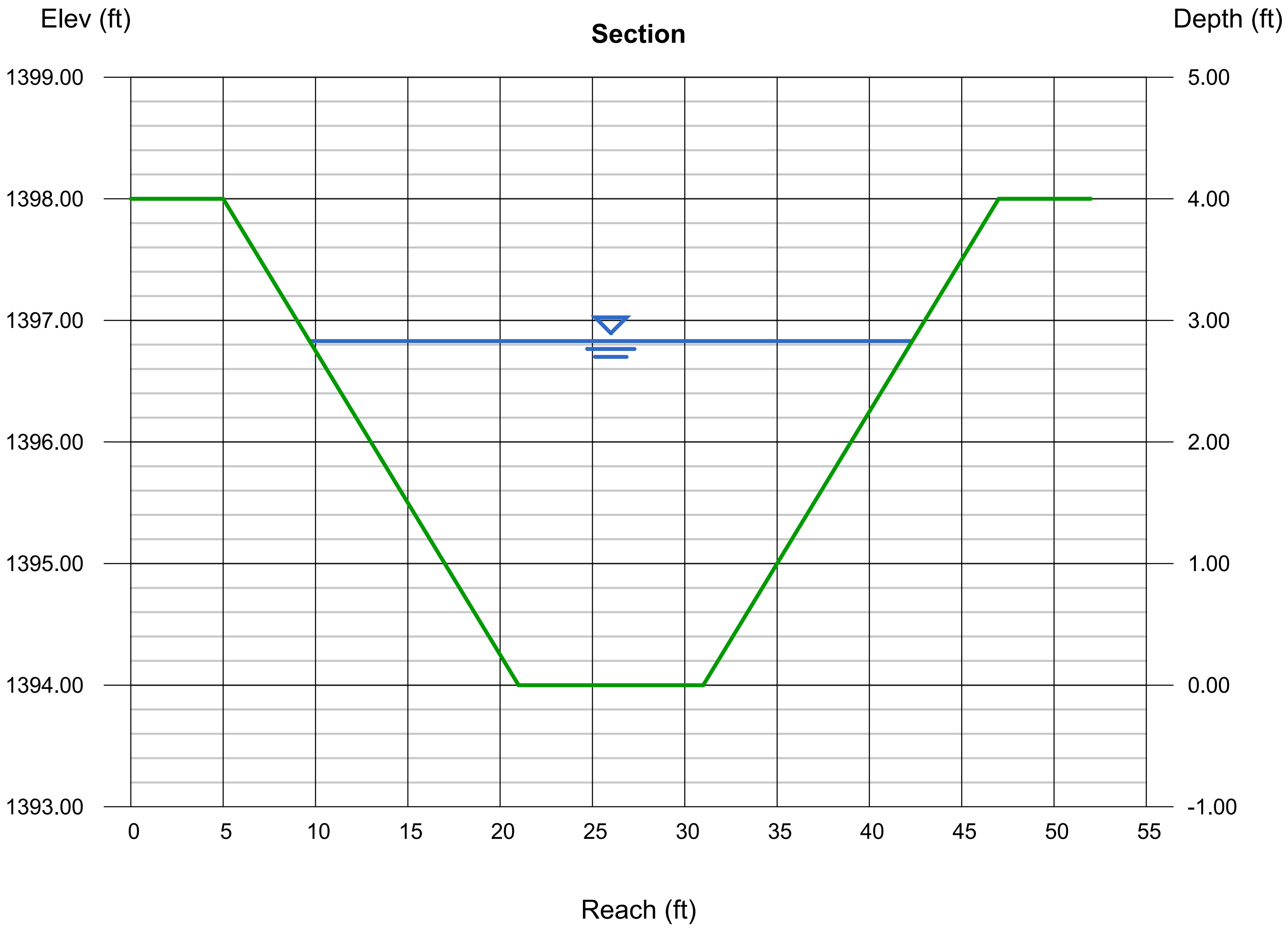
Channel Report

C-1.3 (TW=42FT)

Trapezoidal
Bottom Width (ft) = 10.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 4.00
Invert Elev (ft) = 1394.00
Slope (%) = 0.40
N-Value = 0.032

Calculations
Compute by: Known Q
Known Q (cfs) = 263.00

Highlighted
Depth (ft) = 2.83
Q (cfs) = 263.00
Area (sqft) = 60.34
Velocity (ft/s) = 4.36
Wetted Perim (ft) = 33.34
Crit Depth, Yc (ft) = 2.10
Top Width (ft) = 32.64
EGL (ft) = 3.13



Channel Report

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C-1.4 (TW=42FT)

Trapezoidal

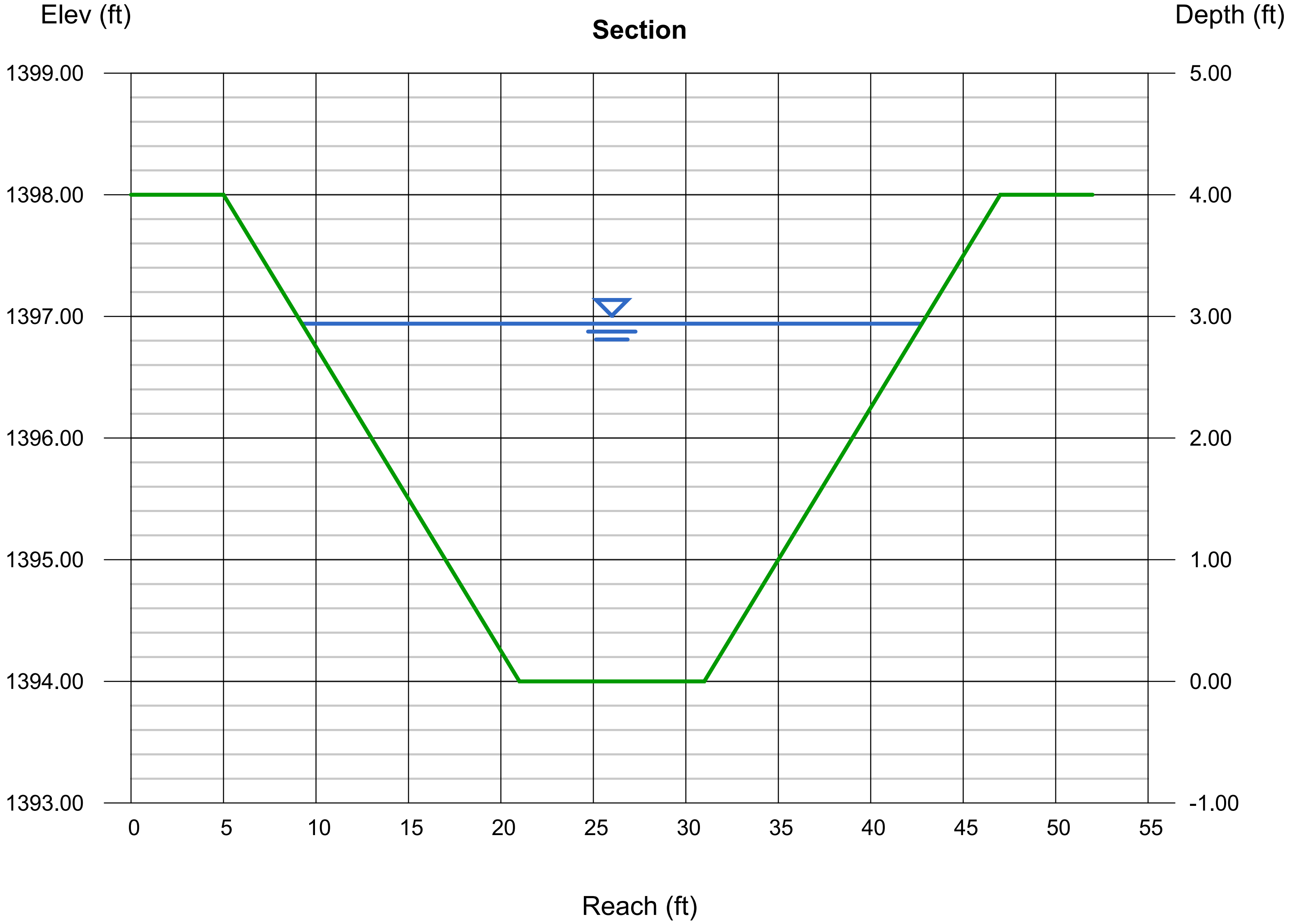
Bottom Width (ft) = 10.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 4.00
Invert Elev (ft) = 1394.00
Slope (%) = 0.40
N-Value = 0.032

Calculations

Compute by: Known Q
Known Q (cfs) = 284.00

Highlighted

Depth (ft) = 2.94
Q (cfs) = 284.00
Area (sqft) = 63.97
Velocity (ft/s) = 4.44
Wetted Perim (ft) = 34.24
Crit Depth, Yc (ft) = 2.19
Top Width (ft) = 33.52
EGL (ft) = 3.25



Channel Report

C-2-INT (TW=39FT) INTERIM

Trapezoidal

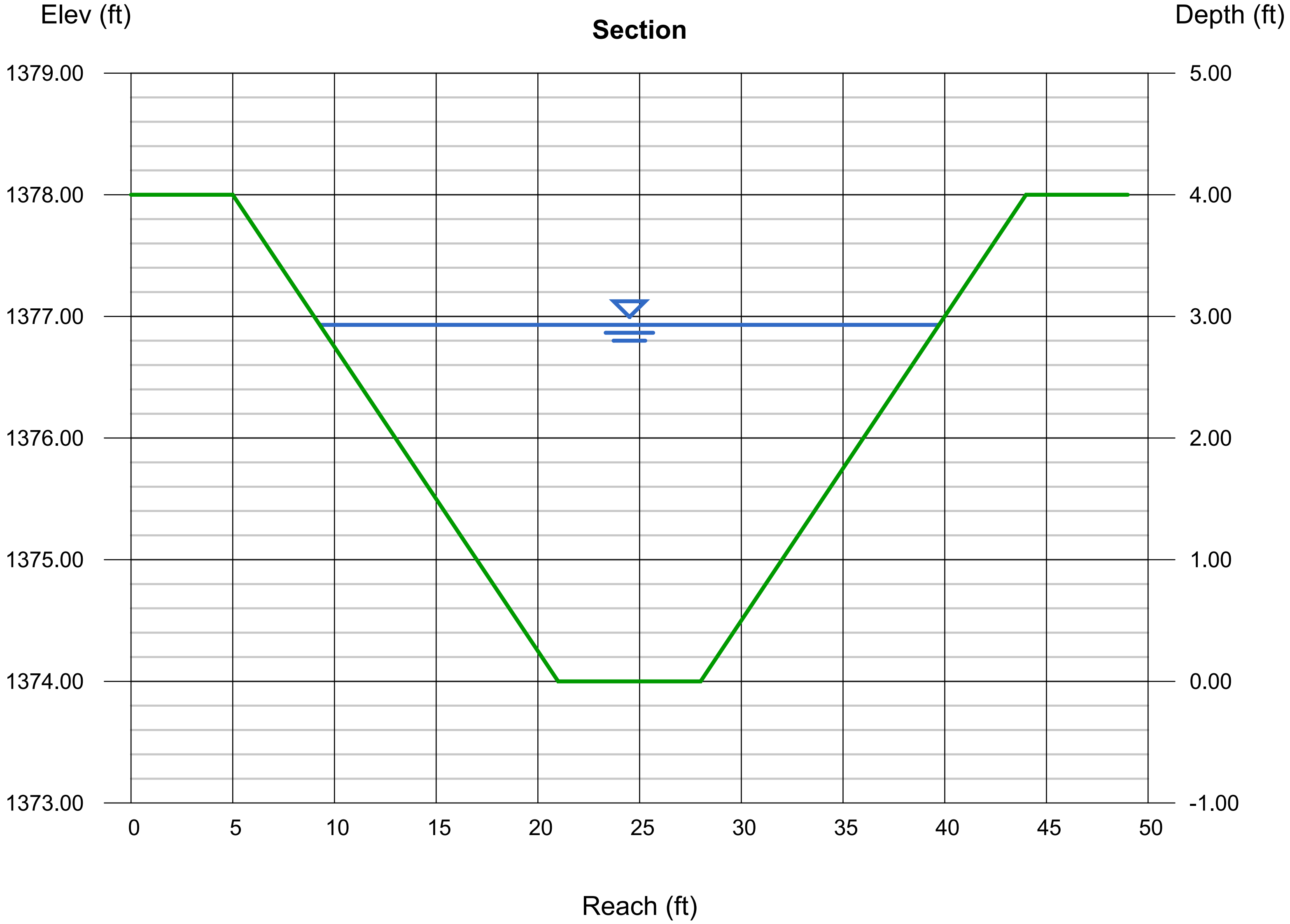
Bottom Width (ft)	= 7.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 1374.00
Slope (%)	= 0.40
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 234.00

Highlighted

Depth (ft)	= 2.93
Q (cfs)	= 234.00
Area (sqft)	= 54.85
Velocity (ft/s)	= 4.27
Wetted Perim (ft)	= 31.16
Crit Depth, Yc (ft)	= 2.20
Top Width (ft)	= 30.44
EGL (ft)	= 3.21



Channel Report

C-3 (TW=32FT)

Trapezoidal

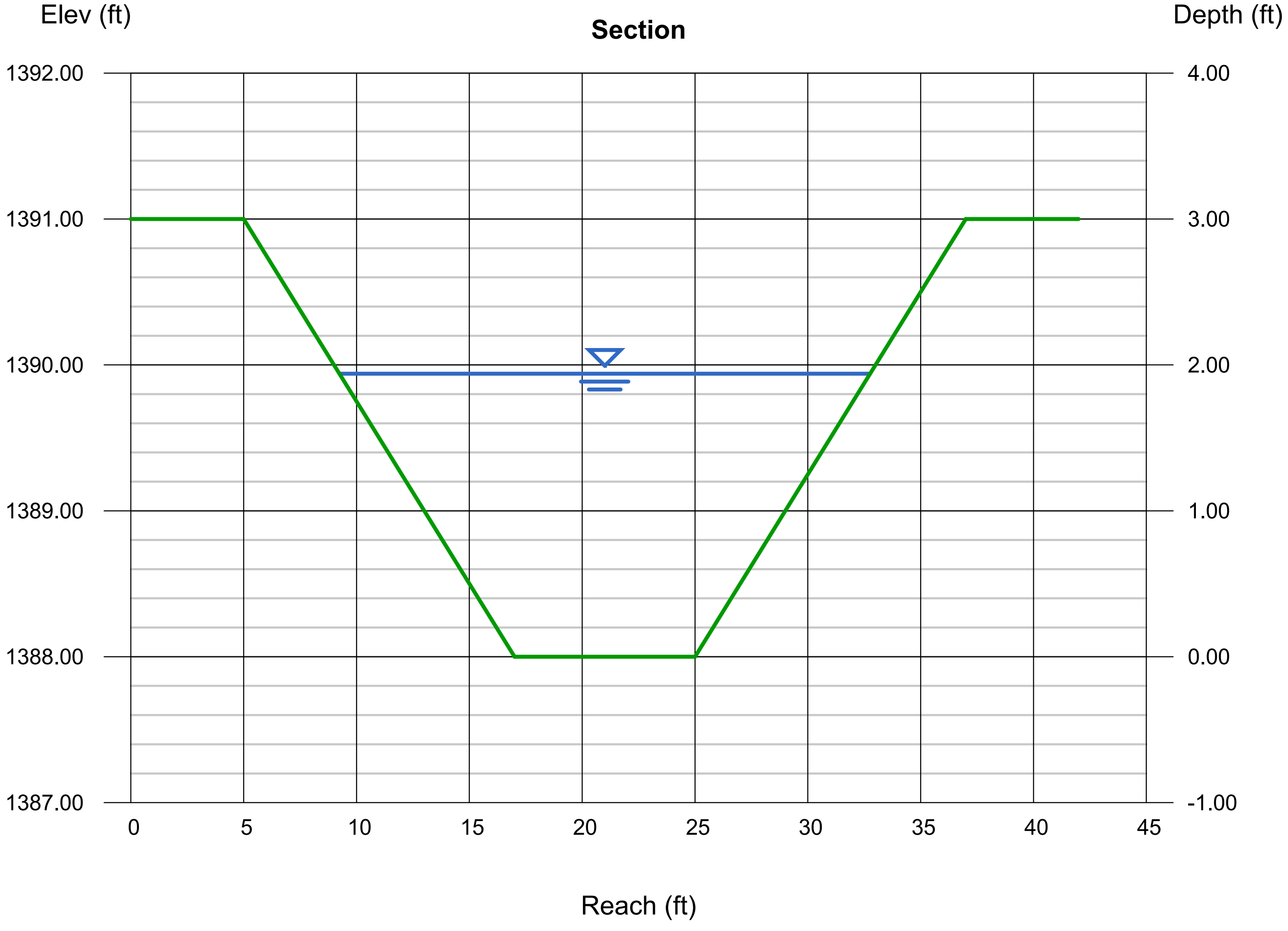
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 1388.00
Slope (%)	= 0.40
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 105.00

Highlighted

Depth (ft)	= 1.94
Q (cfs)	= 105.00
Area (sqft)	= 30.57
Velocity (ft/s)	= 3.43
Wetted Perim (ft)	= 24.00
Crit Depth, Yc (ft)	= 1.39
Top Width (ft)	= 23.52
EGL (ft)	= 2.12



Channel Report

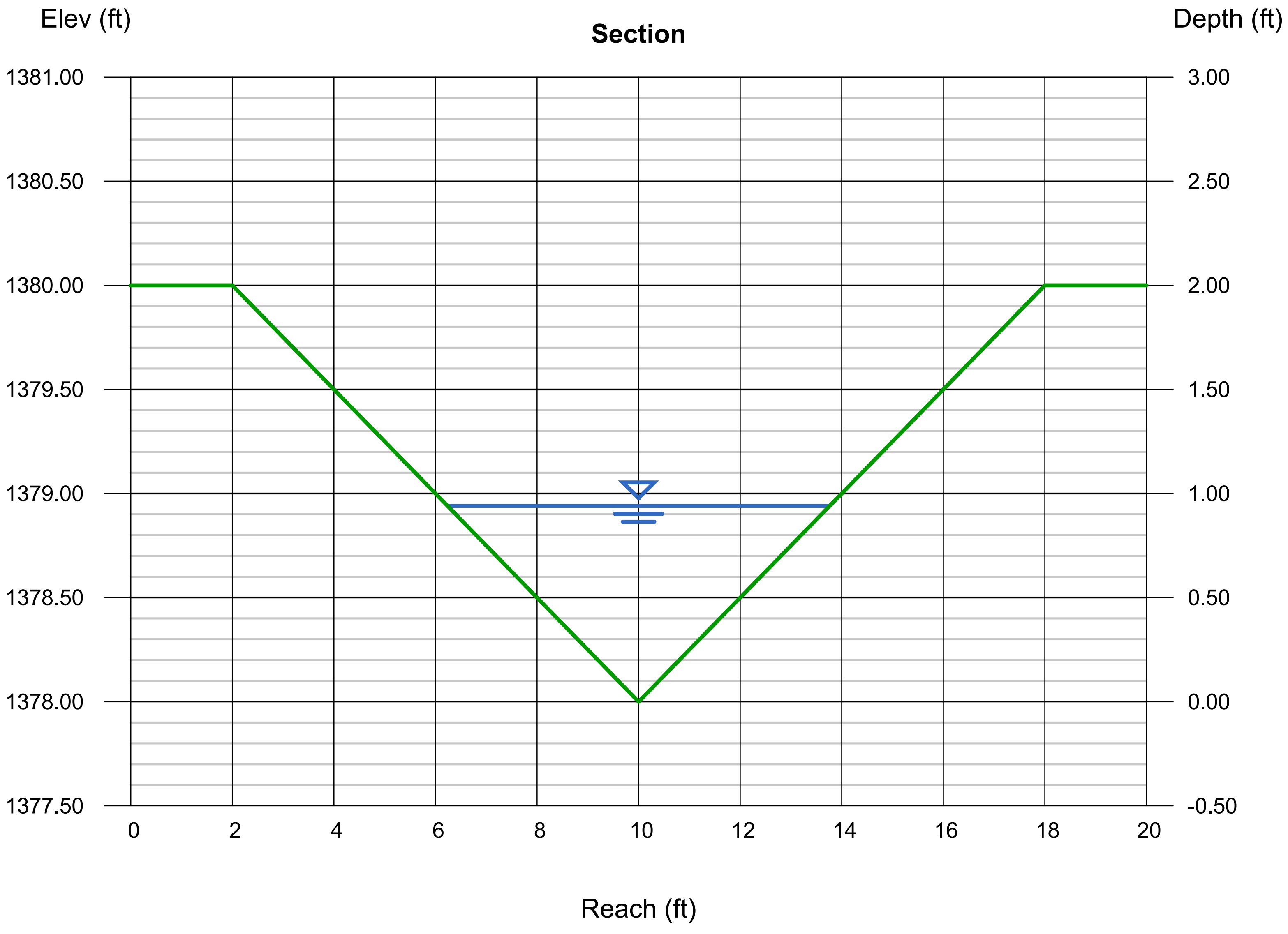
C-4.1 (TW=16FT)

Triangular
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

Invert Elev (ft) = 1378.00
Slope (%) = 0.40
N-Value = 0.032

Calculations
Compute by: Known Q
Known Q (cfs) = 6.00

Highlighted
Depth (ft) = 0.94
Q (cfs) = 6.000
Area (sqft) = 3.53
Velocity (ft/s) = 1.70
Wetted Perim (ft) = 7.75
Crit Depth, Yc (ft) = 0.68
Top Width (ft) = 7.52
EGL (ft) = 0.98



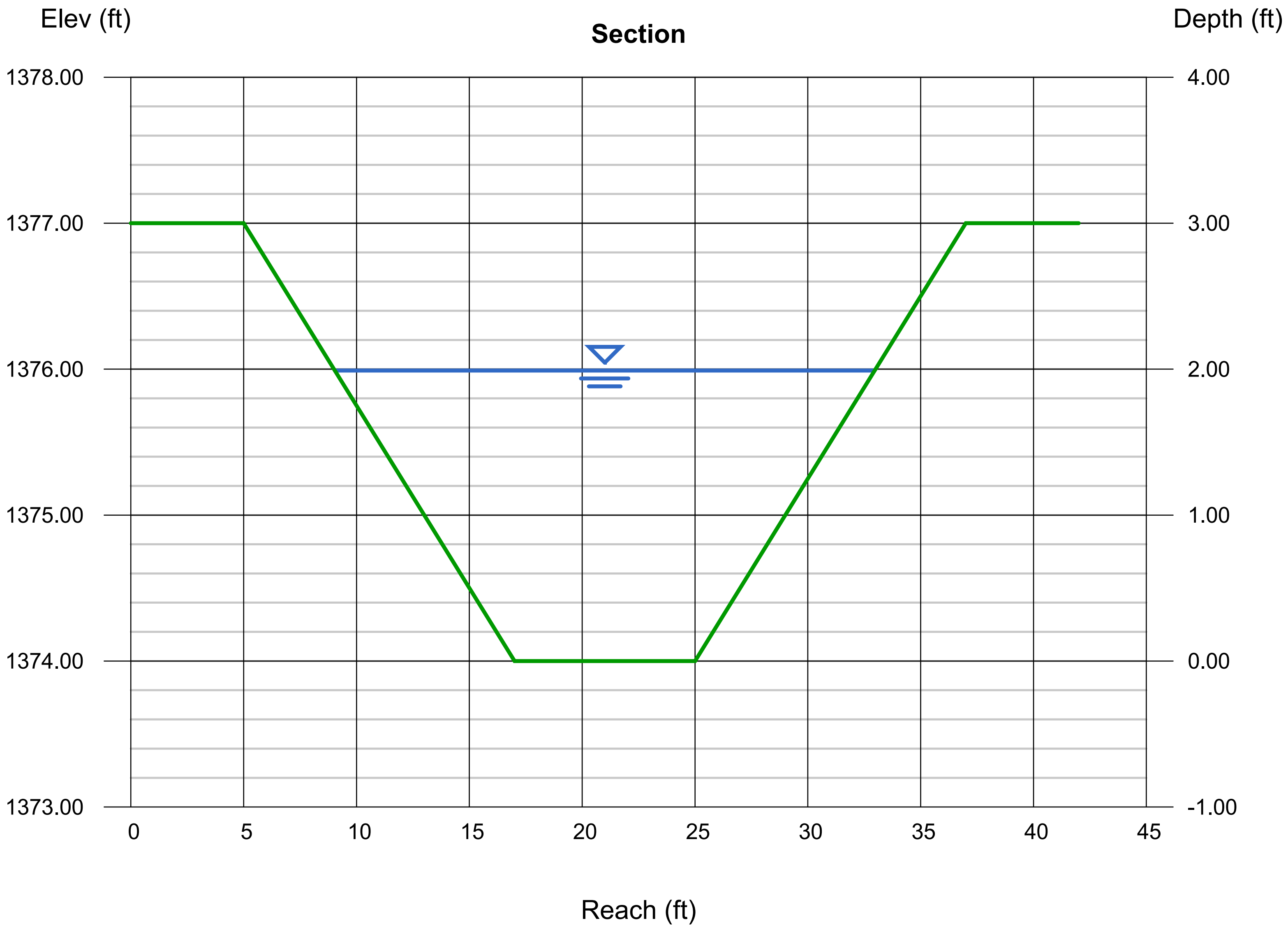
Channel Report

C-4.2 (TW=32FT)

Trapezoidal
Bottom Width (ft) = 8.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 3.00
Invert Elev (ft) = 1374.00
Slope (%) = 0.40
N-Value = 0.032

Calculations
Compute by: Known Q
Known Q (cfs) = 111.00

Highlighted
Depth (ft) = 1.99
Q (cfs) = 111.00
Area (sqft) = 31.76
Velocity (ft/s) = 3.49
Wetted Perim (ft) = 24.41
Crit Depth, Yc (ft) = 1.43
Top Width (ft) = 23.92
EGL (ft) = 2.18



Channel Report

C-4-INT (TW=26FT) INTERIM

Trapezoidal

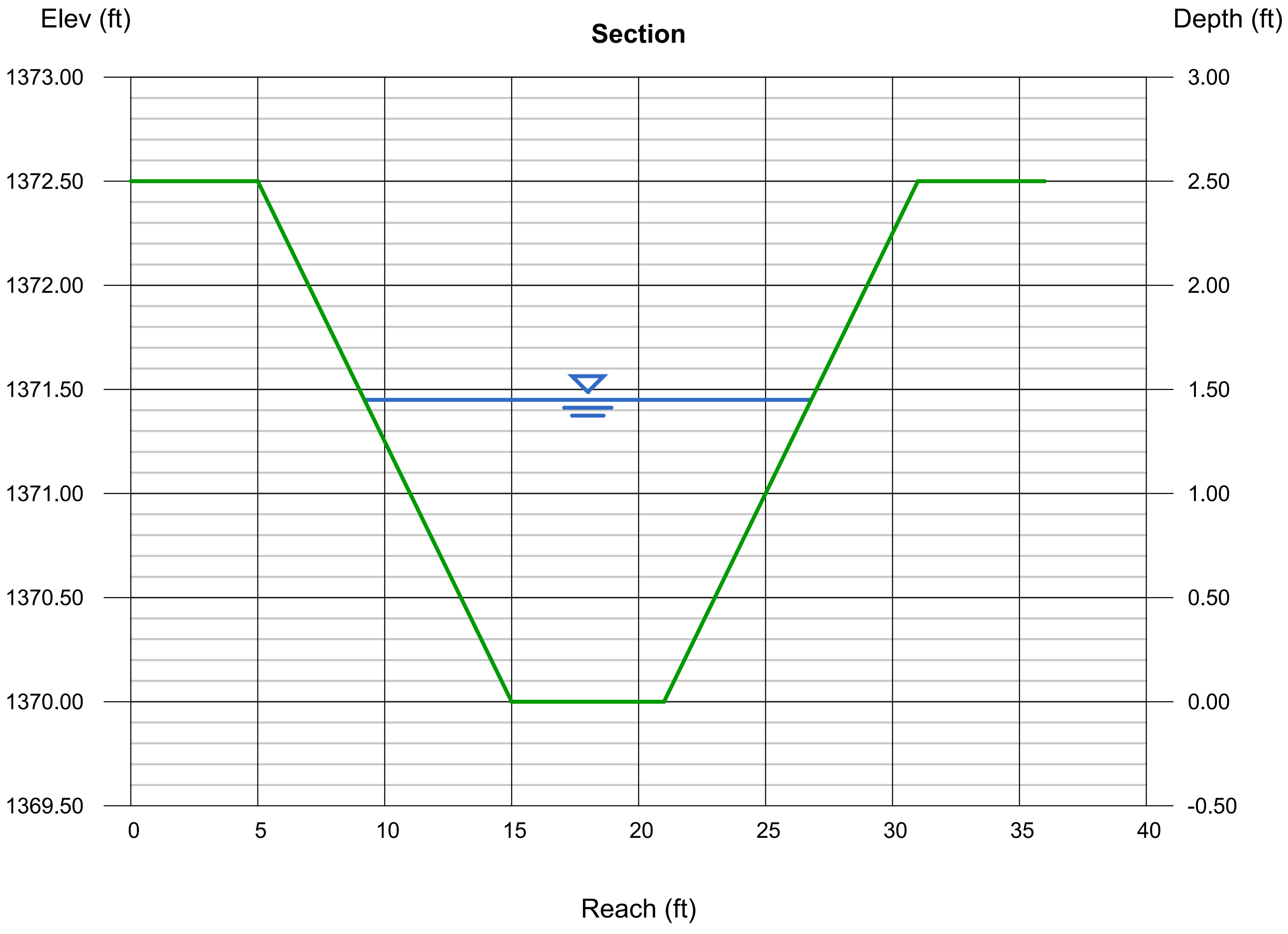
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1370.00
Slope (%)	= 0.33
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 44.00

Highlighted

Depth (ft)	= 1.45
Q (cfs)	= 44.00
Area (sqft)	= 17.11
Velocity (ft/s)	= 2.57
Wetted Perim (ft)	= 17.96
Crit Depth, Yc (ft)	= 0.96
Top Width (ft)	= 17.60
EGL (ft)	= 1.55



Channel Report

C-5 (TW=97FT)

Trapezoidal

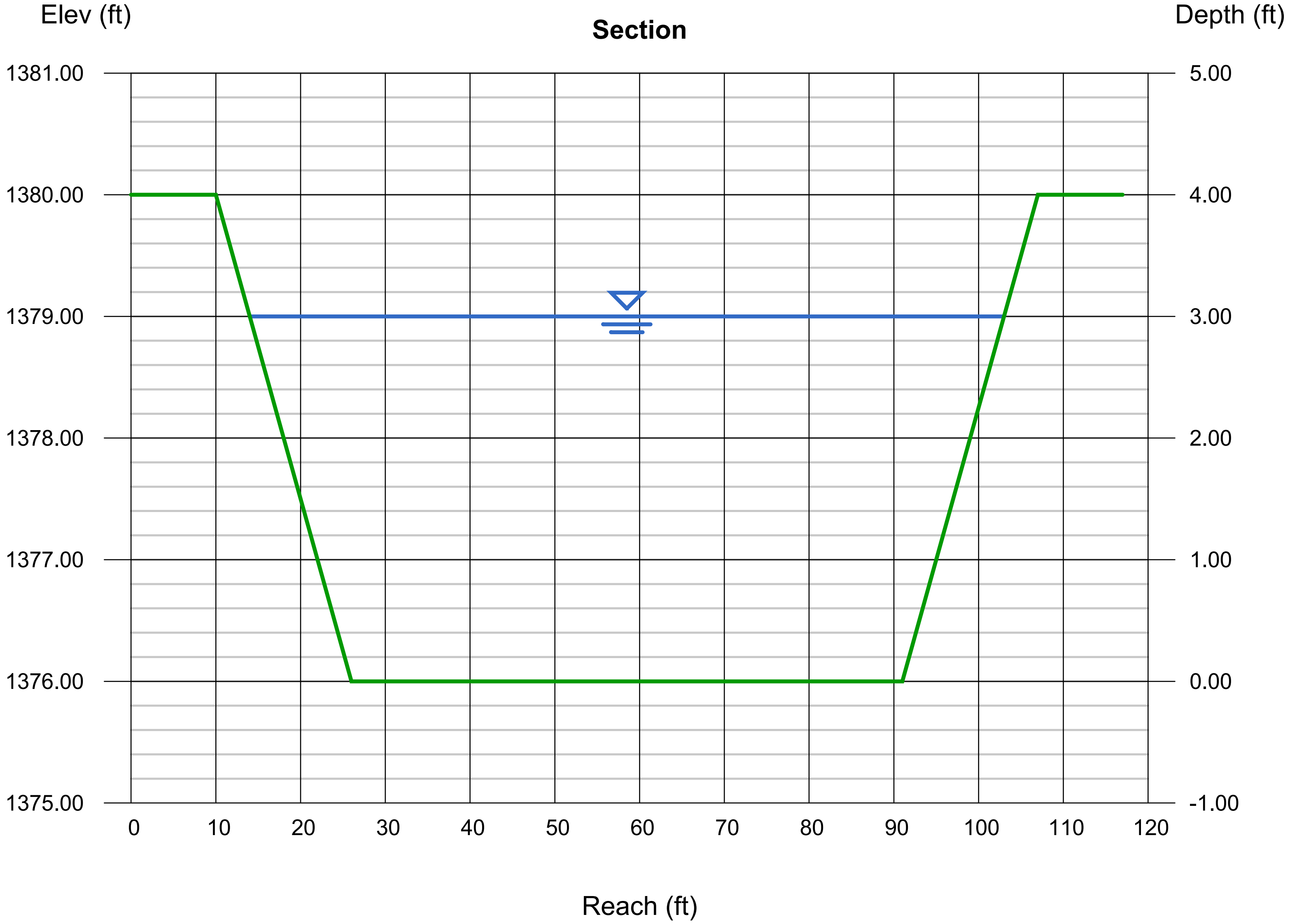
Bottom Width (ft)	= 65.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 1376.00
Slope (%)	= 0.30
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1100.00

Highlighted

Depth (ft)	= 3.00
Q (cfs)	= 1,100
Area (sqft)	= 231.00
Velocity (ft/s)	= 4.76
Wetted Perim (ft)	= 89.74
Crit Depth, Yc (ft)	= 1.99
Top Width (ft)	= 89.00
EGL (ft)	= 3.35



PRELIMINARY CULVERT CALCULATIONS

CULVERT SUMMARY

Project:	Hawes Crossing
Prepared by:	BB
Date:	Oct, 2019

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Culvert ID	Model Q[1] [cfs]	Quantity	Culvert Type
CU-1.1	66	2	36" RCP
CU-1.4	284	2	10'x4' RCBC
CU-3	105	3	36" RCP
CU-4.1	6	1	18" RCP
CU-4.2	111	3	36" RCP
CU-5	1,100	6	10'x4' RCBC
CU-2-INT	234	2	10'x4' RCBC
CU-3-INT	203	6	36" RCP

Notes:

(1) Model Q referneced from calculated Rational Method peak flow.

Culvert Report

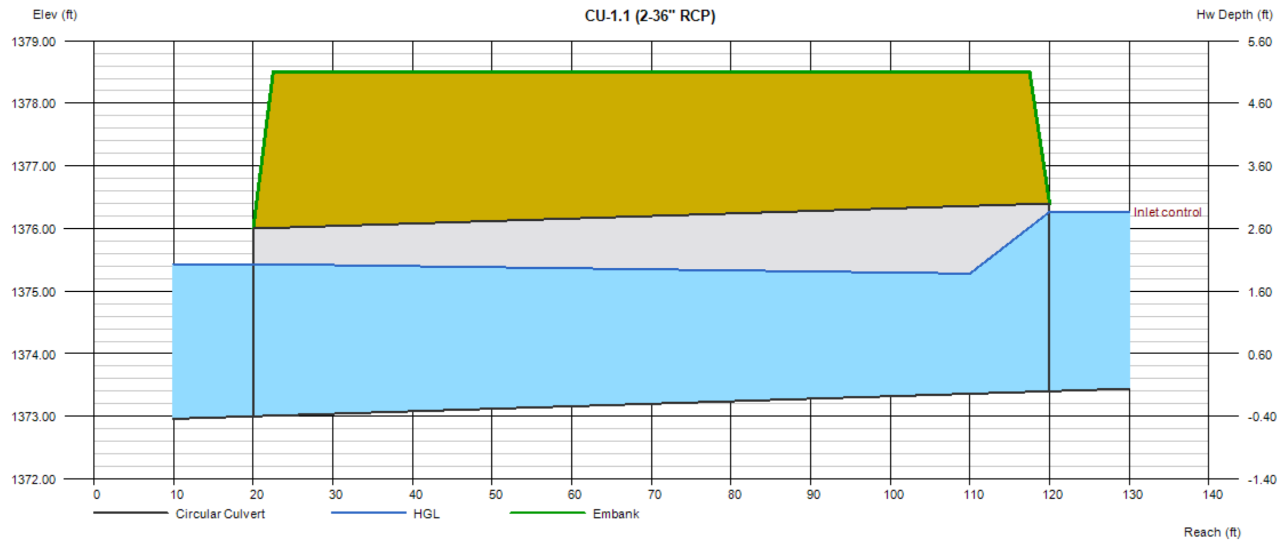
CU-1.1 (2-36" RCP)

Invert Elev Dn (ft) = 1373.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1373.40
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 2
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 1378.50
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations
Qmin (cfs) = 66.00
Qmax (cfs) = 66.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 66.00
Qpipe (cfs) = 66.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.38
Veloc Up (ft/s) = 7.15
HGL Dn (ft) = 1375.43
HGL Up (ft) = 1375.26
Hw Elev (ft) = 1376.27
Hw/D (ft) = 0.96
Flow Regime = Inlet Control



Culvert Report

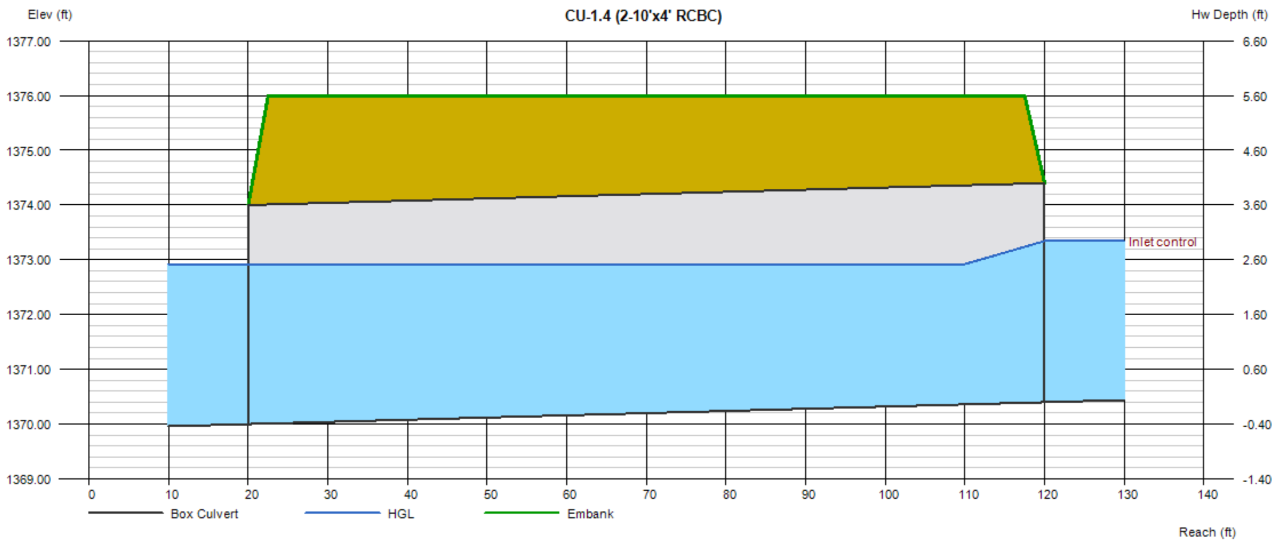
CU-1.4 (2-10'x4' RCBC)

Invert Elev Dn (ft) = 1370.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1370.40
Rise (in) = 48.0
Shape = Box
Span (in) = 120.0
No. Barrels = 2
n-Value = 0.012
Culvert Type = Flared Wingwalls
Culvert Entrance = 30D to 75D wingwall flares
Coeff. K,M,c,Y,k = 0.026, 1, 0.0347, 0.81, 0.4

Embankment
Top Elevation (ft) = 1376.00
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations
Qmin (cfs) = 284.00
Qmax (cfs) = 284.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 284.00
Qpipe (cfs) = 284.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 4.86
Veloc Up (ft/s) = 5.63
HGL Dn (ft) = 1372.92
HGL Up (ft) = 1372.92
Hw Elev (ft) = 1373.34
Hw/D (ft) = 0.74
Flow Regime = Inlet Control



Culvert Report

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CU-2-INT (2-10'x4' RCBC) INTERIM

Invert Elev Dn (ft) = 1370.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1370.40
Rise (in) = 48.0
Shape = Box
Span (in) = 120.0
No. Barrels = 2
n-Value = 0.012
Culvert Type = Flared Wingwalls
Culvert Entrance = 30D to 75D wingwall flares
Coeff. K,M,c,Y,k = 0.026, 1, 0.0347, 0.81, 0.4

Embankment

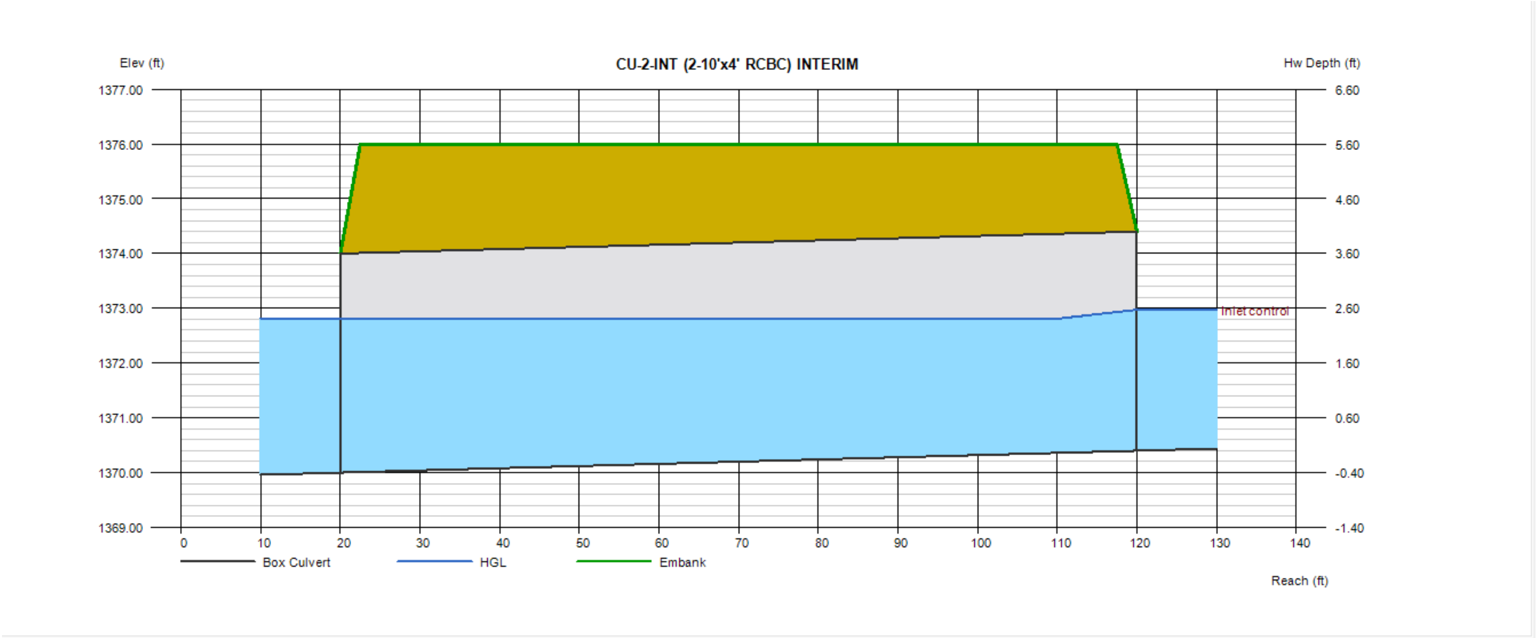
Top Elevation (ft) = 1376.00
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations

Qmin (cfs) = 234.00
Qmax (cfs) = 234.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 234.00
Qpipe (cfs) = 234.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 4.16
Veloc Up (ft/s) = 4.85
HGL Dn (ft) = 1372.81
HGL Up (ft) = 1372.81
Hw Elev (ft) = 1372.98
Hw/D (ft) = 0.64
Flow Regime = Inlet Control



Culvert Report

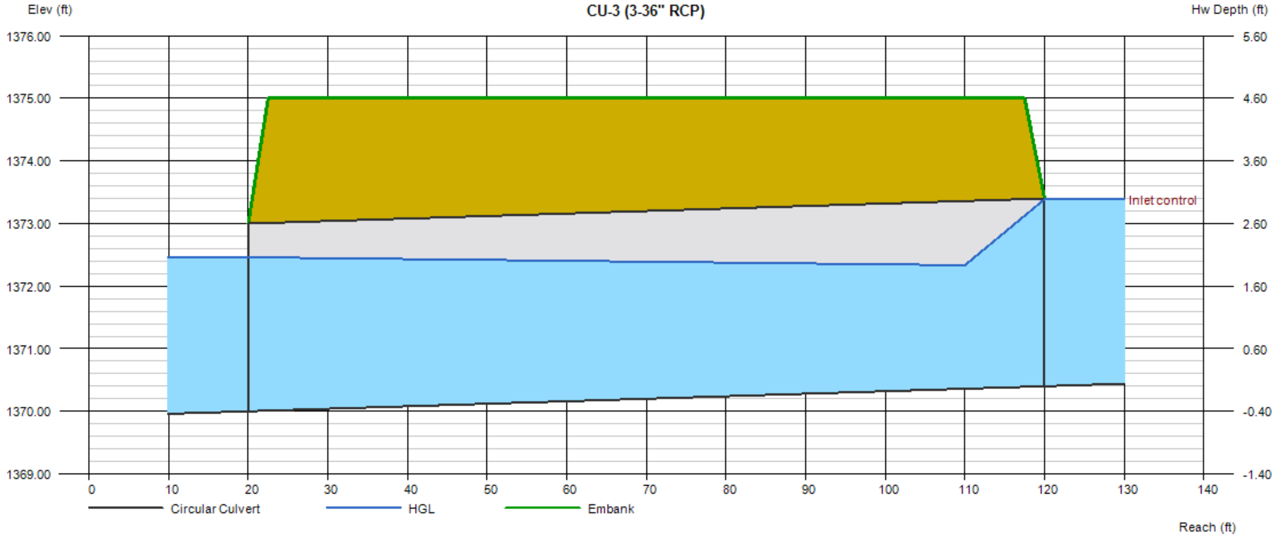
CU-3 (3-36" RCP)

Invert Elev Dn (ft) = 1370.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1370.40
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 3
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 1375.00
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations
Qmin (cfs) = 105.00
Qmax (cfs) = 105.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 105.00
Qpipe (cfs) = 105.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.64
Veloc Up (ft/s) = 7.32
HGL Dn (ft) = 1372.46
HGL Up (ft) = 1372.32
Hw Elev (ft) = 1373.39
Hw/D (ft) = 1.00
Flow Regime = Inlet Control



Culvert Report

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Wednesday, Oct 9 2019

CU-3-INT (6-36' RCP) INTERIM

Invert Elev Dn (ft) = 1370.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1370.40
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 3
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

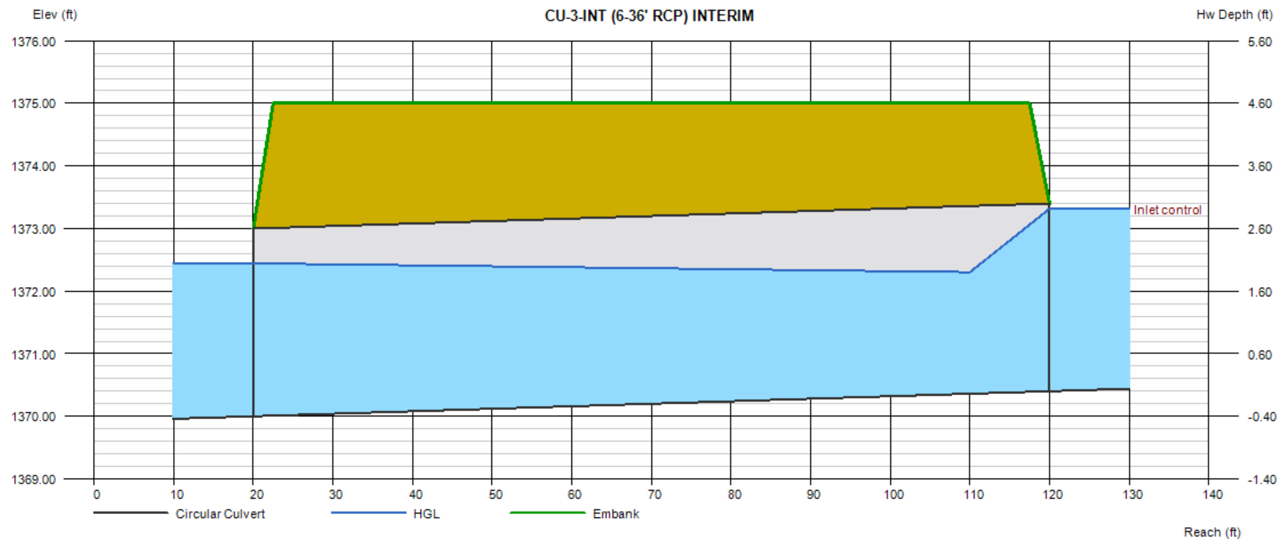
Top Elevation (ft) = 1375.00
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations

Qmin (cfs) = 101.50
Qmax (cfs) = 101.50
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 101.50
Qpipe (cfs) = 101.50
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.49
Veloc Up (ft/s) = 7.22
HGL Dn (ft) = 1372.44
HGL Up (ft) = 1372.29
Hw Elev (ft) = 1373.32
Hw/D (ft) = 0.97
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Oct 9 2019

CU-4.1 (1-18" RCP)

Invert Elev Dn (ft) = 1368.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1368.40
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

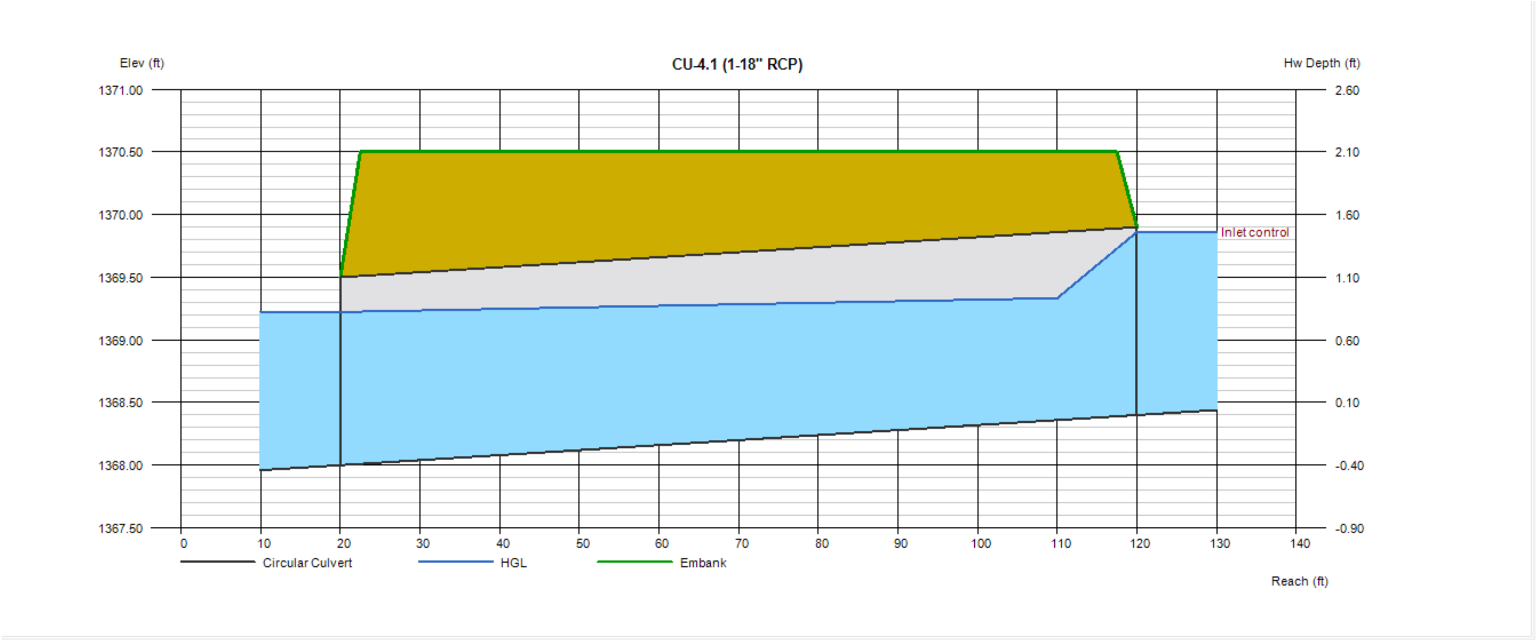
Top Elevation (ft) = 1370.50
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations

Qmin (cfs) = 6.00
Qmax (cfs) = 6.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 6.00
Qpipe (cfs) = 6.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 3.89
Veloc Up (ft/s) = 5.12
HGL Dn (ft) = 1369.22
HGL Up (ft) = 1369.35
Hw Elev (ft) = 1369.86
Hw/D (ft) = 0.97
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Oct 9 2019

CU-4.2 (3-36" RCP)

Invert Elev Dn (ft) = 1360.00
Pipe Length (ft) = 100.00
Slope (%) = 0.40
Invert Elev Up (ft) = 1360.40
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 3
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

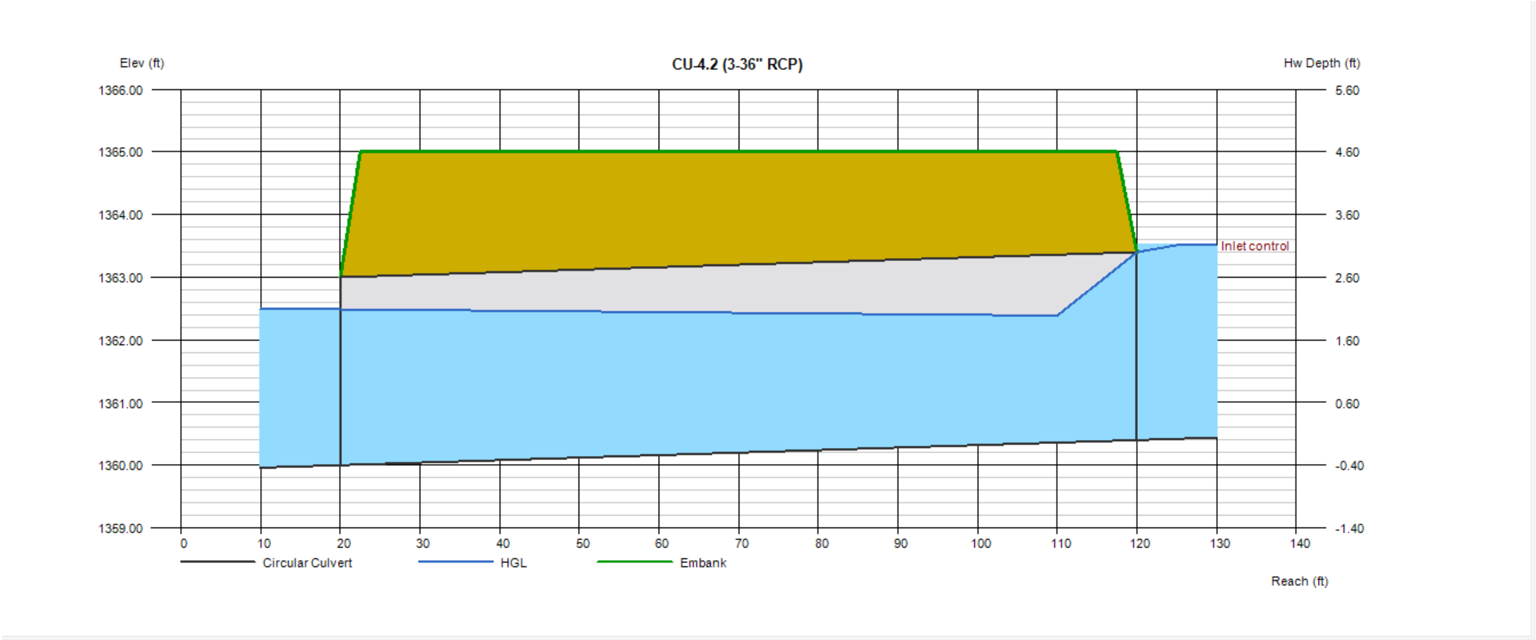
Top Elevation (ft) = 1365.00
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations

Qmin (cfs) = 111.00
Qmax (cfs) = 111.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 111.00
Qpipe (cfs) = 111.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.90
Veloc Up (ft/s) = 7.49
HGL Dn (ft) = 1362.49
HGL Up (ft) = 1362.38
Hw Elev (ft) = 1363.51
Hw/D (ft) = 1.04
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Oct 9 2019

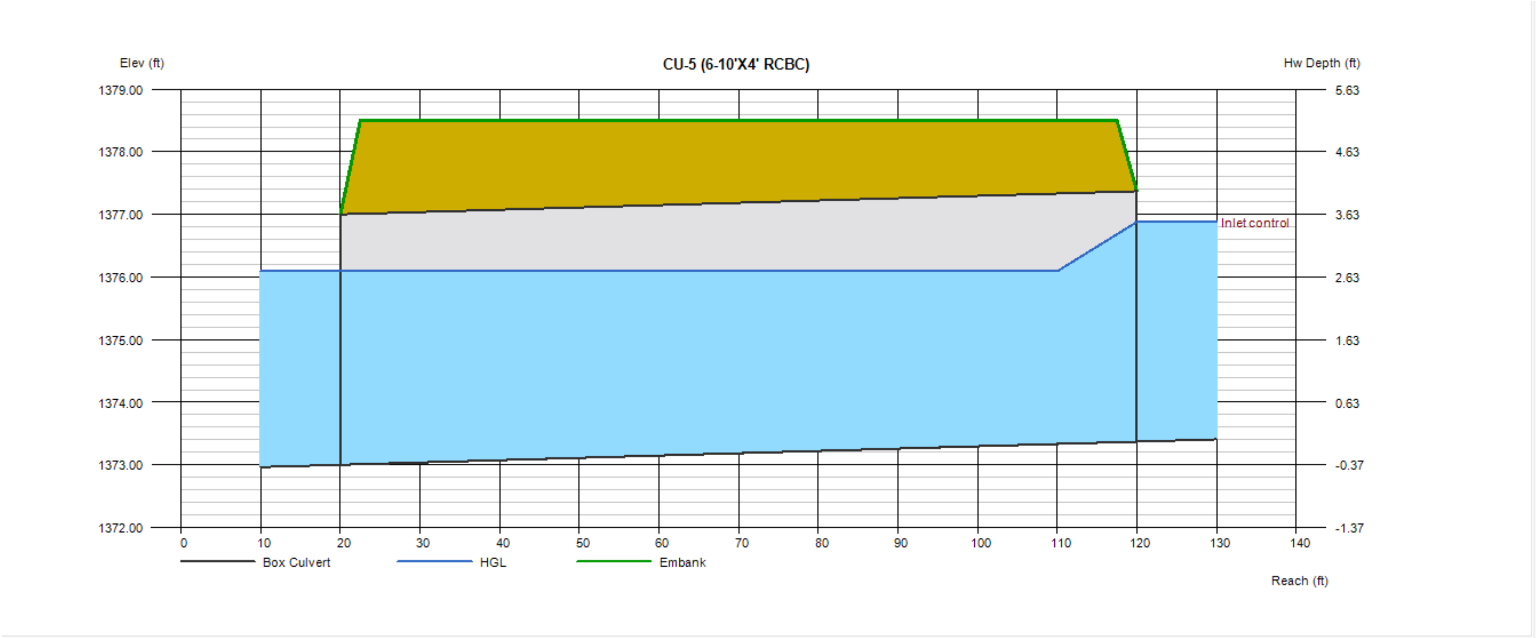
CU-5 (6-10'X4' RCBC)

Invert Elev Dn (ft) = 1373.00
Pipe Length (ft) = 100.00
Slope (%) = 0.37
Invert Elev Up (ft) = 1373.37
Rise (in) = 48.0
Shape = Box
Span (in) = 120.0
No. Barrels = 3
n-Value = 0.012
Culvert Type = Flared Wingwalls
Culvert Entrance = 30D to 75D wingwall flares
Coeff. K,M,c,Y,k = 0.026, 1, 0.0347, 0.81, 0.4

Embankment
Top Elevation (ft) = 1378.50
Top Width (ft) = 95.00
Crest Width (ft) = 95.00

Calculations
Qmin (cfs) = 550.00
Qmax (cfs) = 550.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 550.00
Qpipe (cfs) = 550.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.93
Veloc Up (ft/s) = 6.73
HGL Dn (ft) = 1376.09
HGL Up (ft) = 1376.09
Hw Elev (ft) = 1376.88
Hw/D (ft) = 0.88
Flow Regime = Inlet Control



HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

APPENDIX E

PRELIMINARY RETENTION CALCULATIONS

DRAINAGE SUBAREA SUMMARY TABLE

Project: Hawes Crossing

Prepared by: BB

Date: Oct, 2019

Drainage Subarea ID(s)	Concentration Point	Land Use Category									Total Area	Total Area
		Medium Density Residential	Medium/High Density Residential	Urban Density Residential	Urban/ Mixed Use	Technology/ Mixed Use	Commercial	Office	Park/Open Space	Undeveloped Desert		
		$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	$[ft^2]$	[ac]
ONSITE DRAINAGE AREAS												
A-1	R-A1	938,453	0	0	0	0	0	0	0	0	938,453	21.5
A-2	R-A2	641,582	0	0	0	0	0	0	0	0	641,582	14.7
A-3	R-A3	3,345,498	0	0	0	0	0	0	0	0	3,345,498	76.8
A-4	R-A4	882,719	0	0	0	0	0	0	0	0	882,719	20.3
A-5	R-A5	846,307	0	0	0	0	0	0	0	0	846,307	19.4
B-1	R-B1	0	355,731	0	0	0	0	0	0	0	355,731	8.2
B-2	R-B2	0	357,122	0	0	0	0	0	0	0	357,122	8.2
B-3	R-B3	0	452,704	0	0	0	0	0	0	0	452,704	10.4
B-4	R-B4	0	372,408	0	0	0	0	0	0	0	372,408	8.5
B-5	R-B5	0	374,794	0	0	0	0	0	0	0	374,794	8.6
B-6	R-B6	0	462,018	0	0	0	0	0	0	0	462,018	10.6
B-7	R-B7	0	291,432	0	0	0	0	0	0	0	291,432	6.7
B-8	R-B8	0	296,335	0	0	0	0	0	0	0	296,335	6.8
B-9	R-B9	0	304,135	0	0	0	0	0	0	0	304,135	7.0
B-10	R-B10	0	332,707	0	0	0	0	0	0	0	332,707	7.6
B-11	R-B11	0	385,484	0	0	0	0	0	0	0	385,484	8.8
B-12	R-B12	0	420,596	0	0	0	0	0	0	0	420,596	9.7
B-13	R-B13	0	365,255	0	0	0	0	0	0	0	365,255	8.4
B-14	R-B14	0	404,721	0	0	0	0	0	0	0	404,721	9.3
B-15	R-B15	0	969,838	0	0	0	0	0	0	0	969,838	22.3
B-16	R-B16	0	356,271	0	0	0	0	0	0	0	356,271	8.2
B-17	R-B17	0	356,530	0	0	0	0	0	0	0	356,530	8.2
B-18	R-B18	0	382,251	0	0	0	0	0	0	0	382,251	8.8
B-19	R-B19	0	393,199	0	0	0	0	0	0	0	393,199	9.0
B-20	R-B20	0	396,145	0	0	0	0	0	0	0	396,145	9.1
B-21	R-B21	0	817,291	0	0	0	0	0	0	0	817,291	18.8
B-22	R-B22	0	738,659	0	0	0	0	0	0	0	738,659	17.0
B-23	R-B23	0	534,440	0	0	0	0	0	0	0	534,440	12.3
B-24	R-B24	0	529,576	0	0	0	0	0	0	0	529,576	12.2
B-25	R-B25	0	1,474,408	0	0	0	0	0	0	0	1,474,408	33.8
C-1	R-C1	0	0	406,355	0	0	0	0	0	0	406,355	9.3
C-2	R-C2	0	0	734,601	0	0	0	0	0	0	734,601	16.9
C-3	R-C3	0	0	315,356	0	0	0	0	0	0	315,356	7.2
C-4	R-C4	0	0	349,438	0	0	0	0	0	0	349,438	8.0
C-5	R-C5	0	0	356,704	0	0	0	0	0	0	356,704	8.2
C-6	R-C6	0	0	356,742	0	0	0	0	0	0	356,742	8.2
D-1	R-D1	0	0	0	467,361	0	0	0	0	0	467,361	10.7
D-2	R-D2	0	0	0	925,262	0	0	0	0	0	925,262	21.2
D-3	R-D3	0	0	0	1,051,542	0	0	0	0	0	1,051,542	24.1
D-4	R-D4	0	0	0	602,967	0	0	0	0	0	602,967	13.8
D-5	R-D5	0	0	0	575,820	0	0	0	0	0	575,820	13.2
D-6	R-D6	0	0	0	498,833	0	0	0	0	0	498,833	11.5
D-7	R-D7	0	0	0	1,070,025	0	0	0	0	0	1,070,025	24.6
D-8	R-D8	0	0	0	1,426,698	0	0	0	0	0	1,426,698	32.8
D-9	R-D9	0	0	0	723,465	0	0	0	0	0	723,465	16.6
D-10	R-D10	0	0	0	549,084	0	0	0	0	0	549,084	12.6
D-11	R-D11	0	0	0	802,568	0	0	0	0	0	802,568	18.4
E-1	R-D12	0	0	0	0	3,206,010	0	0	0	0	3,206,010	73.6
E-2	R-D13	0	0	0	0	2,140,971	0	0	0	0	2,140,971	49.1
E-3	R-D14	0	0	0	0	33,033	0	0	0	0	33,033	0.8
E-4	R-D15	0	0	0	0	176,907	0	0	0	0	176,907	4.1
E-5	R-D16	0	0	0	0	695,155	0	0	0	0	695,155	16.0
E-6	R-D17	0	0	0	0	724,502	0	0	0	0	724,502	16.6
E-7	R-D18	0	0	0	0	724,034	0	0	0	0	724,034	16.6
E-8	R-D19	0	0	0	0	1,498,812	0	0	0	0	1,498,812	34.4
E-9	R-D20	0	0	0	0	1,113,971	0	0	0	0	1,113,971	25.6
F-1	R-D21	0	0	0	0	0	965,430	0	0	0	965,430	22.2
F-2	R-D22	0	0	0	0	0	895,691	0	0	0	895,691	20.6
F-3	R-D23	0	0	0	0	0	987,955	0	0	0	987,955	22.7
F-4	R-D24	0	0	0	0	0	1,090,927	0	0	0	1,090,927	25.0
F-5	R-D25	0	0	0	0	0	755,729	0	0	0	755,729	17.3
F-6	R-D26	0	0	0	0	0	1,136,279	0	0	0	1,136,279	26.1
F-7	R-D27	0	0	0	0	0	833,629	0	0	0	833,629	19.1
F-8	R-D28	0	0	0	0	0	694,383	0	0	0	694,383	15.9
G-1	R-D29	0	0	0	0	0	0	385,567	0	0	385,567	8.9
P-1	R-D30	0	0	0	0	0	0	0	170,110	0	170,110	3.9
P-2	R-D31	0	0	0	0	0	0	0	78,595	0	78,595	1.8
P-3	R-D32	0	0	0	0	0	0	0	333,706	0	333,706	7.7
P-4	R-D33	0	0	0	0	0	0	0	42,949	0	42,949	1.0
P-5	R-P5	0	0	0	0	0	0	0	84,686	0	84,686	1.9
P-6	R-P6	0	0	0	0	0	0	0	540,744	0	540,744	12.4
TOTAL		**6,654,559**	**12,124,050**	**2,519,195**	**8,693,626**	**10,313,396**	**7,360,024**	**385,567**	**1,250,791**	**0**	**49,301,208**	**1131.8**

WEIGHTED RUNOFF COEFFICIENT CALCULATIONS

Project: Hawes Crossing

Prepared by: BB

Date: Oct, 2019

Land Use[1]	Land Use Code	C Coefficient
Medium Density Residential	A	0.75
Medium/High Density Residential	B	0.80
Urban Density Residential	C	0.85
Urban/ Mixed Use[2]	D	0.80
Technology/ Mixed Use	E	0.90
Commercial	F	0.90
Office	G	0.90
Park/Open Space	P	0.65
Undeveloped Desert	--	0.50

NOTES:

(1) From Table 6.3 of the FCDMC Drainage Policies and Standards, Arizona (August, 2018)

(2) Assumes average of Urban and Commercial density coefficients

Drainage Subarea ID(s)	Concentration Point	Subarea Surface Types & Areas											Weighted C Coefficient
		Medium Density Residential [ft^2]	Medium/High Density Residential [ft^2]	Urban Density Residential [ft^2]	Urban/ Mixed Use [ft^2]	Technology/ Mixed Use [ft^2]	Commercial [ft^2]	Office [ft^2]	Park/Open Space [ft^2]	Undeveloped Desert [ft^2]	Total [ft^2]	Total [ac]	C_w - 100 Year
ONSITE DRAINAGE AREAS													
A-1	R-A1	938,453	0	0	0	0	0	0	0	0	938,453	21.5	0.75
A-2	R-A2	641,582	0	0	0	0	0	0	0	0	641,582	14.7	0.75
A-3	R-A3	3,345,498	0	0	0	0	0	0	0	0	3,345,498	76.8	0.75
A-4	R-A4	882,719	0	0	0	0	0	0	0	0	882,719	20.3	0.75
A-5	R-A5	846,307	0	0	0	0	0	0	0	0	846,307	19.4	0.75
B-1	R-B1	0	355,731	0	0	0	0	0	0	0	355,731	8.2	0.80
B-2	R-B2	0	357,122	0	0	0	0	0	0	0	357,122	8.2	0.80
B-3	R-B3	0	452,704	0	0	0	0	0	0	0	452,704	10.4	0.80
B-4	R-B4	0	372,408	0	0	0	0	0	0	0	372,408	8.5	0.80
B-5	R-B5	0	374,794	0	0	0	0	0	0	0	374,794	8.6	0.80
B-6	R-B6	0	462,018	0	0	0	0	0	0	0	462,018	10.6	0.80
B-7	R-B7	0	291,432	0	0	0	0	0	0	0	291,432	6.7	0.80
B-8	R-B8	0	296,335	0	0	0	0	0	0	0	296,335	6.8	0.80
B-9	R-B9	0	304,135	0	0	0	0	0	0	0	304,135	7.0	0.80
B-10	R-B10	0	332,707	0	0	0	0	0	0	0	332,707	7.6	0.80
B-11	R-B11	0	385,484	0	0	0	0	0	0	0	385,484	8.8	0.80
B-12	R-B12	0	420,596	0	0	0	0	0	0	0	420,596	9.7	0.80
B-13	R-B13	0	365,255	0	0	0	0	0	0	0	365,255	8.4	0.80
B-14	R-B14	0	404,721	0	0	0	0	0	0	0	404,721	9.3	0.80
B-15	R-B15	0	969,838	0	0	0	0	0	0	0	969,838	22.3	0.80
B-16	R-B16	0	356,271	0	0	0	0	0	0	0	356,271	8.2	0.80
B-17	R-B17	0	356,530	0	0	0	0	0	0	0	356,530	8.2	0.80
B-18	R-B18	0	382,251	0	0	0	0	0	0	0	382,251	8.8	0.80
B-19	R-B19	0	393,199	0	0	0	0	0	0	0	393,199	9.0	0.80
B-20	R-B20	0	396,145	0	0	0	0	0	0	0	396,145	9.1	0.80
B-21	R-B21	0	817,291	0	0	0	0	0	0	0	817,291	18.8	0.80
B-22	R-B22	0	738,659	0	0	0	0	0	0	0	738,659	17.0	0.80
B-23	R-B23	0	534,440	0	0	0	0	0	0	0	534,440	12.3	0.80

Drainage Subarea ID(s)	Concentration Point	Subarea Surface Types & Areas											Weighted C Coefficient
		Medium Density Residential [ft^2]	Medium/High Density Residential [ft^2]	Urban Density Residential [ft^2]	Urban/ Mixed Use [ft^2]	Technology/ Mixed Use [ft^2]	Commercial [ft^2]	Office [ft^2]	Park/Open Space [ft^2]	Undeveloped Desert [ft^2]	Total [ft^2]	Total [ac]	C_w - 100 Year
B-24	R-B24	0	529,576	0	0	0	0	0	0	0	529,576	12.2	0.80
B-25	R-B25	0	1,474,408	0	0	0	0	0	0	0	1,474,408	33.8	0.80
C-1	R-C1	0	0	406,355	0	0	0	0	0	0	406,355	9.3	0.85
C-2	R-C2	0	0	734,601	0	0	0	0	0	0	734,601	16.9	0.85
C-3	R-C3	0	0	315,356	0	0	0	0	0	0	315,356	7.2	0.85
C-4	R-C4	0	0	349,438	0	0	0	0	0	0	349,438	8.0	0.85
C-5	R-C5	0	0	356,704	0	0	0	0	0	0	356,704	8.2	0.85
C-6	R-C6	0	0	356,742	0	0	0	0	0	0	356,742	8.2	0.85
D-1	R-D1	0	0	0	467,361	0	0	0	0	0	467,361	10.7	0.80
D-2	R-D2	0	0	0	925,262	0	0	0	0	0	925,262	21.2	0.80
D-3	R-D3	0	0	0	1,051,542	0	0	0	0	0	1,051,542	24.1	0.80
D-4	R-D4	0	0	0	602,967	0	0	0	0	0	602,967	13.8	0.80
D-5	R-D5	0	0	0	575,820	0	0	0	0	0	575,820	13.2	0.80
D-6	R-D6	0	0	0	498,833	0	0	0	0	0	498,833	11.5	0.80
D-7	R-D7	0	0	0	1,070,025	0	0	0	0	0	1,070,025	24.6	0.80
D-8	R-D8	0	0	0	1,426,698	0	0	0	0	0	1,426,698	32.8	0.80
D-9	R-D9	0	0	0	723,465	0	0	0	0	0	723,465	16.6	0.80
D-10	R-D10	0	0	0	549,084	0	0	0	0	0	549,084	12.6	0.80
D-11	R-D11	0	0	0	802,568	0	0	0	0	0	802,568	18.4	0.80
E-1	R-D12	0	0	0	0	3,206,010	0	0	0	0	3,206,010	73.6	0.90
E-2	R-D13	0	0	0	0	2,140,971	0	0	0	0	2,140,971	49.1	0.90
E-3	R-D14	0	0	0	0	33,033	0	0	0	0	33,033	0.8	0.90
E-4	R-D15	0	0	0	0	176,907	0	0	0	0	176,907	4.1	0.90
E-5	R-D16	0	0	0	0	695,155	0	0	0	0	695,155	16.0	0.90
E-6	R-D17	0	0	0	0	724,502	0	0	0	0	724,502	16.6	0.90
E-7	R-D18	0	0	0	0	724,034	0	0	0	0	724,034	16.6	0.90
E-8	R-D19	0	0	0	0	1,498,812	0	0	0	0	1,498,812	34.4	0.90
E-9	R-D20	0	0	0	0	1,113,971	0	0	0	0	1,113,971	25.6	0.90
F-1	R-D21	0	0	0	0	0	965,430	0	0	0	965,430	22.2	0.90
F-2	R-D22	0	0	0	0	0	895,691	0	0	0	895,691	20.6	0.90
F-3	R-D23	0	0	0	0	0	987,955	0	0	0	987,955	22.7	0.90
F-4	R-D24	0	0	0	0	0	1,090,927	0	0	0	1,090,927	25.0	0.90
F-5	R-D25	0	0	0	0	0	755,729	0	0	0	755,729	17.3	0.90
F-6	R-D26	0	0	0	0	0	1,136,279	0	0	0	1,136,279	26.1	0.90
F-7	R-D27	0	0	0	0	0	833,629	0	0	0	833,629	19.1	0.90
F-8	R-D28	0	0	0	0	0	694,383	0	0	0	694,383	15.9	0.90
G-1	R-D29	0	0	0	0	0	0	385,567	0	0	385,567	8.9	0.90
P-1	R-D30	0	0	0	0	0	0	0	170,110	0	170,110	3.9	0.65
P-2	R-D31	0	0	0	0	0	0	0	78,595	0	78,595	1.8	0.65
P-3	R-D32	0	0	0	0	0	0	0	333,706	0	333,706	7.7	0.65
P-4	R-D33	0	0	0	0	0	0	0	42,949	0	42,949	1.0	0.65
P-5	R-P5	0	0	0	0	0	0	0	84,686	0	84,686	1.9	0.65
P-6	R-P6	0	0	0	0	0	0	0	540,744	0	540,744	12.4	0.65
TOTAL		**6,654,559**	**12,124,050**	**2,519,195**	**8,693,626**	**10,313,396**	**7,360,024**	**385,567**	**1,250,791**	**0**	**49,301,208**	**1,131.8**	--

RETENTION CALCULATION TABLE

Project: Hawes Crossing
Prepared by: BB
Date: Oct, 2019

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Volume Required = C * (P/ 12) * A   Where: A= Plan-view area of an individual drainage area
Cw=Weighted Runoff Coefficient (100-Yr)
P=2.17 in (100-Yr, 2-Hr)

Retention Basin ID	Drainage Area(s)	Total Area A [ft^2]	Total Area A [ac]	Weighted Runoff "C" Coefficient	100-Yr, 2-Hr Volume Required [ft^3]	100-Yr, 2-Hr Volume Required [ac-ft]
R-A1	A-1	938,453	21.5	0.75	127,278	2.9
R-A2	A-2	641,582	14.7	0.75	87,015	2.0
R-A3	A-3	3,345,498	76.8	0.75	453,733	10.4
R-A4	A-4	882,719	20.3	0.75	119,719	2.7
R-A5	A-5	846,307	19.4	0.75	114,780	2.6
R-B1	B-1	355,731	8.2	0.80	51,462	1.2
R-B2	B-2	357,122	8.2	0.80	51,664	1.2
R-B3	B-3	452,704	10.4	0.80	65,491	1.5
R-B4	B-4	372,408	8.5	0.80	53,875	1.2
R-B5	B-5	374,794	8.6	0.80	54,220	1.2
R-B6	B-6	462,018	10.6	0.80	66,839	1.5
R-B7	B-7	291,432	6.7	0.80	42,160	1.0
R-B8	B-8	296,335	6.8	0.80	42,870	1.0
R-B9	B-9	304,135	7.0	0.80	43,998	1.0
R-B10	B-10	332,707	7.6	0.80	48,132	1.1
R-B11	B-11	385,484	8.8	0.80	55,767	1.3
R-B12	B-12	420,596	9.7	0.80	60,846	1.4
R-B13	B-13	365,255	8.4	0.80	52,840	1.2
R-B14	B-14	404,721	9.3	0.80	58,550	1.3
R-B15	B-15	969,838	22.3	0.80	140,303	3.2
R-B16	B-16	356,271	8.2	0.80	51,541	1.2
R-B17	B-17	356,530	8.2	0.80	51,578	1.2
R-B18	B-18	382,251	8.8	0.80	55,299	1.3
R-B19	B-19	393,199	9.0	0.80	56,883	1.3
R-B20	B-20	396,145	9.1	0.80	57,309	1.3
R-B21	B-21	817,291	18.8	0.80	118,235	2.7
R-B22	B-22	738,659	17.0	0.80	106,859	2.5
R-B23	B-23	534,440	12.3	0.80	77,316	1.8
R-B24	B-24	529,576	12.2	0.80	76,612	1.8
R-B25	B-25	1,474,408	33.8	0.80	213,298	4.9
R-C1	C-1	406,355	9.3	0.85	62,460	1.4
R-C2	C-2	734,601	16.9	0.85	112,914	2.6
R-C3	C-3	315,356	7.2	0.85	48,473	1.1
R-C4	C-4	349,438	8.0	0.85	53,712	1.2
R-C5	C-5	356,704	8.2	0.85	54,828	1.3

Retention Basin ID	Drainage Area(s)	Total Area A [ft^2]	Total Area A [ac]	Weighted Runoff "C" Coefficient	100-Yr, 2-Hr Volume Required [ft^3]	100-Yr, 2-Hr Volume Required [ac-ft]
R-C6	C-6	356,742	8.2	0.85	54,834	1.3
R-D1	D-1	467,361	10.7	0.80	67,612	1.6
R-D2	D-2	925,262	21.2	0.80	133,855	3.1
R-D3	D-3	1,051,542	24.1	0.80	152,123	3.5
R-D4	D-4	602,967	13.8	0.80	87,229	2.0
R-D5	D-5	575,820	13.2	0.80	83,302	1.9
R-D6	D-6	498,833	11.5	0.80	72,165	1.7
R-D7	D-7	1,070,025	24.6	0.80	154,797	3.6
R-D8	D-8	1,426,698	32.8	0.80	206,396	4.7
R-D9	D-9	723,465	16.6	0.80	104,661	2.4
R-D10	D-10	549,084	12.6	0.80	79,434	1.8
R-D11	D-11	802,568	18.4	0.80	116,105	2.7
R-D12	E-1	3,206,010	73.6	0.90	521,778	12.0
R-D13	E-2	2,140,971	49.1	0.90	348,443	8.0
R-D14	E-3	33,033	0.8	0.90	5,376	0.1
R-D15	E-4	176,907	4.1	0.90	28,792	0.7
R-D16	E-5	695,155	16.0	0.90	113,137	2.6
R-D17	E-6	724,502	16.6	0.90	117,913	2.7
R-D18	E-7	724,034	16.6	0.90	117,837	2.7
R-D19	E-8	1,498,812	34.4	0.90	243,932	5.6
R-D20	E-9	1,113,971	25.6	0.90	181,299	4.2
R-D21	F-1	965,430	22.2	0.90	157,124	3.6
R-D22	F-2	895,691	20.6	0.90	145,774	3.3
R-D23	F-3	987,955	22.7	0.90	160,790	3.7
R-D24	F-4	1,090,927	25.0	0.90	177,548	4.1
R-D25	F-5	755,729	17.3	0.90	122,995	2.8
R-D26	F-6	1,136,279	26.1	0.90	184,929	4.2
R-D27	F-7	833,629	19.1	0.90	135,673	3.1
R-D28	F-8	694,383	15.9	0.90	113,011	2.6
R-D29	G-1	385,567	8.9	0.90	62,751	1.4
R-D30	P-1	170,110	3.9	0.65	19,995	0.5
R-D31	P-2	78,595	1.8	0.65	9,238	0.2
R-D32	P-3	333,706	7.7	0.65	39,224	0.9
R-D33	P-4	42,949	1.0	0.65	5,048	0.1
R-P5	P-5	84,686	1.9	0.65	9,954	0.2
R-P6	P-6	540,744	12.4	0.65	63,560	1.5
TOTAL		49,301,208	1,131.8	--	7,387,490	169.6