Plan # _____

Case # 11-DR-2020

Q-S # 16-44

X Approved

____ Corrections

Richard M. Anderson 07/12/2021

Reviewed By Date

PRELIMINARY DRAINAGE REPORT

Museum Square Building 4
Scottsdale, Arizona

11-DR-2020

Prepared For:

ARC Scottsdale Holdings, LLLP
3225 N. Central Avenue, Suite 100
Phoenix, AZ 85012

Prepared by:

Kimley»Horn

291430000
April 2021

Museum Square Building 4

PRELIMINARY DRAINAGE REPORT

APRIL 2021

Prepared By:

Kimley»Horn

11-DR-2020
5/21/2021

Kimley»Horn

Contents

Appendices

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

ARC Scottsdale Holdings, LLLP is proposing to construct a multi-family development at the northeast corner of E. 2nd Street and N. Marshall Way in Scottsdale, Arizona. Museum Square Building 4, the "project", is anticipated to consist of a six-story apartment building with adjacent on-street parking, a two-level underground parking garage, and utility infrastructure improvements.

1.2 SITE LOCATION

The proposed development encompasses approximately 1.24 net acres in a portion of the Northeast Quarter of Section 27, Township 2 North, Range 4 East of the Gila and Salt River Base and Meridian in Maricopa County, Arizona. The proposed development consists of four previously developed parcels. All parcels are vacant lots zoned D/OC-2. More specifically, the development site is bounded on the west by Marshall Way, on the south by 2nd Street, on the east by an existing CenturyLink site with parking and a data center, and on the north by 1st Street. The site slopes from the northwest to the southeast at approximately 1.1%. See Appendix A for the Site Location Map. See Figure 1 in Appendix C for a Context Aerial Map.

1.3 PURPOSE

This Preliminary Drainage Report is intended to satisfy City of Scottsdale requirements for the Development Review submittal. This report provides a description of the current stormwater drainage patterns and a description of the required and proposed drainage improvements.

1.4 OBJECTIVES

This report provides a drainage plan for the site that is intended to meet the drainage standards and guidelines of the City of Scottsdale and the Flood Control District of Maricopa County (FCDMC). In particular, this report will demonstrate the following:

1. Any existing off-site flows from the adjacent properties will be handled and conveyed in a way consistent with the current drainage patterns.

2. The proposed on-site drainage patterns will remain consistent with the current drainage patterns.

3. Per the City of Scottsdale Design Standards and Policies Manual Section 4-1.201.C.1.b, no on-site storm water storage is required since the runoff coefficient (C-value) will be equal to or less than the pre-development condition.

4. The site will provide first flush treatment prior to discharging to the City storm drain system.

5. Building finish floor elevations will be determined in accordance with City of Scottsdale and FEMA Flood Zone requirements (if applicable).

2.0 DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

2.1 EXISTING ON-SITE DRAINAGE CONDITIONS

The site consists of vacant lots used for construction staging and surface parking. The parcels are improved with asphalt pavement and limited landscaping. The site slopes from the northwest to the southeast at approximately 1.1%.

Stormwater from the site currently flows to the southeast corner as sheet flow where it overtops the adjacent sidewalk and curb and flows east along E. 2nd Street. No retention or stormwater conveyance features currently exist on the site. Site-generated stormwater ultimately reaches the City of Scottsdale storm drain system through a catch basin approximately 90 feet east of the southeast corner project along E. 2nd Street.

The pre-development site includes 4,403 SF of landscape/pervious area and 49,496 SF of paved/impervious area, resulting in a pre-development runoff coefficient of 0.91. The resulting 10-year and 100-year runoff flows are 5.3 CFS and 8.4 CFS, respectively.

Refer to Figure 2 in Appendix C for the Existing Conditions Exhibit.

2.2 EXISTING OFF-SITE DRAINAGE CONDITIONS

The proposed site is not impacted by off-site stormwater runoff.

The adjacent portions of E. 1st Street, N. Marshall Way, and E. 2nd Street convey storm water from areas to the north and west of the site. Dibble Engineering prepared the *Mashall Way Goldwater Blvd to Indian School Road* Drainage Report in August 2017 (Marshall Way Drainage Report), and the flows in the adjacent streets were quantified in this report. Based on the Marshall Way Drainage Report, the 100-year flows are:

- 52.5 cfs flowing east in E. 1st Street
- 37.5 cfs flowing south in N. Marshall Way
- 43.3 cfs flowing east in E. 2nd Street

Stormwater runoff from the adjacent portion of N. Marshall Way is conveyed south via curb and gutter to the intersection of N. Marshall Way and E. 2nd Street and conveyed east on E. 2nd Street to the City storm drain system via a catch basin approximately 90 feet east of the southeast corner project along E. 2nd Street. Stormwater runoff from the adjacent portion of E. 1st Street flows east to the City storm drain system via a curb inlet at the southwest corner of E. 2nd Street and Scottsdale Road. The City storm drain system includes an existing 72-inch storm drain in E. 2nd Street. The adjacent portions of E. 2nd Street, N. Marshall Way, and E. 1st Street are all crowned near their respective centerlines.

Refer to Figure 2 in Appendix C for the Existing Conditions Exhibit. Refer to Appendix D for the Marshall Way Drainage Report.

2.3 FEMA FLOOD HAZARD AREAS

The site is located in Flood Zone “X” according to the Flood Insurance Rate Map 04013C2235L, dated October 16, 2013. Zone “X” is designated by FEMA as “areas of minimal flood hazard.” Refer to Appendix B for the FEMA FIRMette map for the site.

3.0 PROPOSED PRELIMINARY DRAINAGE PLAN

3.1 GENERAL DESCRIPTION

In the analysis of the proposed drainage conditions the following items are considered:

- Area Types (concrete pavement, building, and desert landscaping)
- Magnitude of areas
- Slopes

3.2 PROPOSED SITE CONDITIONS

According to the City of Scottsdale's Design Standards & Policies Manual (DS&PM) Section 4-1.201.C.1.b, storm water storage is not required for previously developed sites provided that the runoff coefficient does not increase with the proposed conditions.

The proposed site will provide 11,364 SF of landscaping/pervious area and 42,535 SF of roof/paved/impervious area, resulting in a post-development runoff coefficient of 0.84. The resulting 10-year and 100-year runoff flows are 4.9 CFS and 7.7 CFS, respectively.

The development will be required to provide storage or treatment for the first flush of storm water from the site. Per conversations with City of Scottsdale staff, the building roof are is excluded from the first flush calculations. This project proposes to treat the first flush using a storm water separator unit that will be located immediately upstream from the connection to the City storm drain system. An Oldcastle Dual-Vortex Separator (or approved equal) will be used to treat the first flush flow rate from the site. Flows in excess of the first flush will bypass the unit and flow to the City storm drain system. Refer to Appendix F for the First Flush Flow Rate Calculations and for Cut Sheets for the Oldcastle Dual-Vortex Separator.

Storm water runoff from portions of the roof area, will be collected internally and discharged to adjacent public rights-of-way consistent with the current drainage patterns. A gravity storm drain system for surface flows and a storm drain pump in the bottom floor of the parking garage will connect to the proposed on-site storm drain system that will be routed through the storm water separator unit before discharging to the existing 72-inch storm drain pipe in E. 2nd Street.

The building finished floor will be at elevation 1256.70 and the ultimate site outfall is 1255.12 located at the proposed top of curb near the southeast corner of the site. The building finished floor will be approximately 19 inches above the ultimate site outfall.

Refer to Figure 3 in Appendix C for the Preliminary Grading and Drainage Plan.

3.3 PROPOSED OFF-SITE CONDITIONS

As previously noted, off-site flows from areas north and west of the site are present in the adjacent streets. These flows were quantified in the Marshall Way Drainage Report. Four sections were analyzed to determine whether the off-site flows in the adjacent street will impact the site. The sections account for the

surveyed roadway cross-section, the proposed on-site grading, and the longitudinal slope. Based on the sections, the 100-year flows noted in the Marshall Way Drainage Report are contained within the curbs and have a normal depth of less than six inches, except Section C. Section C is located at the narrowest section of Marshall Way, and in this location the normal depth is 8.7 inches. The 100-year flow will overtop the curb in this location; however, the hardscape and landscape areas are sloped such that the building is not affected by the 100-year off-site flows. Refer to Appendix E for the Street Capacity Analysis.

A proposed catch basin east of the angled parking along E. 2nd Street will be installed to capture additional site-generated surface flows and act as an air break in the on-site storm drain connection to the existing 72-inch storm drain pipe in E. 2nd Street. Valley gutters will be installed at the rear of the proposed angled parking along E. 2nd Street and at the street side of the parallel parking on N. Marshall Way and E. 1st Avenue to convey flow consistent with the current drainage patterns.

3.4 STORMWATER STORAGE REQUIREMENTS

As previously noted, the proposed development will not be required to retain on-site stormwater runoff per the City of Scottsdale Design Standards and Policies Manual Section 4-1.201(2)(d).

3.5 PRE- AND POST-DEVELOPMENT RUNOFF CHARACTERISTICS AT CONCENTRATION POINTS

The existing site consists of an asphalt parking lot. Current topography indicates the site drains from the northwest to the southeast. The concentration point for the existing runoff is at the southeast corner of the site.

Roof drainage will be collected internally and discharged to adjacent public rights-of-way consistent with the current drainage patterns. Similar to the existing condition, the stormwater runoff concentration point for the proposed development will be located at the southeast corner of the site.

Table 1 below includes the pre-development and post-development runoff characteristics for the site.

Table 1: Pre-Development and Post-Development Site Runoff Characteristics

	Runoff Coefficient	Treated First Flush (CFS)	10-Year Flow (CFS)	100-Year Flow (CFS)
Pre-Development	0.91	0	5.3	8.4
Post-Development	0.84	2.5	4.9	7.7

Refer to Figure 2 in Appendix C for the Existing Conditions Exhibit.

3.6 ADEQ AZPDES REQUIREMENTS

Prior to construction an executed Notice of Intent (NOI) shall be submitted to Arizona Department of Environmental Quality (ADEQ) in conformance with the Arizona Pollution Discharge Elimination System Permit (AZPDES) permit. The NOI and associated stormwater management best management practices

will remain active on the site until construction is complete and a Notice of Termination is filed with ADEQ in conformance with AZPDES permit.

3.7 PROJECT PHASING

This project will be constructed in a single phase.

4.0 SPECIAL CONDITIONS

4.1 404 DISCUSSION

Due to the previous development of the project site, no 404 washes are anticipated.

5.0 CONCLUSION

5.1 OVERALL PROJECT

Based on the results of this Preliminary Drainage Report, the following can be concluded:

- Off-site stormwater will not impact the proposed site.
- The site runoff coefficient will decrease in the post-development condition, therefore no storm water storage is required.
- The first flush runoff flow will be treated prior to discharge to the City storm drain system.
- Based on the current Flood Insurance Rate Map (FIRM), the site is located in the Zone “X”.
- The building finish floor elevations will be at least fourteen inches above the ultimate site outfall elevation.

This report is intended to provide a level of assurance that the site will adhere to all appropriate reviewing agency guidelines with respect to drainage and flood protection.

Kimley»Horn

6.0 REFERENCES

1. City of Scottsdale, *Design Standards and Policies Manual, Chapter 4: Grading and Drainage,* January 2018.

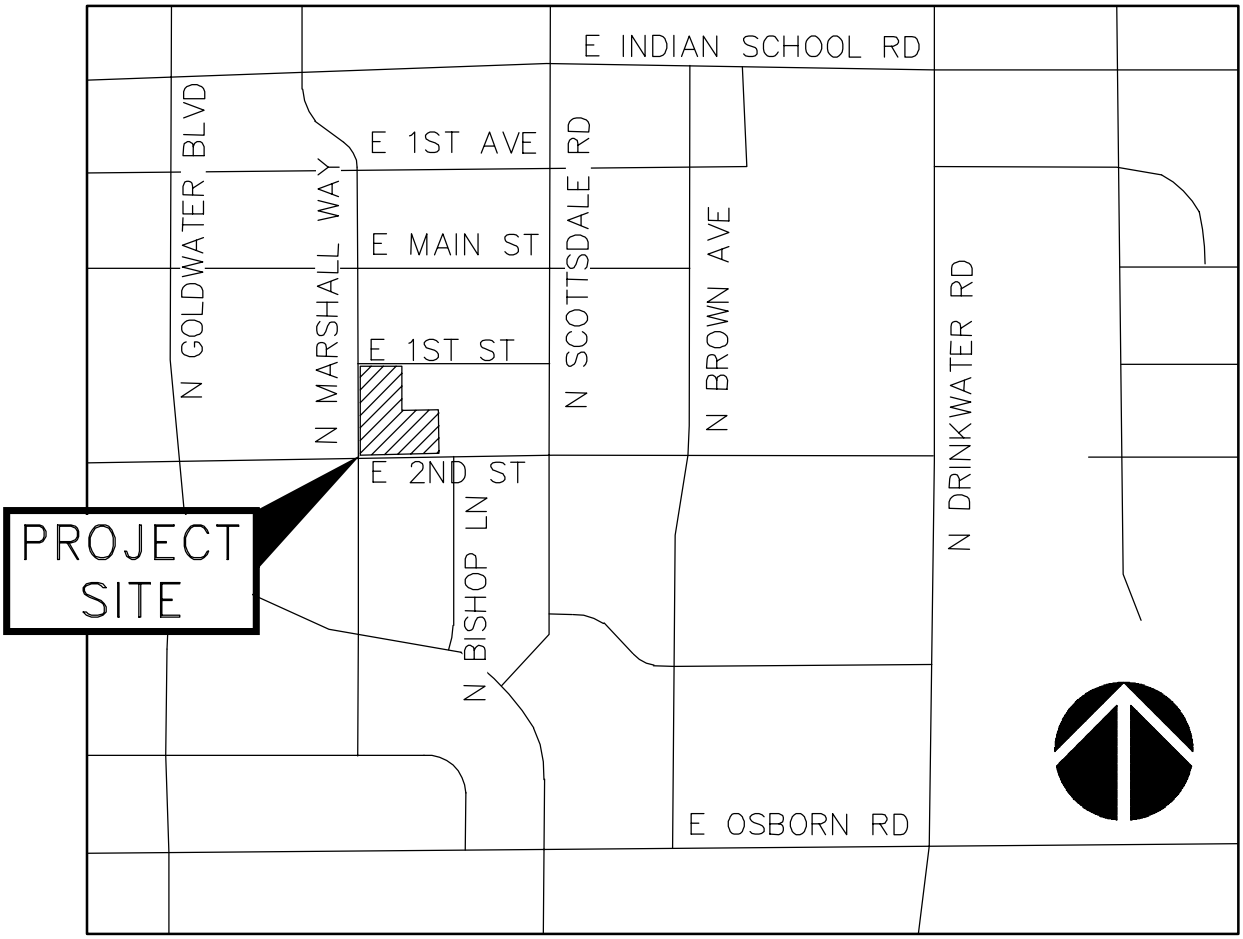
2. Federal Emergency Management Agency (FEMA), *Flood Insurance Rate Map (FIRM) of Maricopa County, Arizona and Incorporated Areas, Panel 1320 of 4425, Map Number 0413C1320L*, October 16, 2013.

3. Flood Control District of Maricopa County (FCDMC), *Drainage Design Manual for Maricopa County, Hydrology Volume, February*, 2008.

4. Flood Control District of Maricopa County (FCDMC), *Drainage Design Manual for Maricopa County, Hydraulics Volume,* January, 1996.

5. Dibble Engineering, *Marshall Way Goldwater Blvd to Indian School Road Drainage Report*, August 2017.

Appendix A – Site Location Map



VICINITY MAP

SCOTTSDALE, AZ
N.T.S.

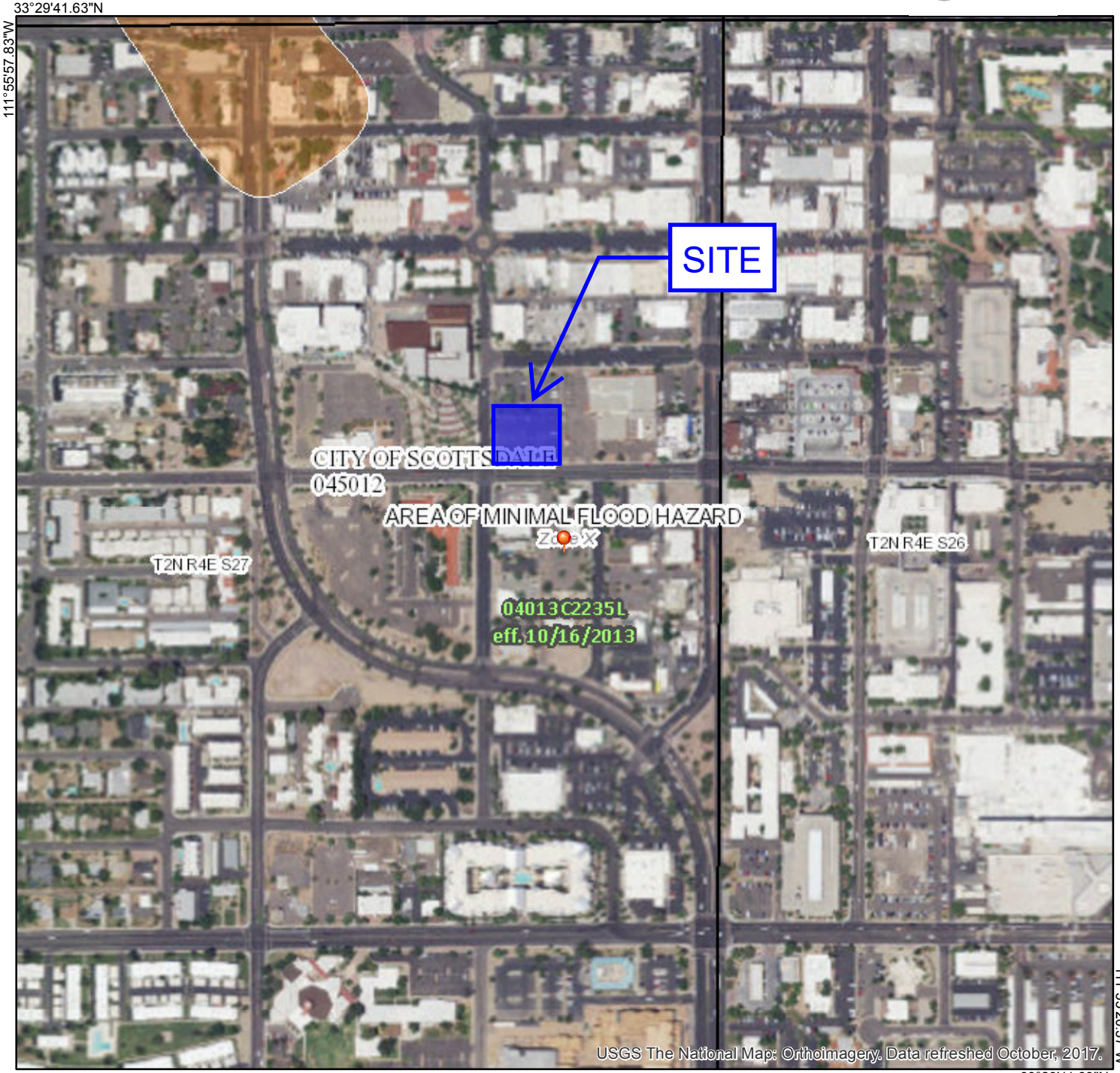
Kimley»Horn

11-DR-2020
5/21/2021

Appendix B – FEMA Flood Insurance Rate Map (FIRM)

National Flood Hazard Layer FIRMette

FEMA



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/1/2019 at 9:07:34 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

11-DR-2020

5/21/2021

Appendix C – Figures

NORTH

GRAPHIC SCALE IN FEET
0 25 50 100

EXISTING CONDITIONS

Kimley»Horn

11-DR-2020
5/21/2021

K:\PHX_Civil\291430000 - Museum Square\CADD\Exhibits\2020-04-01 Existing Conditions.dwg Apr 28, 2021 traver.jones
XREFS: X99000VF

MG–SCOTTSDALE LLC
APN: 130–12–119A
ZONING: D/DMU–2

E 1ST STREET

N MARSHALL WAY

CITY OF SCOTTSDALE
APN: 130–13–106
ZONING: D/DMU–2

PROP.
BUILDING

MOUNTAIN STATES TELEPHONE
& TELEGRAPH CO
APN: 130–12–158
ZONING: C–2

LUTHER LLC
APN: 130–12–171A
ZONING: C–3

E 2ND STREET

DOWNTOWN SCOTTSDALE GIUDON LLC
APN: 130–13–010
ZONING: C–1

NEXT GEN OLD TOWN LLC
APN: 130–13–030A
ZONING: C–3

SITE LIMITS

NORTH

GRAPHIC SCALE IN FEET
0 25 50 100

CONTEXT AERIAL MAP

Kimley»Horn

11-DR-2020
5/21/2021

K:\PHX_Civil\291430000 – Museum Square\CADD\Exhibits\2020-04-01 Context Aerial Map.dwg Apr 28, 2021 traver.jones
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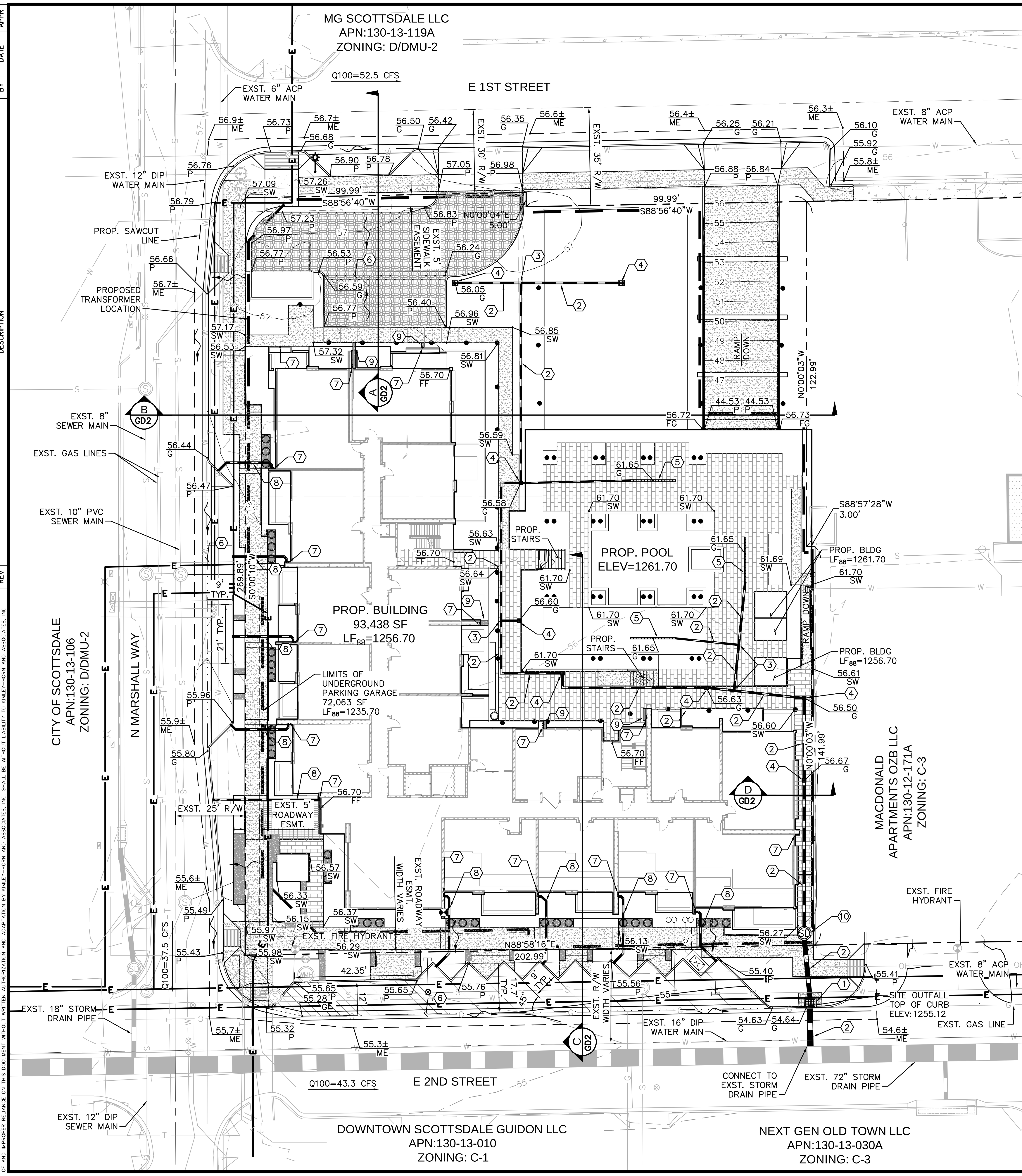


DEVELOPER/OWNER

ARC SCOTTSDALE HOLDINGS, LLLP
3225 N. CENTRAL AVE, SUITE 100
PHOENIX, AZ 85012
PH: (480) 315-1108
CONTACT: BILL BORDERS

LAND SURVEYOR

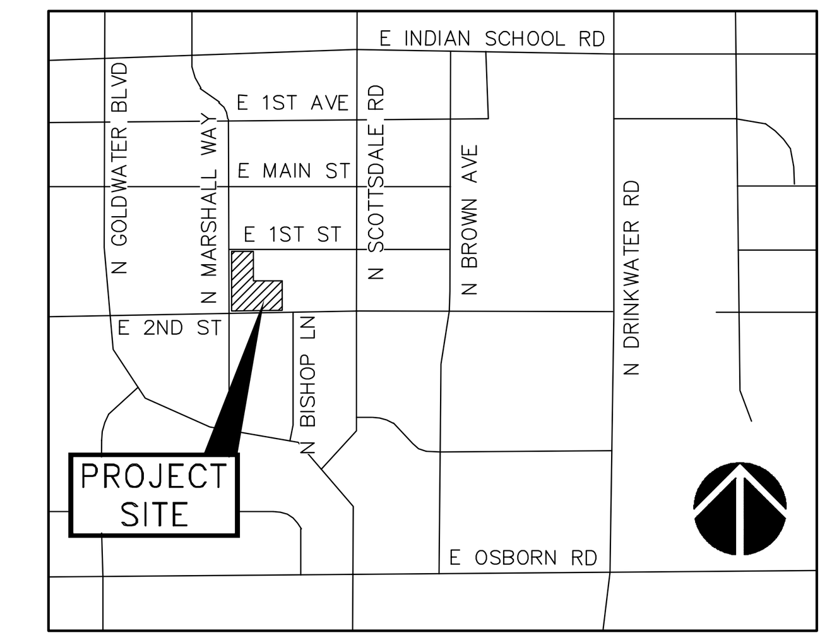
SURVEY INNOVATION GROUP, INC
22425 N 16TH ST. SUITE 1
PHOENIX, ARIZONA 85024
PH: (480) 922-0780
CONTACT: JARED HANSMANN, R.L.S.

CIVIL ENGINEER

KIMLEY-HORN AND ASSOCIATES, INC
7740 N. 16TH STREET, SUITE 300
PHOENIX, ARIZONA 85020
PH: (602) 944-5500
CONTACT: TRAVER JONES, PE

ARCHITECT

SWABACK PLLC
7550 E. MCDONALD DR.
SCOTTSDALE, ARIZONA 85250
PH: (480) 367-2100
CONTACT: JEFF DENZAK



VICINITY MAP

SCOTTSDALE, AZ
N.T.S.

FLOOD INFORMATION

ACCORDING TO THE FLOOD INSURANCE RATE MAP #04013C2235L DATED OCTOBER 16, 2013 THIS PROPERTY IS LOCATED IN FLOOD ZONE "X": AREAS OF 0.2% ANNUAL CHANCE FLOOD; AREAS OF 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS OF 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FROM 1% ANNUAL CHANCE FLOOD.

BENCHMARK

FOUND 3" CITY OF SCOTTSDALE BRASS CAP IN HANDHOLE AT THE INTERSECTION OF OSBORN ROAD AND SCOTTSDALE ROAD.

GDACS DATA
NAVD88
ELEVATION = 1246.52'

BASIS OF BEARING

THE CENTERLINE OF 2ND STREET AS IN BOOK 32, PAGE 50, MARICOPA COUNTY RECORDS. SAID LINE BEARS N89°03'00"E.

FLOOD INFORMATION

THE FLOOD ZONE DESIGNATION FOR THIS AREA IS ZONE X.
DEFINED AS: AREAS OF 0.2% ANNUAL CHANCE FLOOD; AREAS OF 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS OF LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FROM 1% ANNUAL CHANCE FLOOD.
MAP NUMBER 04013C2235L, REVISED OCTOBER 16, 2013.

COMMUNITY NUMBER	COUNTY NUMBER	PANEL # PANEL DATE	SUFFIX	DATE OF FIRM (INDEX DATE)	FIRM ZONE	BASE FLOOD ELEVATION (IN AO ZONE USE DEPTH)
045012	04013C	2235	L	OCTOBER 16, 2013	X	N/A

ENGINEER'S CERTIFICATION:

THE LOWEST FLOOR ELEVATION(S) AND/OR FLOOD PROOFING ELEVATION(S) ON THIS PLAN ARE SUFFICIENTLY HIGH TO PROVIDE PROTECTION FROM FLOODING CAUSED BY A 100-YEAR STORM, AND ARE IN ACCORDANCE WITH SCOTTSDALE REVISED CODE, CHAPTER 37 – FLOODPLAIN AND STORMWATER REGULATION.

GRADING AND DRAINAGE NOTES

1. CATCH BASIN
2. STORM DRAIN PIPE
3. STORM DRAIN TEE
4. STORM DRAIN AREA DRAIN
5. STORM DRAIN TRENCH DRAIN
6. 3' WIDE VALLEY GUTTER
7. ROOF DRAINAGE BUILDING DISCHARGE
8. ROOF DRAIN "CURB-O-LET" BOX PIPE AND CURB DRAIN, REF DRAINAGE REPORT FOR SPEC. SHEETS.
9. 2' WIDE ROOF DRAIN VALLEY GUTTER
10. STORM WATER FIRST FLUSH TREATMENT. OLDCASTLE DVS-48 OR APPROVED EQUAL.

NOTES

1. ADD 1200' TO ALL ELEVATIONS.
2. ADD 0.5' TO PAVEMENT (P) ELEVATIONS TO OBTAIN TOP OF CURB ELEVATIONS, UNLESS OTHERWISE NOTED.

LEGEND

PROPERTY LINE
RIGHT OF WAY LINE
STREET CENTERLINE
EASEMENT LINE
EXISTING SEWER MAIN
EXISTING PUBLIC WATER MAIN
PROPOSED WATER MAIN
PROPOSED SEWER MAIN
PROPOSED STORM DRAIN
EXISTING STORM DRAIN
HP HIGH POINT
PROPOSED CONTOUR
EXISTING CONTOURS
10.00 P PROPOSED PAVEMENT SPOT ELEVATION
EXISTING SPOT ELEVATION
EXISTING SANITARY SEWER MANHOLE
EXISTING FIRE HYDRANT
PROPOSED FIRE HYDRANT
PROPOSED CATCH BASIN
SURFACE FLOW DIRECTION

NORTH

GRAPHIC SCALE IN FEET
0 10 20 40

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA 811
Call 811 or click Arizona811.com

Kimley»Horn

7740 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500

7108 E. 2ND STREET
PRELIMINARY GRADING AND DRAINAGE PLAN
SCOTTSDALE, ARIZONA 85251

PROJECT No.	291999000
SCALE (H):	1"=20'
SCALE (V):	NONE
DRAWN BY:	BEQ
DESIGN BY:	BEQ
CHECK BY:	TMJ
DATE:	04/29/21

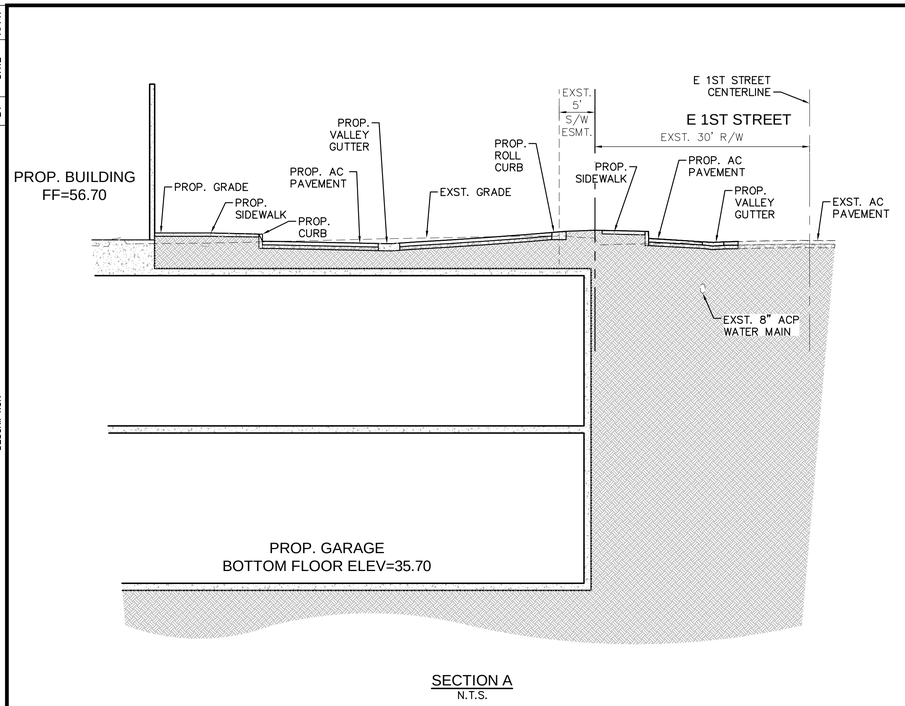
Registered Professional Engineer (Civil) CERTIFICATE NO. 52738 TRAVER JONES Date Signed 04/29/21 ARIZONA, U.S.A. Expires 09/30/23

999000Pre-GD.dwg

GD1
1 OF 2 SHEETS

REV	DESCRIPTION	BY	DATE	APPR

11-DR-2020
5/21/2021



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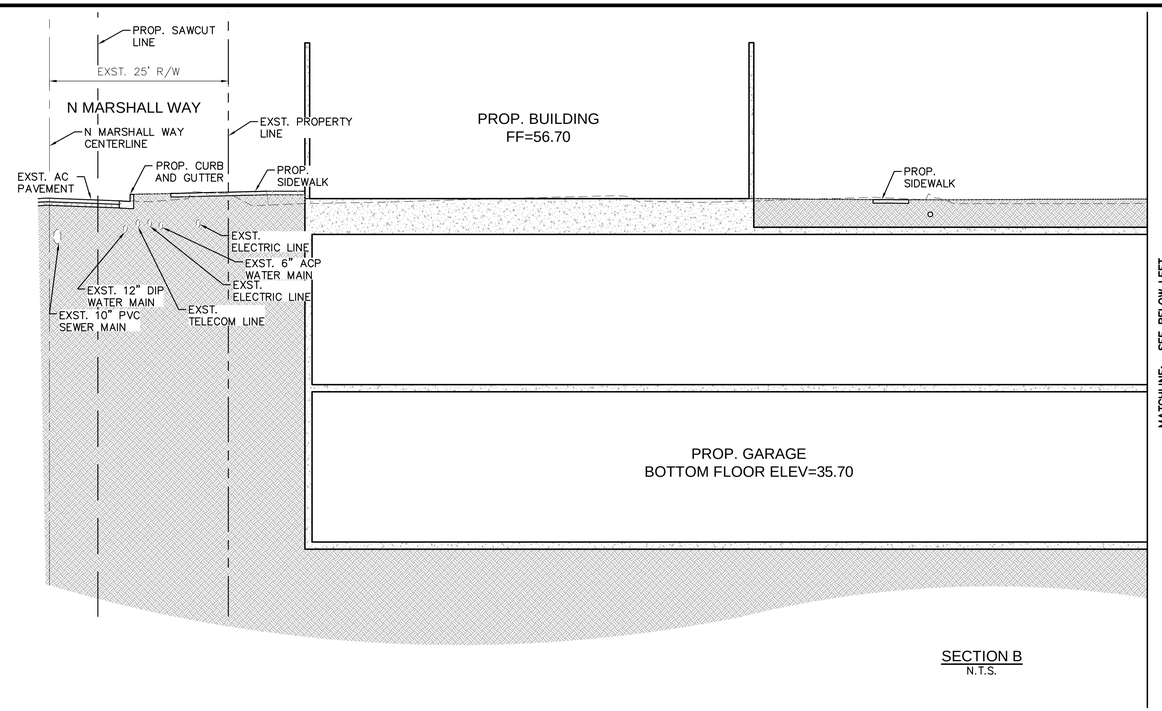

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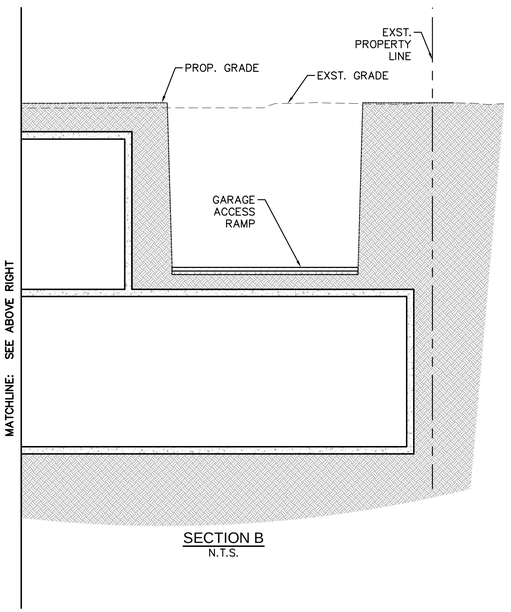

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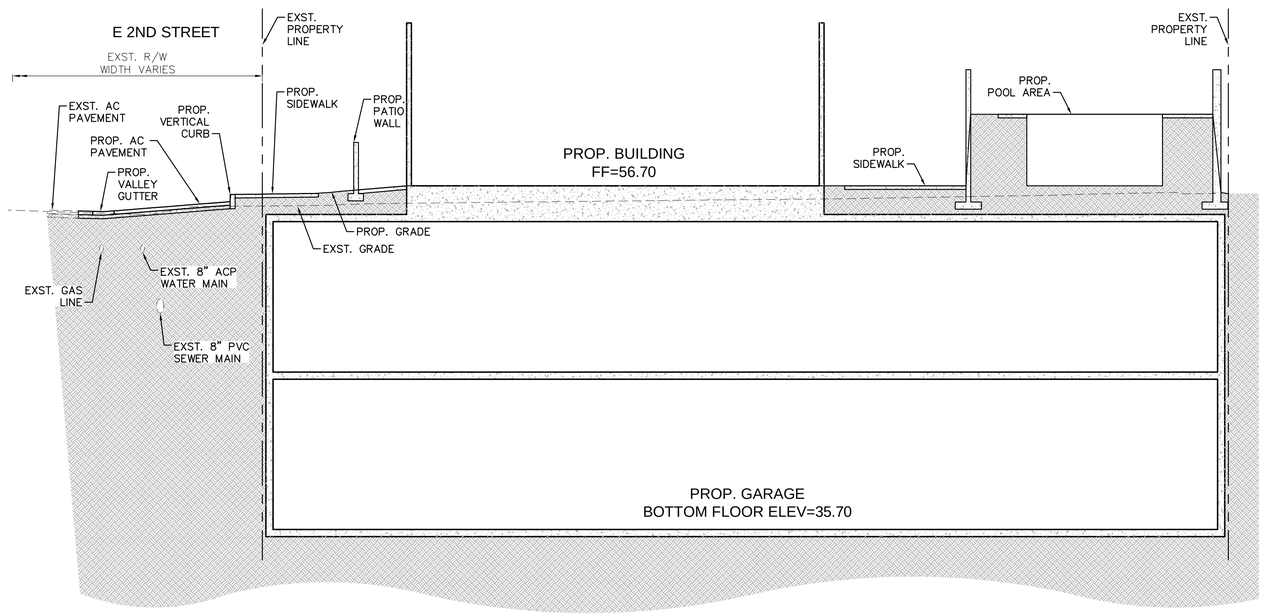

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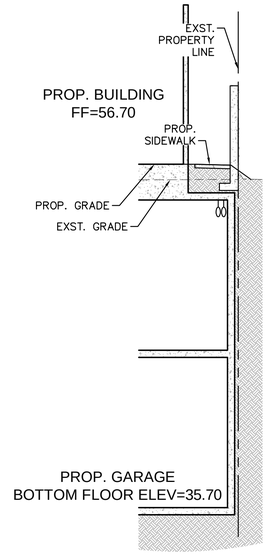

SECTION D
N.T.S.

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or click Arizona811.com

Kimley»Horn

7740 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500

7108 E. 2ND STREET
SECTIONS
SCOTTSDALE, ARIZONA
85251

PROJECT No.	291999000
SCALE (H):	NONE
SCALE (V):	NONE
DRAWN BY:	BEQ
DESIGN BY:	BEQ
CHECK BY:	TMJ
DATE:	04/29/21

Registered Professional Engineer (Civil)
CERTIFICATE NO.
52736
TRAVER
JONES
Date Signed 04/29/21
ARIZONA, U.S.A.
Expires 09/30/22

999000Pre-GD.dwg

GD2
2 OF 7 SHEETS

REV	DESCRIPTION	BY	DATE	APPR

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XREFS: x999001b x999002bm x999002bvf X999002bvS X999000GD X999000HS X999000UT X999000BM-ARCH X999000BM_2 X999000BM-ARCH_2 X999000BM_ARCH_2

11-DR-2020
5/21/2021

Appendix D – Marshall Way Drainage Report

Marshall Way
Goldwater Blvd to Indian School Road

Drainage Report

Project No.: TD01/1015013.02

August 8, 2017

Prepared For:

CITY OF SCOTTSDALE
ARIZONA

City of Scottsdale Capital Project Management

Plan # 2774-17
Case #
Q-S #
[X] Accepted
[ ] Corrections
N.Baronas 8-14-17
Reviewed By Date

Dibble Engineering

7878 North 16th Street
Suite 300
Phoenix, Arizona 85020
P. 602.957.1155
F. 602.957.2838
www.dibblecorp.com

Registered Professional Engineer (Civil)
CERTIFICATE NO.
25015
ANDREW JOHN SPEAR
Date Signed 8/8/17
ARIZONA, U.S.A.
Expires 06/30/16

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Appendices

I. INTRODUCTION

Marshall Way lies in the heart of Old Scottsdale, set in the art district just west of the Civic Center. Marshall is a minor collector connecting Goldwater Boulevard with Indian School Road and up to 5th Avenue. Main Street crosses Marshall Way just north of midway between Goldwater Blvd and Indian School Road and as is one of the main art gallery corridors in Downtown Scottsdale.

From halfway between 1st Street and Main St, this area is within the Main Street Design District, part of the Downtown Character Area. North of Indian School, Marshall Way continues north into the Marshall Way-Craftsman's Court and Fifth Avenue Districts.

Marshall Way is a vehicular, bike, and pedestrian link between the districts; however, the perception of the Marshall Way corridor south of Indian School Road is dark and not secure. Low levels and non-continuous roadway lighting have a significant role in these perceptions.

The area is known for ponding issues. The City and Flood Control District of Maricopa County are currently developing the Lower Indian Bend Wash Flood Study and a preliminary Flow2D model has been prepared.

This study has developed contributing watershed boundaries, runoff concentration points, intersection flow splits and cross-sections of key roadway locations on Marshall Way and 1st Avenue.

The hydraulic analysis only looked at the 100-year discharge and compared that value to the computer street capacity at 14 cross section locations.

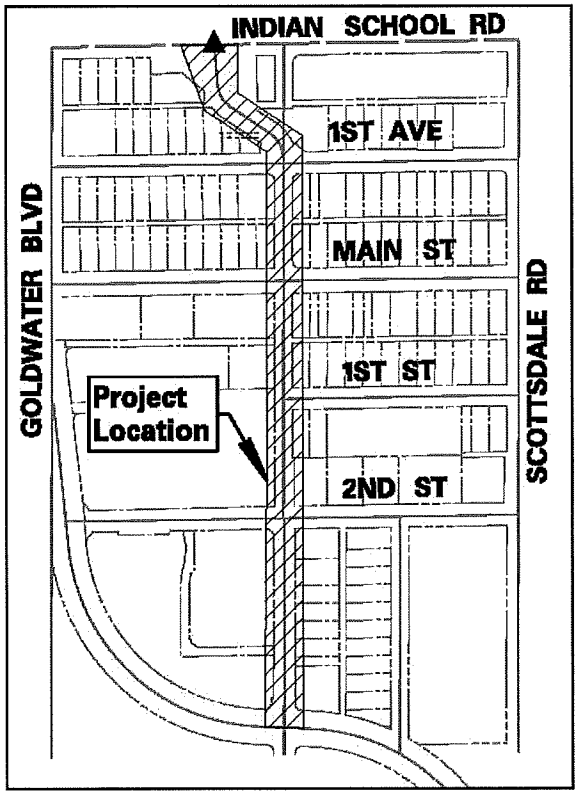


Figure 1- Vicinity Map

II. EXISTING CONDITIONS ANALYSIS

A. Goldwater Blvd to 2nd Street

Marshall Way is a 46 foot wide (back of curb (bc)-bc) paved roadway with two lanes and parallel parking on both sides. The right-of-way width is 60' with 65' at 2nd Street, but the ownership is listed in the County Assessor's as a City owned parcel as part of a plat, not as dedicated right-of-way. The right-of-way line on the west side is within the existing sidewalk. An 8-foot wide sidewalk is attached to the left curb and a 5-foot sidewalk is attached right. Goldwater Boulevard has a storm drain which outfalls into the Indian Bend Wash. At Marshall Way, the storm drainage has a 24-inch storm drain lateral which connects two existing catch basins located at each curb return on Marshall Way. The catch basins are City of Phoenix Standard curb opening type with 17-foot wings to the north. The west side of Marshall Way is vertical curb and the east side is primarily rolled curb.

The Flow2D model does not show significant issues with flow depth within this segment. The Flow2D model is shown in Figure 2.

An existing cross section, Cross Section 1, was prepared which showed the existing street has capacity for the 100-year discharge.

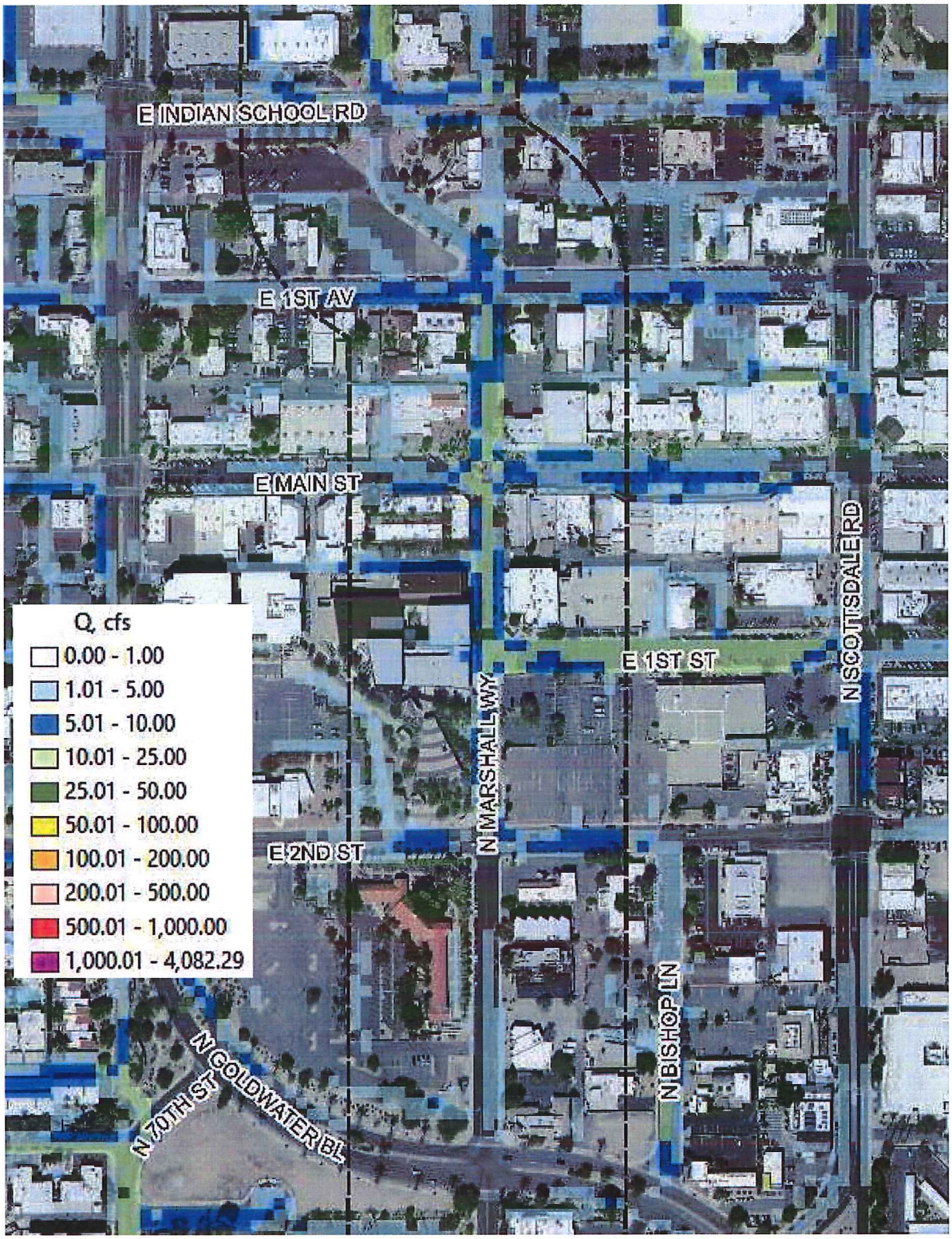


Figure 2 - Flow2D Preliminary Model Flows
Source: (FCDMC)

B. 2nd Street to 1st Street

Marshall Way in this segment is 32-foot wide except where southbound just north of 2nd Street. Parallel parking is allowed on the right. The right of way varies but starts out as 55-feet north of 2nd Street and reduces to 50 feet up to 1st Street. The east side sidewalk is 5-foot in width and attached. The west side sidewalk is variable in width and incorporated into the Museum of the West's pedestrian sidewalks. Two driveways are located on the east side. No driveways to the west. Roadway drainage is confined to the street drainage except near 2nd Street where a storm drain is located in 2nd street and flows easterly to Indian Bend Wash. Two catch basins are located at the west curb returns on 2nd Street. These are curb opening inlets with 17-foot wings to each side of a 3-foot wide basin. The 72-inch diameter storm drain was constructed as part of the Second Street Storm Drain, 69th Street to Wells Fargo Avenue, Project No. F-1704, as-built date 3/11/93.

An additional catch basin with an 18-inch diameter lateral is located on Marshall Way at the northwest curb return which drains the west curb and gutter to the 72-inch storm drain. The storm drain as-builts show a 30-inch diameter stub-out was designed to the north but not installed, suggesting the possibility that the storm drain was designed for additional flow at Marshall Way. The profile of the storm drain include a grade break at the west side Marshall Way at the catch basin laterals. The steeper grade to the east would have developed a higher capacity in the storm drain.

In addition, scuppers are located at the Low Impact Design linear basin and bio swales located on the Museum of the West property. These curb openings allow some of the runoff to exit the roadway and be used to irrigate the landscaped areas on the site. A recent rainstorm shows that flows can leave the roadway into the landscape areas but the capacity is small so that any additional rain will begin to pond along the west curb.

At the 2nd street intersection, the west curb line bulbs out into the road, creating a parking lane along the west curb north of this pint. The Scottsdale Trolley uses this parking lane for the bus stop location. The east curb has a recessed bus pullout just north of the 2nd Street intersection with a valley gutter to convey runoff to 2nd Street and then easterly.

The Flow2D shows depths of flow over the curb in this segment. The model shows that the incoming flow from the north splits at 1st Avenue with a significant percentage of the runoff flowing easterly in the 1st Avenue right-of-way.

To the west is identified watershed ON4 which is bounded by south of 1st Street to 2nd Street, Goldwater to Marshall. The Flow2D model shows that the majority of this watershed discharges into 2nd Street with only the east half of the Museum of the West building and Marshall right-of-way discharging into Marshall Way.

C. 1st Street to Main Street

Marshall Way in this segment is 32-foot wide except where southbound parallel parking is allowed in the northerly portion toward Main Street. Parallel parking is allowed on the right. The right of way varies but starts out as 55-feet north of 2nd Street and reduces to 50 feet up to Main Street. The east side sidewalk is 5-foot in width and attached. The west side sidewalk is variable in width and incorporated into the Museum of the West's pedestrian sidewalks. Three driveways are located on the east side. No driveways to the west. The curb and gutter is vertical to the west and on the east side from the alley north to Main Street, and rolled from 1st Street to the alley.

Runoff from the north enters this segment at Main Street. The Flow2D model shows a flow split at Main Street with a slightly larger amount heading south in Marshall Way than in Main Street. The Flow2D model also shows ponding issues.

The Arizona School of Real Estate and Business has the rolled curb in front. The finished floor (elevation 1258.78) of the building is 1.0 higher than the back of rolled curb. The existing rolled curb limits the capacity of the street section.

D. Main Street to 1st Avenue

The roadway width in this segment varies from 24-feet at the bump-outs to 50-feet where there is parallel parking to the east and 45° parking to the west. The portion from the alley to 1st Avenue is 40 feet wide and parallel parking is allowed on both sides. The right-of-way is 50 feet wide. The 45° parking has part of the parking space and curb outside of the right-of-way. The sidewalks are 5 feet wide and attached. Two driveways are located within this section at the alleyway halfway between Main Street and 1st Avenue.

North of Main Street, the west curb has a bump-out island with an 8.25-foot wide open scupper along the main curb line. The east curb also has a bump-out with a 2.5-foot wide covered scupper.

E. 1st Avenue to Indian School Road

The roadway is 40 feet wide and is signed for "No Parking". The right-of-way varies but it is generally 70 feet in width. The land is platted but the right-of-way is not shown as dedicated right-of-way. Marshall Way has a reverse curve to the west to match into the location of Marshall Way to the north of Indian School Road. The sidewalks are 8 feet wide and detached with a 5-foot landscape buffer. One driveway is located on each side of Marshall Way. Runoff comes from the south curb of Indian School Road at Goldwater Boulevard into the Marshall Way roadway. Part of the land bounded by 1st Avenue to Indian School Road and Goldwater Blvd. to Marshall Way flows onto the Marshall Way roadway and part into the 1st Avenue roadway. Runoff is conveyed through curb and gutter within the right of way. At the intersection of 1st Avenue and Marshall Way, the flow splits east and south. The majority is shown in the Flow2D model to flow south.

III. ROADWAY DRAINAGE CRITERIA

The City of Scottsdale (COS) is the owner on this project and will be responsible for the maintenance of the roadway and drainage system following construction completion. Per the design criteria, this report will look at the 100-year design discharge and compare to the street capacity. For the 100-year design discharge, the full right-of-way can be used with the test of the water surface elevation not being greater than the adjacent finish floor elevation. This was completed in two steps. First the existing roadway capacity was calculated with the software program HydraFlow. Cross-section were developed from the existing surface developed from survey data collected in January 2017. The Cross sections were edited using the survey data and field photo graphs to support any changes.

If the 100-year discharge exceeded the gutter capacity, than the right-of-way capacity was calculated. If the design discharge exceed the street capacity for both the existing and proposed condition, the results were note and the finished floor elevations were checked.

The proposed cross sections were developed from the plans. If the design plans required changes, the cross sections were revised until the criteria was met and the plans were revised accordingly.

Fourteen cross sections were developed at key locations as shown on the figure below.

IV. DRAINAGE RESULTS

A. Hydrology

The rational Method was incorporated in the hydrology by using the Drainage Design Management System (DDMS) software by the FCDMC. The City of Scottsdale criteria was used include a 5-munite minute minimum time of concentration.

Nine watersheds were delineated for the area. Four, labeled ON1 through ON4, cover the area comprised of urban buildings and roadways. Five, labeled ON5 through ON9, cover the open areas or eastern half street sections of Indian School Road and Marshall Way. Appendix A shows the watershed boundaries.

The Flow2D model shows runoff flows splitting at the roadway intersections in the 100-year design flow scenario. The Flow2D results were used to develop flow splits for the rational method routing. The Flow2D model shows flows splits at 1st Avenue, Main Street and 1st Street. At 2nd Street, the southerly flowing Marshall Way runoff turns and flows east in 2nd Street. Using the Flow2D GIS depth grid, each intersection flow split was determined and shown in **Table 1**. After review, the Flow Splits were also determined by using the cross-sectional area method using Hydraflow to determine the cross sectional area to determine the percentage of flow on the south leg versus the east leg of an intersection flow split. The results are shown in Appendix D.

Table 1 - Flow Splits

Intersection	Flow Split (% south/% east) By Flow2D	Flow Split (% south / % east) By Cross Section
Marshall Way / 1st Avenue	75% / 25%	69% / 31%
Marshall Way / Main Street	60% / 40%	46% / 54%
Marshall Way / 1st Street	20% / 80%	41% / 59%

Routing is based on adding the subareas. No attenuation is accounted for. A test case was performed at Concertation Point No. 2 located at Marshall Way and Main Street. The additive sub-basin routing was compared to the combined watershed area as one. The sub-basin routing was calculated to be 64.1 and the single watershed was calculated to be 61.9, a 3% difference. The sub-basin routing yields a more conservative analysis.

Appendix B shows the DDMS results.

B. Hydraulics

In the hydraulic design, HydraFlow software was used and incorporated FCDMC Manning's n-values were used as well as the City's composite street section n-value of 0.015. Any offsite decomposed granite or dirt areas used an n-value of 0.03.

Table 2 below show the results of the hydraulic analysis. Appendix B shows the existing and proposed sections with the street capacity calculations.

Table 2 - Q100 Street Drainage Results

Cross Section	Station	Existing Street Capacity (cfs)	Proposed Street Capacity (cfs)	Q100 (cfs)	Meets Existing	Meets Proposed	
1	10+75	57.76	56.66	13.1	Yes	Yes	
2	16+32	10.79	10.79	37.5	No	No	#1
3	17+00	60.34	74.1	34.7	Yes	Yes	
4	17+90	38.66	33.88	26.7	Yes	Yes	
5	18+85	104.48	104.48	26.7	Yes	Yes	
6	19+70	59.5	45.19	37.0	Yes	Yes	
7	20+94	24.81	37.59	36.1	No	Yes	
8	21+60	41.62	35.5	35.1	Yes	Yes	#2
9	23+15	31.59	31.59	28.2	Yes	Yes	#3
10	24+30	59.56	30.93	28.1	Yes	Yes	
11	25+50	57.13	39.05	26.2	Yes	Yes	
12	25+82/33' Lt	42.13	27.14	22.0	Yes	Yes	#4
13	25+82/93' Lt	38.17	38.17	22.0	Yes	Yes	
14	26+20	27.62	44.95	13.0	Yes	Yes	

Notes:

#1

Existing street section is under capacity. No changes in proposed conditions. Q100 flow will overtop curb and flow into parking area as sheet flow with low depth. Catch basin at northwest corner of 2nd St and Marshall has 5.2 cfs capacity at 8-inch depth (including depression).

#2

Revised island in Project Plans to a 3-foot scupper and reduced width 1' to obtain design criteria.

#3

Revised NW ramp on Marshall Way only, deleted proposed changes to island.

#4

Widened 1st Avenue SW bulb out 1 foot to south from plans to add street drainage capacity to meet design criteria.

V. RESULTS

A. Goldwater to 2nd Street

The project proposes to reduce the street capacity. The west curb will be moved into the road approximately 5 feet and the east side 1 foot. The west catch basin will be replaced with the same size as the existing catch basin, a City of Phoenix Standard P1569-1 with a 17-foot wing.

The existing catch basin is in sump condition at an approach slope of 0.58%. A similar on-grade catch basin is located on the northwest corner of Goldwater Boulevard and Marshall Way along the north curb of Goldwater Blvd. At the intersection, the street transverse cross sloe transitions to a valley gutter which flows to the east. North of the intersection, the cross slope is 2.0%. The DDMS reports shows a 10-year design discharge for street drainage is 6.1 cfs. The spread at the design flow is 15 feet. See the calculations in Appendix E. The spread will encroach 5 feet into the 10-foot wide. The 20-foot catch basin has a capacity of 5.4 cfs (with 25% clogging factor). The yields 0.7 cfs which will not be intercepted by the catch basin and flow to the next downstream catch basin located in Goldwater Blvd. This condition is consistent with the existing conditions. The calculations conducted herein are based on a larger area of the parking lot which may actually not reach the street but be directed to on-site retention.

B. 2nd Street to 1st Street

The cross sections were cut at the existing and proposed bottlenecks for the 100-year drainage flow. Cross Section 2 shows the existing cross section does not meet the design flow. The runoff will overtop the eastern curb into a parking lot and flow south easterly back into 2nd Street. The proposed project does not change this condition.

Cross section 3 has excess street drainage capacity. The new driveway and curb does not reduce the capacity. The loss of the bus pullout does not affect the capacity because of the downstream bottleneck at cross section 2.

An existing sump catch basin is located at the northwest corner of Marshall Way and 2nd Street. The capacity of the catch basin has been calculated to be 5.2 cfs. The calculations are in Appendix E.

Cross section 4 also has the runoff capacity in the proposed condition.

Cross section 5 also has runoff capacity. The east curb is proposed to be moved into the road approximately 5 feet.

C. 1st street to Main Street

Cross section 6 is located at a point where the bulb out could create a ponding which would impact the Building on the northeast corner of 1st Street and Marshall Way. Finished floor elevations were surveyed to be 1257.85. Cross section 6 capacity is 45.1 cfs at the finished floor in the proposed condition. The design discharge is 37.0 cfs.

Cross Section 7 is located at the driveway and alleyway at Station 20+94. The east side alley driveway will be extended into the street effectively reducing the street drainage capacity. The curb will be revised to a vertical which adds 2-inch of additional height to the water surface before the runoff spills into the alley. Anecdotal evidence suggests that this condition occurs in heavy storms in the current condition. The proposed changes will increase the capacity of the street by raising the back of sidewalk elevation.

Cross section 8 is located at a proposed parking island at Station 21+60. The island is required in order to place a street light at this location. The analysis showed that the original island design need to be revised to include a 3-foot wide scupper and the width of the island into the street reduced by 1 foot to provide the design capacity.

D. Main Street to 1st Avenue

Cross section 9 is located just north of the roundabout where existing curb bulb outs extend into Marshall Way. Originally, the plans proposed to extend the NW ramp into the Marshall Way street to match the exiting bulb out. This required reducing the west scupper width which bought the design capacity of the street below the design discharge. Options to mitigate the loss in capacity failed to alleviate the issue. This report recommends the design be revised to match the existing condition.

Cross Section 10 is located at the alleyway north of Main Street. Alleys are located both east and west of Marshall Way. The proposed condition is to extend the driveways into Marshall Way parking lane to create pocket for street lighting. The west side is an extension of the curb line to the north so the alley extension does not affect drainage. The east side does reduce the street drainage capacity but it still has a capacity greater than the design discharge.
Cross section 11 is located one the south leg of the 1st Avenue and Marshall Way intersection where two new curb bulb-outs are proposed. The street capacity will continue to be greater than the design discharge here.

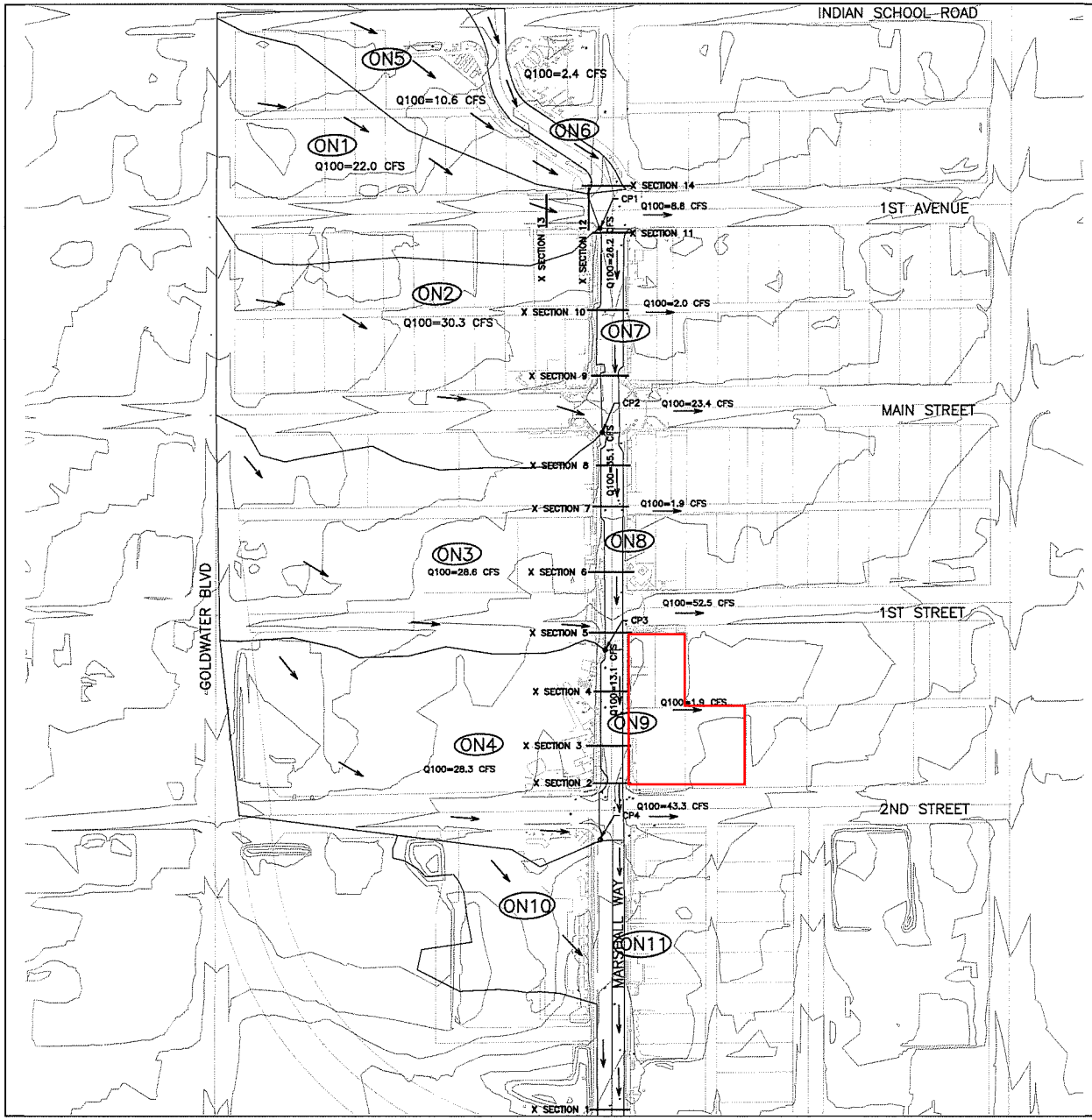
E. 1st Avenue west of Marshall Way

On 1st avenue west of Marshall Way, the building at the southwest corner has a finished floor lower than the street curb elevation. An existing swale made from bricks is located at the doorway on the north side of the building. The swale drains to the east around the building in a rock swale. The finished floor elevation is 1260.95 and the brick swale elevation is 0.20-0.40 feet lower.

Cross section 12 is located at the west curb returns of the intersection. The returns are proposed to be bulb-outs to define the parking lanes and reduce the pedestrian crossing distance. The top of sidewalk is capacity of the street section. A scupper is planned for the low flows in the 1st Avenue south gutter to be routed to the Marshall Way west curb. The design as shown in the 100% plans did not have the capacity to convey the runoff by a minor amount. In order to mitigate this, the south bulb-out curb will be moved to the south 1-foot to provide the required capacity in the 1st Avenue street section.

Cross section 13 is located adjacent to the building's doors to determine the existing roadway capacity. The design discharge was determined to be below the street capacity.

APPENDIX A
WATERSHED MAP



CONCENTRATION POINT	TOTAL Q100 (CFS)	TOTAL Q10 (CFS)
CP1	35.00	18.30
CP2	58.50	30.40
CP3	65.60	33.60
CP4	43.30	22.40

N

0' 40' 80' 160'

SCALE: 1"=80'

DRAINAGE EXHIBIT

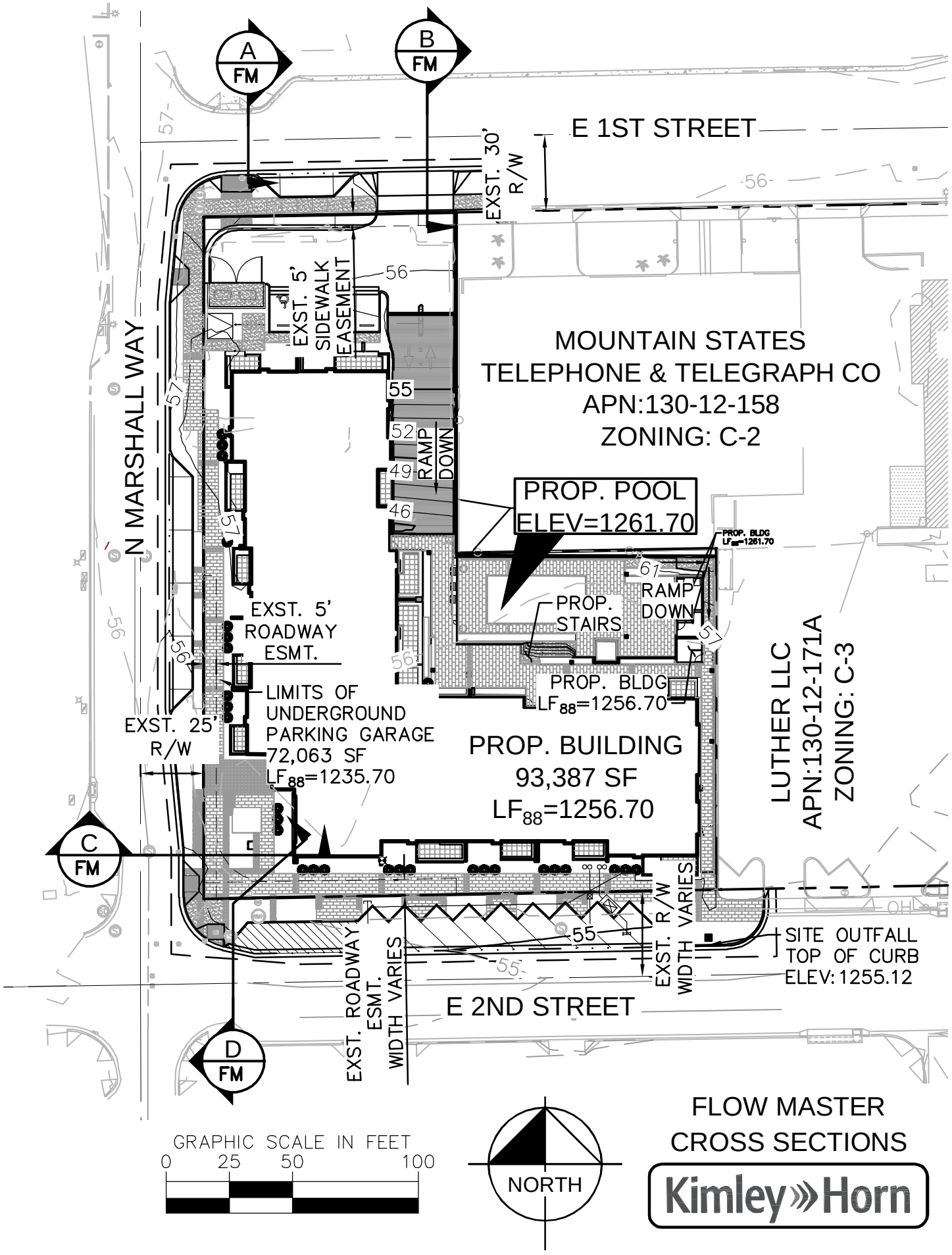
MARSHALL WAY PEDESTRIAN IMPROVEMENTS STUDY

DIBBLE PROJECT - 1015013.02

Dibble Engineering
7878 North 16th Street
Suite 300
Phoenix, AZ 85020
P 602.957.1155
F 602.957.2838
www.dibblecorp.com

11-DR-2020
5/21/2021

Appendix E – Street Capacity Analysis



FLOW MASTER
CROSS SECTIONS

Kimley»Horn

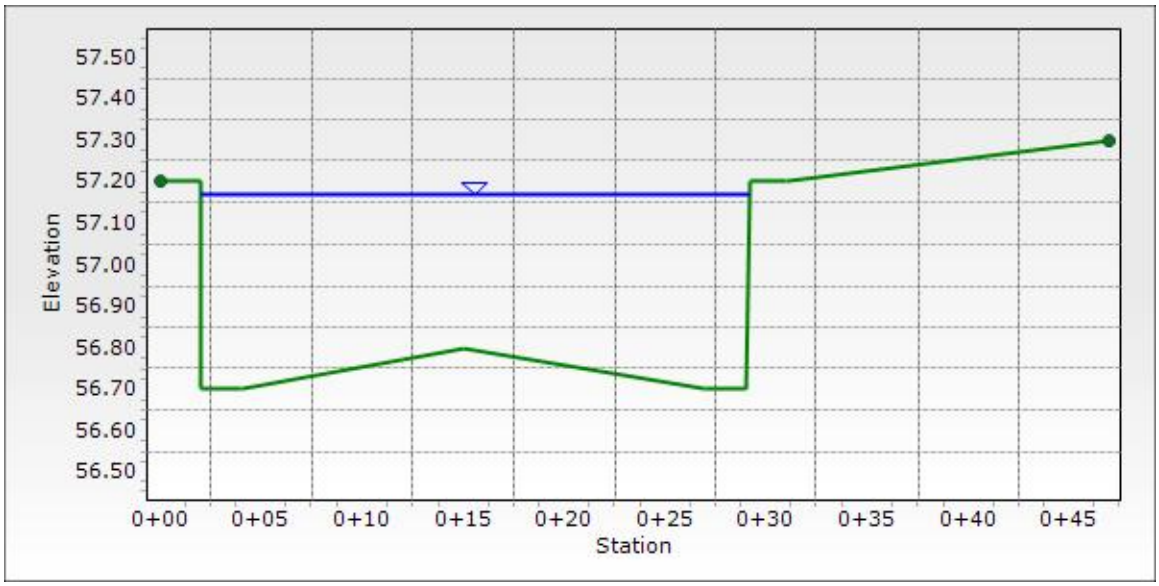
11-DR-2020
5/21/2021

K:\PHX_Civil\291999000 — Museum Square\CADD\Exhibits\2020-06-22 Flowmaster Sections.dwg Jul 24, 2020 Bryce.Quigley

Cross Section for Section A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.770 %
Normal Depth	5.6 in
Discharge	52.50 cfs



Worksheet for Section A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.770 %
Discharge	52.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	57.20
0+02	57.20
0+02	56.70
0+04	56.70
0+15	56.83
0+27	56.70
0+29	56.74
0+29	57.21
0+31	57.20
0+47	57.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 57.20)	(0+47, 57.30)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	5.6 in
Elevation Range	56.7 to 57.3 ft
Flow Area	11.1 ft²
Wetted Perimeter	27.9 ft
Hydraulic Radius	4.8 in
Top Width	27.17 ft
Normal Depth	5.6 in
Critical Depth	7.2 in
Critical Slope	0.483 %
Velocity	4.71 ft/s
Velocity Head	0.34 ft

Worksheet for Section A

Results	
Specific Energy	0.81 ft
Froude Number	1.297
Flow Type	Supercritical

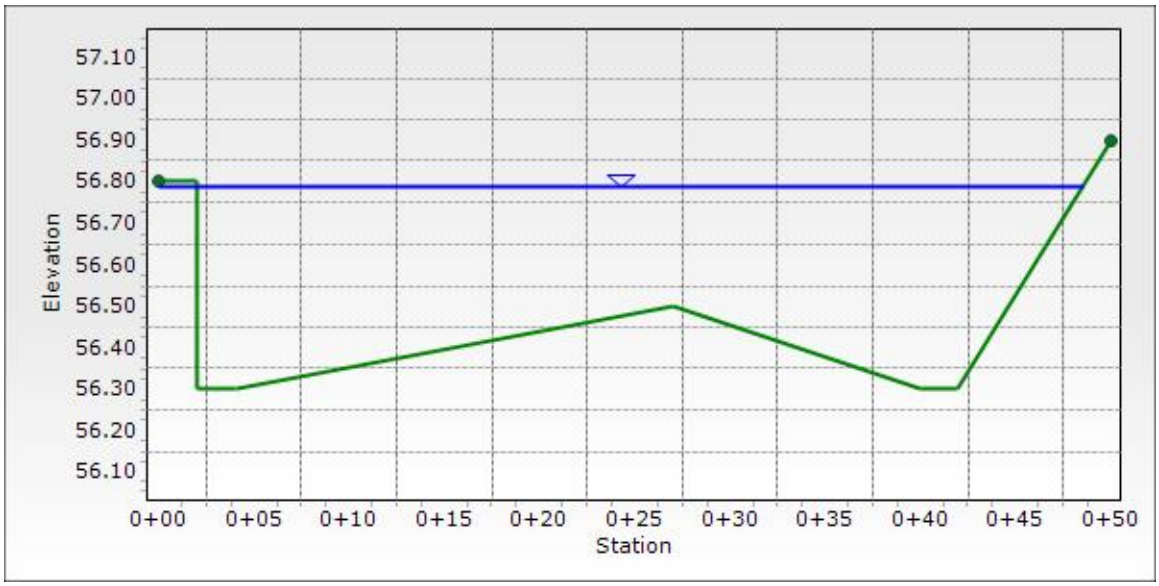
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.6 in
Critical Depth	7.2 in
Channel Slope	0.770 %
Critical Slope	0.483 %

Cross Section for Section B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.340 %
Normal Depth	5.9 in
Discharge	52.50 cfs



Worksheet for Section B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.340	%
Discharge	52.50	cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	56.76
0+02	56.76
0+02	56.30
0+04	56.30
0+27	56.50
0+40	56.30
0+42	56.30
0+50	56.90

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 56.76)	(0+50, 56.90)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	5.9	in
Elevation Range	56.3 to 56.9	ft
Flow Area	17.8	ft²
Wetted Perimeter	49.1	ft
Hydraulic Radius	4.4	in
Top Width	48.58	ft
Normal Depth	5.9	in
Critical Depth	5.4	in
Critical Slope	0.475	%
Velocity	2.94	ft/s
Velocity Head	0.13	ft
Specific Energy	0.63	ft
Froude Number	0.856	

Worksheet for Section B

Results	
Flow Type	Subcritical

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

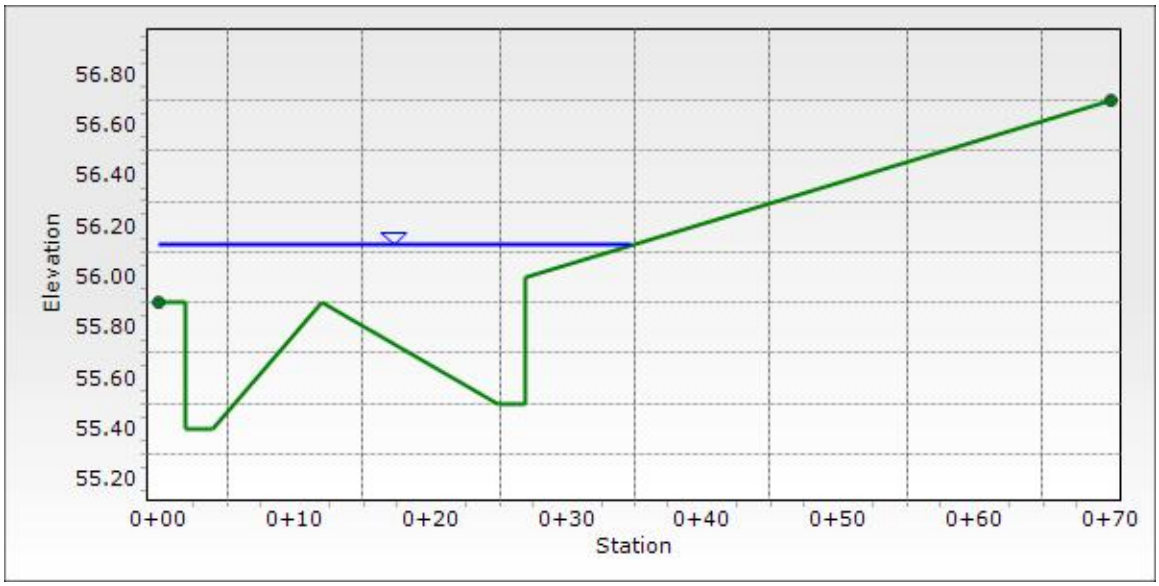
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.9	in
Critical Depth	5.4	in
Channel Slope	0.340	%
Critical Slope	0.475	%

Messages	
Messages	Water Surface Elevation exceeds lowest end station by 0.033790088 6244498ft.

Cross Section for Section C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.330 %
Normal Depth	8.7 in
Discharge	37.50 cfs



Worksheet for Section C

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.330	%
Discharge	37.50	cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	55.88
0+02	55.90
0+02	55.40
0+04	55.40
0+12	55.90
0+25	55.50
0+27	55.50
0+27	56.00
0+70	56.70

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 55.88)	(0+70, 56.70)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	8.7	in
Elevation Range	55.4 to 56.7	ft
Flow Area	13.0	ft²
Wetted Perimeter	36.0	ft
Hydraulic Radius	4.3	in
Top Width	34.70	ft
Normal Depth	8.7	in
Critical Depth	8.0	in
Critical Slope	0.487	%
Velocity	2.89	ft/s
Velocity Head	0.13	ft
Specific Energy	0.85	ft

Worksheet for Section C

Results		
Froude Number	0.832	
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

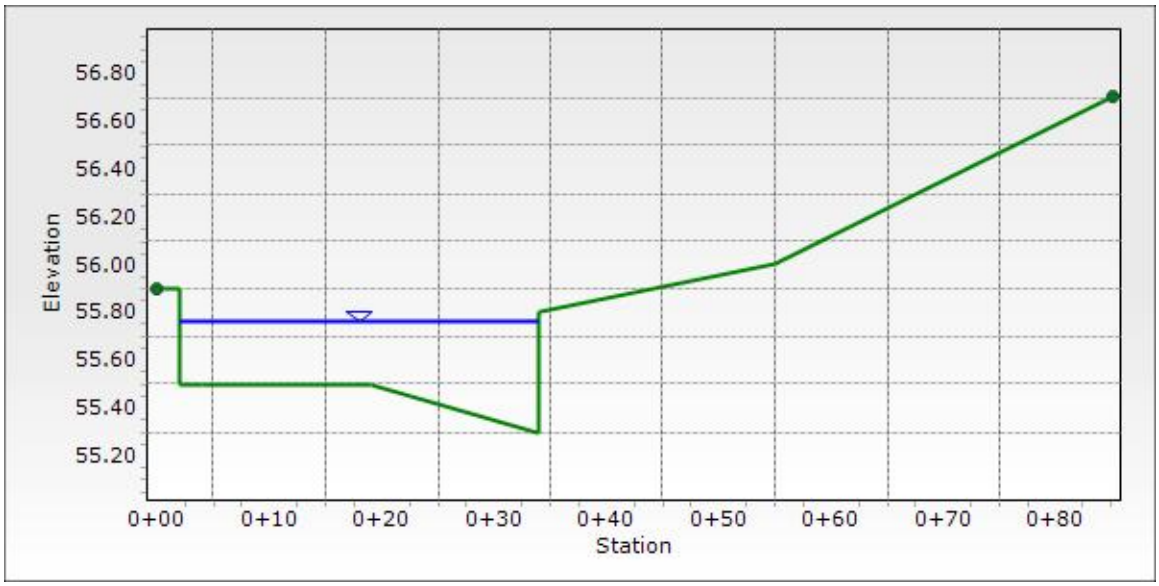
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.7	in
Critical Depth	8.0	in
Channel Slope	0.330	%
Critical Slope	0.487	%

Messages	
Messages	Water Surface Elevation exceeds lowest end station by 0.245351037187419ft.

Cross Section for Section D

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.940 %
Normal Depth	5.6 in
Discharge	43.30 cfs



Worksheet for Section D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.940 %
Discharge	43.30 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	55.89
0+02	55.90
0+02	55.50
0+04	55.50
0+19	55.50
0+34	55.30
0+34	55.80
0+55	56.00
0+85	56.70

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 55.89)	(0+85, 56.70)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	5.6 in
Elevation Range	55.3 to 56.7 ft
Flow Area	10.0 ft²
Wetted Perimeter	32.7 ft
Hydraulic Radius	3.7 in
Top Width	32.00 ft
Normal Depth	5.6 in
Critical Depth	6.7 in
Critical Slope	0.482 %
Velocity	4.35 ft/s
Velocity Head	0.29 ft
Specific Energy	0.76 ft

Worksheet for Section D

Results	
Froude Number	1.374
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.6 in
Critical Depth	6.7 in
Channel Slope	0.940 %
Critical Slope	0.482 %

Kimley»Horn

Appendix F - First Flush Calculations and Storm Water Separator Cut Sheet

First Flush Flow Calculations								
Location	**Runoff Coefficient (C)**	**Contributing Area (A)**	**Overland Flow Time of Concentration (T_{C1})**	**Pipe Flow Time of Concentration (T_{C2})**	**Total Time of Concentration, Minimum 10 min ($Tc=T_{C1}+T_{C2}$)**	**Rainfall Intensity (I)**	**First Flush Flow (Q_{FF})**	**Oldcastle Dual-Vortex Separator Size**
		AC	Min	Min	Min		CFS	
Site	1.00	0.78	5.00	4.26	10.00	3.00	2.3	DVS-60

Note: the Contributing Area excludes building roof area and pool area.

Per City of Phoenix Storm Water Policies and Standards Manual (2013) Section 6.8.3:

$Q_{FF} = C \times I \times A$

Where:

Q_{FF}= minimum First Flush discharge in cfs
C = Runoff Coefficient, 1.00 for First Flush
A = Contributing Area in acres
T_C = Time of Concentration (minutes), minimum of 10 minutes
I = Rainfall Intensity: (0.5 inches/hour x 60 minutes/hour) / T_C

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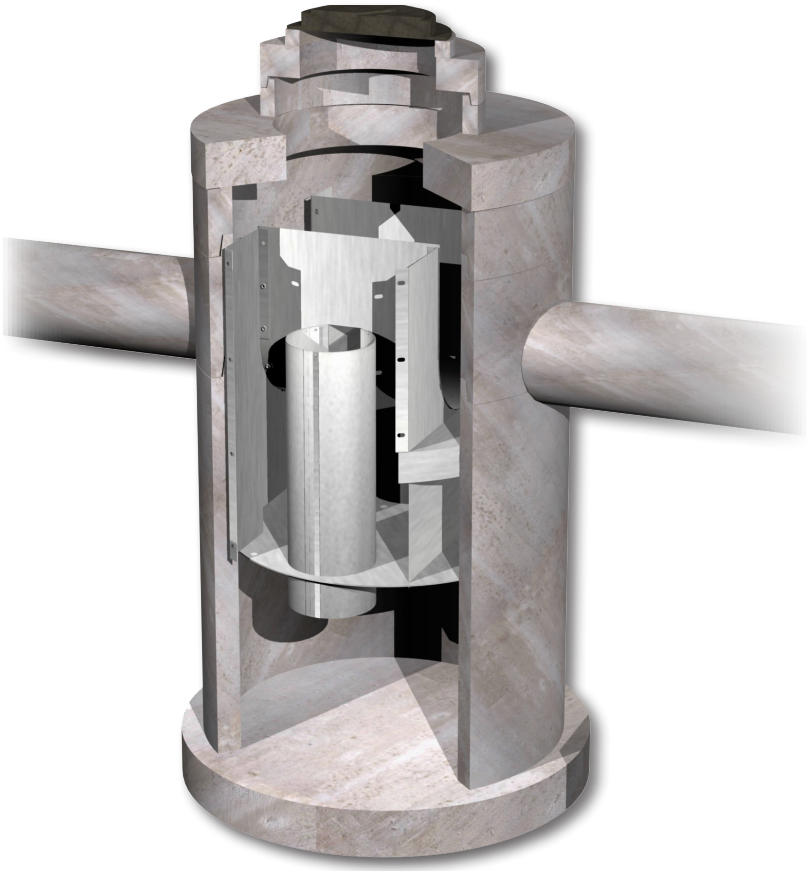
Oldcastle Precast®

DUAL-VORTEX SEPARATOR

Enhanced Gravity Separation of Stormwater Pollutants in a Compact Configuration



Dual-Vortex Efficiency

Particle settling is enhanced by circular flow patterns and a highly circuitous flow path created by two independent vortex cylinders.

Settled particles are collected in the isolated bottom storage area, while floating trash, debris and petroleum hydrocarbons are retained in the cylinders and upper storage areas.

During peak events, flows in excess of design treatment overtop the bypass weir and exit the system without entering the cylinders and lower storage area, thereby eliminating re-entrainment issues.

FEATURES	BENEFITS
Maintenance Accessible Design	Open access to accumulated floatables and two access points to sediment storage area
Economical Installation	Prepackaged and provided as compact round or square manholes or small vaults
Access Options	Multiple access options (manhole cover or optional hinged lid) allow for site-specific customization
Online System Capability	Internal high-flow bypass weir system provides for online or offline configurations
Durable Construction	Stainless-steel components installed in a reinforced concrete structure
Proven Performance	Third party tested and certified
Treatment Train	Can be installed upstream of infiltration, detention and retention systems or other treatment BMP's

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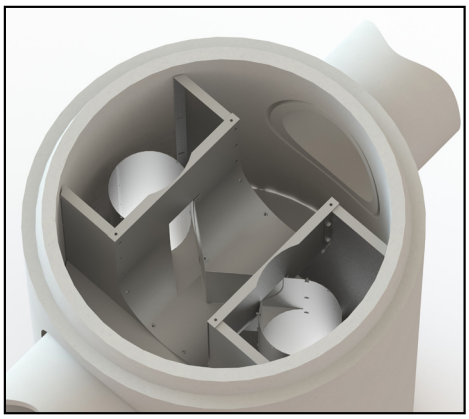
HYDRODYNAMIC SEPARATION

Oldcastle Precast®

Dual-Vortex Separator Offers an Innovative, Economical Alternative for Removal of Suspended Pollutants from Stormwater Runoff



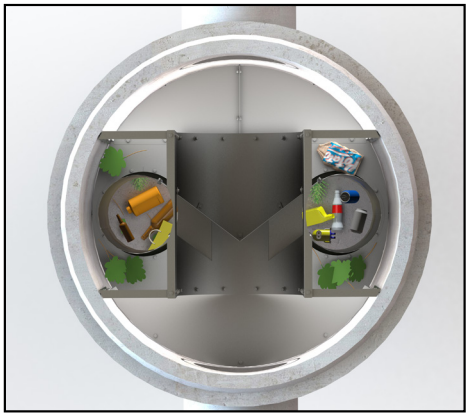
How it Works

STEP 1 **Independent Vortex Cylinders & Control Weir** - Flows are directed to the two independent vortex cylinders where particle settling is enhanced by circular flow patterns.

STEP 2 **Captured Floatables** - Floating trash, debris and petroleum hydrocarbons accumulate at the top of the two cylinders where they are held until transfer into the upper storage area by peak storm events.

STEP 3 **Removal of Total Suspended Solids (TSS)** - Particle settling is enhanced by the circular flow patterns and a highly circuitous flow path created by two independent vortex cylinders. Sediments are collected and retained in the isolated bottom storage area.

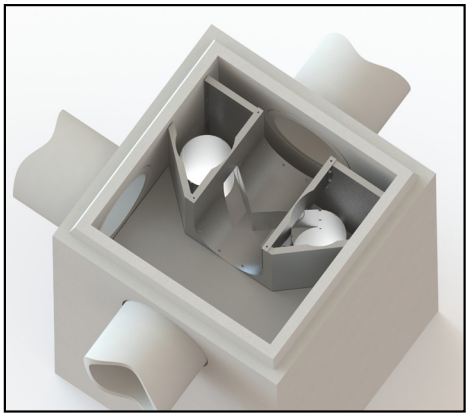
STEP 4 **High-Flow Bypass** - Flows in excess of the design treatment overtop the bypass weir and exit the system without entering the cylinders and re-entraining captured pollutants.



Models and Nominal Dimensions

Model No.	Structure Diameter (ft.)	Standard Sump Depth* (ft.)	Minimum Rim to Invert Depth (ft.)	Sediment Storage* (cubic feet)	Oil and Floatables Storage (cubic feet)	NJCAT Treatment Flow Rate (cfs)	Maximum Treatment Flow Rate (cfs)
DVS-36	3	4.5	2.5	11	6	0.56	0.56
DVS-48	4	5.0	3.0	19	15	1.00	1.25
DVS-60	5	5.5	3.5	29	29	1.56	2.50
DVS-72	6	6.5	4.5	42	49	2.25	4.25
DVS-84	7	7.0	5.0	58	79	3.06	6.50
DVS-96	8	8.0	5.5	75	116	4.00	9.50
DVS-120	10	10.0	7.0	118	226	6.25	16.80
DVS-144	12	11.5	8.0	170	388	9.00	26.40

**Depth of unit can be increased to add storage capacity*



Available Options

- Square configurations to accept multiple inlet pipes or to meet other special site conditions
- Flume inlet control for grated inlet applications

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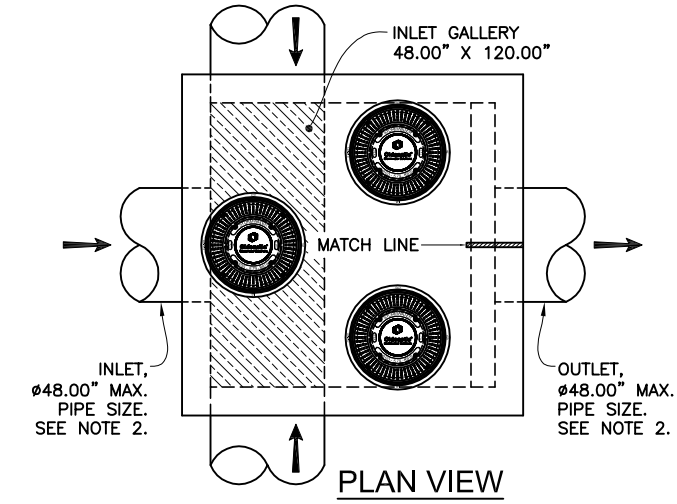
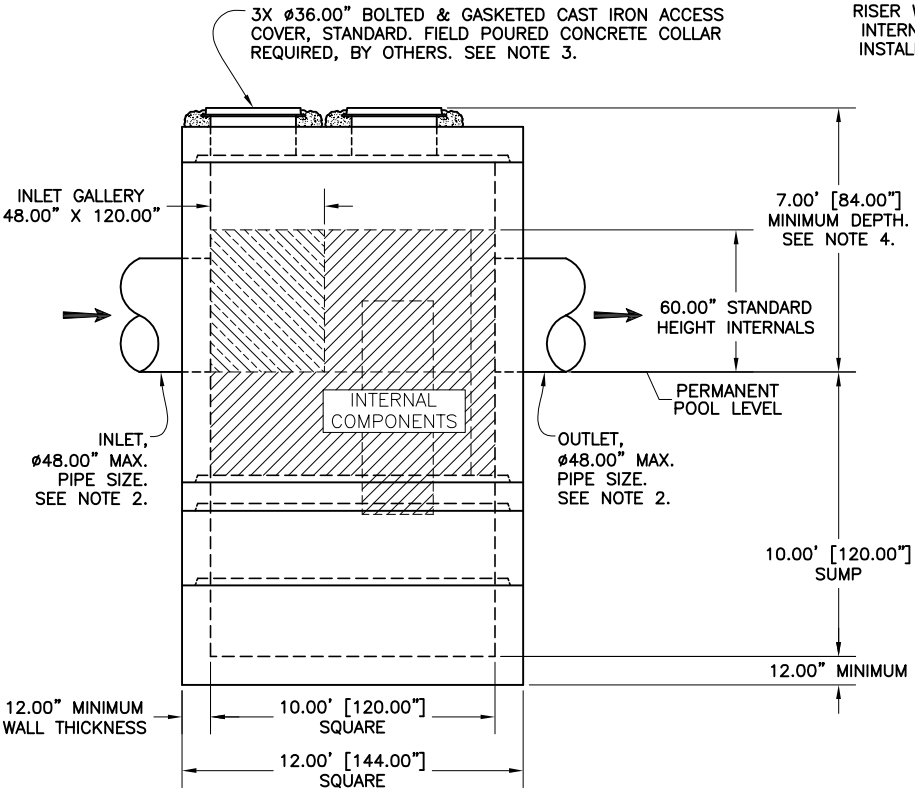
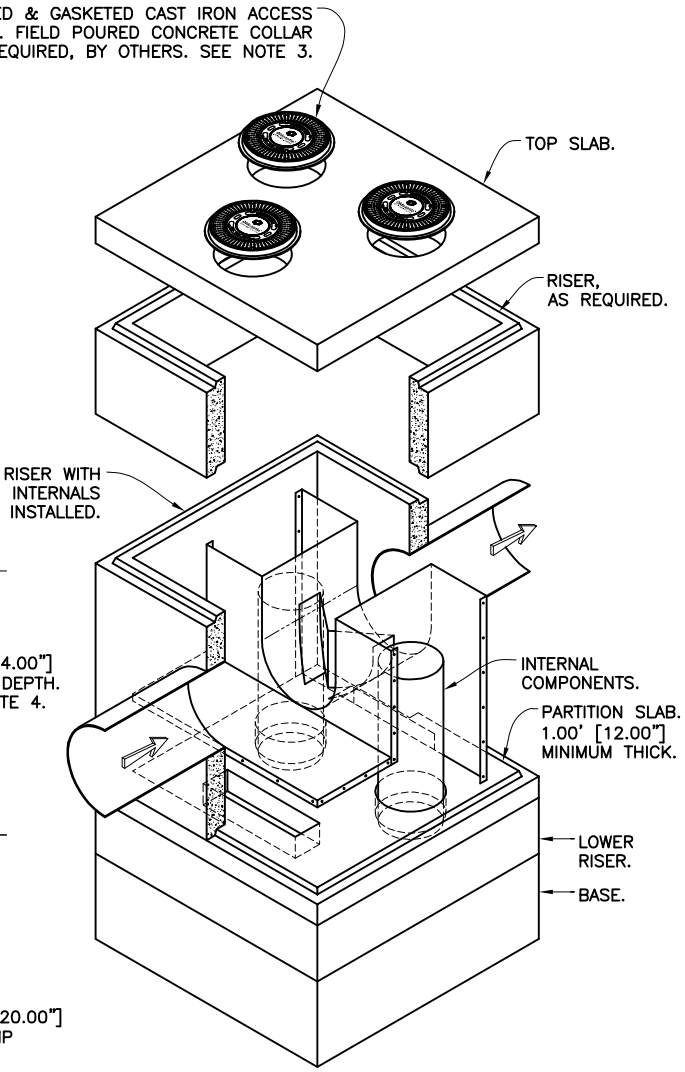


PLAN VIEW



ELEVATION VIEW



ISOMETRIC VIEW

SCALE 3/4

NOTES:

1. TREATMENT CAPACITY IS DEPENDENT ON LOCAL REGULATORY REQUIREMENTS. BYPASS CAPACITY IS DEPENDENT ON OUTLET PIPE DIAMETER. CONTACT OLDCASTLE PRECAST® STORMWATER FOR PROJECT–SPECIFIC TREATMENT AND BYPASS SIZING RECOMMENDATIONS.
2. STANDARD INLET/OUTLET PIPE CONFIGURATION TO ENTER AND EXIT STRUCTURE AT 180°. SPECIAL ANGLED CONFIGURATIONS AVAILABLE.
3. ACCESS COVER(S) MAY BE FIELD ADJUSTED TO GRADE. INLET GRATES & ALTERNATE COVER OPTIONS ARE AVAILABLE.
4. FOR DEPTHS LESS THAN THE MINIMUM SHOWN CONTACT OLDCASTLE PRECAST® STORMWATER.
5. STRUCTURE SHALL MEET AASHTO HS–20–44 DESIGN LOADING. CONCRETE COMPONENTS MANUFACTURED IN ACCORDANCE WITH ASTM C890 & C913.
6. UPON REQUEST, OLDCASTLE PRECAST® STORMWATER CAN PROVIDE A PROJECT–SPECIFIC DRAWING WITH DETAILED DIMENSIONS, PICK WEIGHTS, AND SPECIALS (AS REQUIRED).

Hydrodynamic Separation

DVS-120S

Dual Vortex Separator™

Square Structure

Oldcastle Precast® Stormwater

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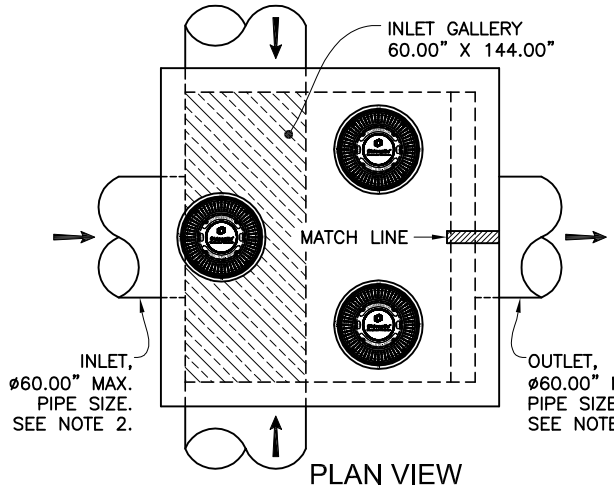
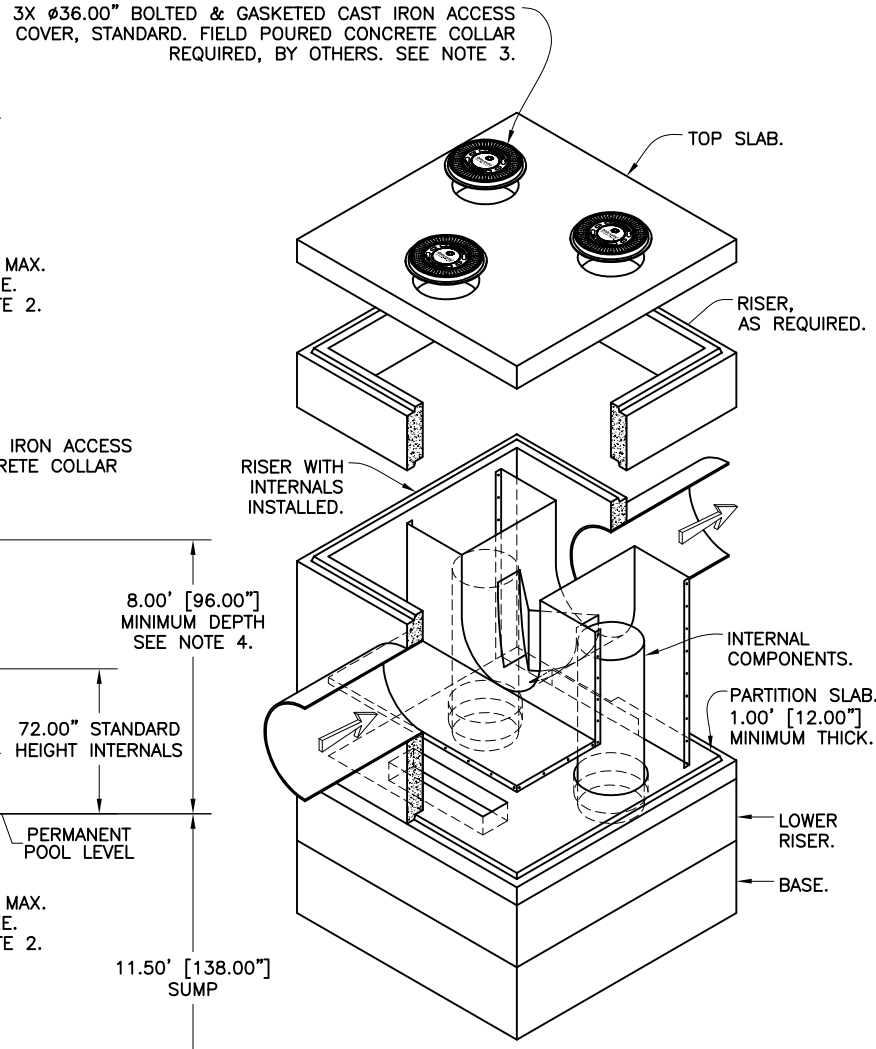
DRAWING NO.	REV	ECO	DATE	SHEET
DVS-120S	E	ECO–0152 SRA 6/12/17	JPR 4/25/11	1 OF 1

11-DR-2020

5/21/2021

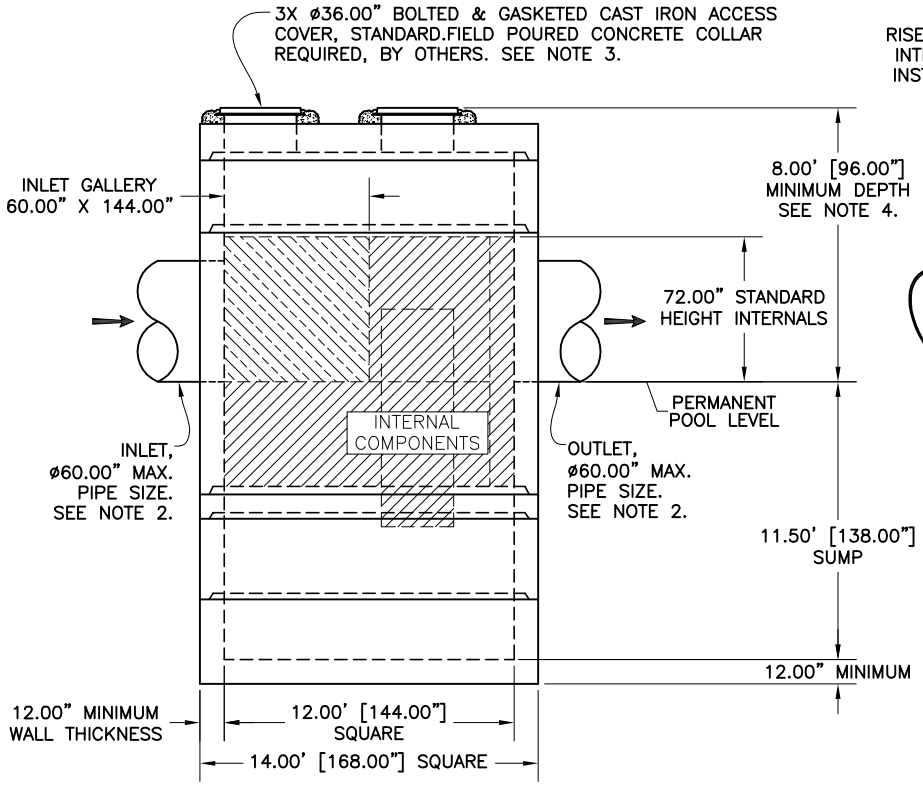


PLAN VIEW



ISOMETRIC VIEW

SCALE 3/4



ELEVATION VIEW

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Hydrodynamic Separation

DVS-144S

Dual Vortex Separator™

Square Structure

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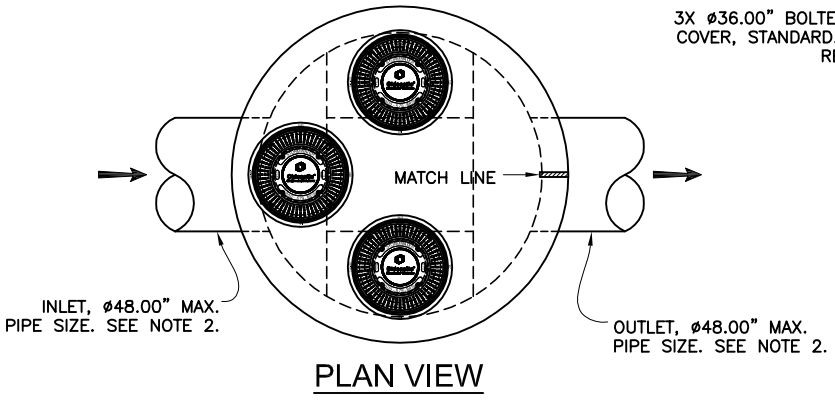
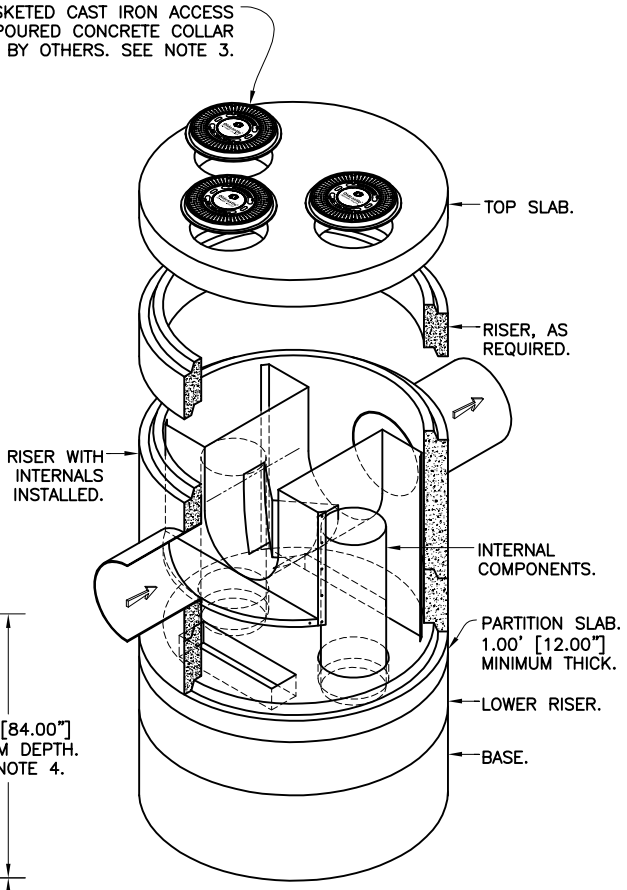
5/21/2021

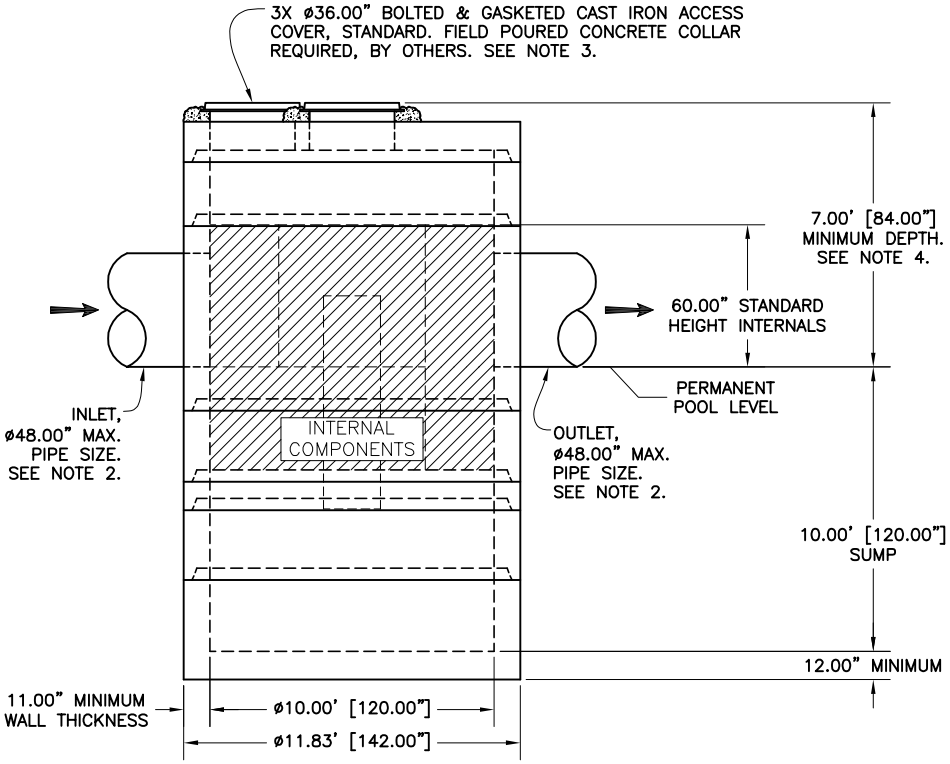


PLAN VIEW



ISOMETRIC VIEW

SCALE 3/4



ELEVATION VIEW

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6. UPON REQUEST, OLDCASTLE PRECAST® STORMWATER CAN PROVIDE A PROJECT–SPECIFIC DRAWING WITH DETAILED DIMENSIONS, PICK WEIGHTS, AND SPECIALS (AS REQUIRED).

Hydrodynamic Separation

DVS-120C

Dual Vortex Separator™

Circular Structure

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