

Memorandum



To: Joe Phillips, PE
From: Mark Gavan, PE and Omer Karovic, PE
Date: January 6, 2021
Project: Drainage Investigation
Bell Road at Loop 101 Freeway
Subject: Drainage Memorandum



PURPOSE OF MEMORANDUM

The purpose of this memorandum is twofold. One is to document the hydrologic analysis that was performed to determine the 100-year peak discharges that reach the Bell Road box culvert at the Loop 101 Freeway. The second purpose is to provide a determination on whether the previously planned concept for a regional detention basin on the DC Ranch Neighborhood Park parcel is still necessary.

ATTACHMENTS

- **Attachment I** – Existing Condition Drainage Area Map
- **Attachment II** – Developed Condition Flows Exhibit

INTRODUCTION / BACKGROUND INFORMATION

This analysis was done at the request of City of Scottsdale staff to reexamine the need for a regional detention basin within the City owned parcel that is located on the southwest corner of 91st Street and Trailside View. The need for the regional detention basin was identified in the “EPICENTER Master Drainage Plan” prepared by Coe & Van Loo (CVL) in 2008. It was envisioned that the basin would attenuate flood flows to eliminate potential flood hazards along Bell Road, especially at the existing four barrel, 10’x3’ box culvert located just east of the Loop 101 Freeway. The culvert, as well as the developed channel downstream of Bell Road, were designed to convey a peak discharge of 1,035 cfs, but the 100-year, 6-hour HEC-1 model that was developed by CVL for the EPICENTER development calculated a peak discharge of 1,719 cfs at the box culvert.

There are three primary offsite inflows that enter to the EPICENTER parcel and concentrate along Bell Road. They include the flow that crosses under Pima Road in a 6’x4’ box culvert approximately 1,000 feet east of the Loop 101 Freeway, the flow that crosses under Trailside View in a dual barrel 10’x4’ box culvert just east of Pima Road and the flow that crosses under 91st Street in a triple barrel 10’x5’ box culvert at Palo Brea Bend. The detention basin proposed by CVL was designed to capture the latter two offsite flows in a 55 ac-ft storage basin in order to

attenuate the 100-year peak discharge so that it does not exceed the conveyance capacity of the Bell Road box culvert and its downstream channel.

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

The hydrologic analysis done for this investigation was performed using the “Pinnacle Peak South Area Drainage Master Study” (PPS ADMS) FLO-2D model that was prepared by TY Lin International for the City of Scottsdale in 2013.

The portion of the 100-year, 24-hour FLO-2D model that directly contributes to the Bell Road box culvert at the Loop 101 was reviewed in detail and certain modifications were made to better represent flow patterns in the upstream drainage area. These modifications consisted of adjusting grid elevations to 1) prevent flows from erroneously breaking out of the contributing washes and 2) directing the runoff generated in the contributing drainage area to the correct location based on inspection of contour mapping, aerial photography, and as-built plans. These modifications removed erroneous flow splits and diversions.

The largest inflow to the EPICENTER parcel is 635 cfs through the dual barrel 10’x4’ box culvert underneath Trailside View, just east of Pima Road. As can be seen in the Existing Conditions Drainage Area Map in Attachment I, the wash extends from Trailside View north along the east side of Pima Road to Legacy Boulevard. Once it crosses under Legacy Boulevard, it runs in a northeasterly direction to Desert Camp Drive. The drainage area between Desert Camp Drive and the Trailside View is long and narrow, encompassing a total watershed area of approximately 125 acres. The main inflow to the wash, which crosses Desert Camp Drive east of 94th Street, consists primarily of breakout flow from Reata Wash at Deer Valley Road (extended).

The breakout flow from Reata Wash overwhelms the drainage infrastructure north of Desert Camp Drive with excess runoff flowing through housing developments and commingling between washes. Since the 100-year flow is not contained, no model adjustments were made upstream of Desert Camp Drive, but it appears to provide a reasonable prediction of the flow patterns and 100-year peak discharges that reach Desert Camp Drive. The Sierra Pinta flood control channel, which runs along the south side of Desert Camp Drive, starts just east of 94th Street and intercepts most of the upstream flow. However, runoff enters the offsite wash at two locations just east of the upstream end of the Sierra Pinta channel. The main inflow is an existing box culvert underneath Desert Camp Drive which lies about 900 feet east of 94th Street. It conveys a peak discharge of 635 cfs. The other inflow occurs at an opening in the wall along the south side of Desert Camp Drive. This wall opening is located about 300 feet west of the culvert inflow. The flow through this wall opening is 70 cfs. Therefore, the combined peak flow that enters the main offsite wash from north of Desert Camp Drive is 705 cfs.

Due to the delayed peak inflow associated with the Reata Wash breakout flow and the long, narrow shape of the watershed downstream of Desert Camp Drive, the peak discharge in the main wash is attenuated from 705 cfs at Desert Camp Drive, to 655 cfs at Downing Olson Drive and finally to

635 cfs at Trailside View. Refer to Attachment I for the Existing Condition Drainage Area Map that shows the local contributing drainage area south of Desert Camp Drive and the location of the Sierra Pinta Channel.

The second inflow into the EPICENTER parcel is 310 cfs through the existing triple barrel 10'x5' box culvert underneath 91st Street at Palo Brea Bend. The contributing drainage area for this inflow extends from Palo Brea Bend north along the east side of 91st Street to Legacy Boulevard. North of Legacy Boulevard, there are two tributary washes that run in a northeasterly direction toward Hualapai Drive. The west tributary wash extends north to Desert Camp Drive. The east tributary wash crosses Hualapai Drive and intercepts breakout flows from a wash that runs along the 96th Street alignment wash. The contributing drainage area to the triple barrel box culvert at Palo Brea Bend is 235 acres. This does not include the watershed area associated with the breakout flows. Refer to the Existing Conditions Drainage Area Map in Attachment I for the location of the breakout flows that spill out of the wash along 96th Street.

The last inflow into the EPICENTER parcel is 85 cfs through the existing 6'x4' concrete box culvert underneath Pima Road, approximately 1000 feet east of the Loop 101 Freeway. The drainage area to this culvert extends west to the old Pima Road, north past Union Hills Drive and east to the new Pima Road alignment. The total contributing drainage area is about 70 acres.

In addition to these three main wash inflows, the FLO-2D model also includes the existing conditions runoff from the EPICENTER, DC Ranch Neighborhood Park, StorAmerica and APS Substation parcels. The total contributing drainage area from these four parcels is 135 acres. Refer to the Drainage Area Map in Attachment I for the contributing drainage area boundary as well as the major flow paths through the undeveloped EPICENTER parcel.

EXISTING CONDITIONS HYDROLOGIC RESULTS

The 100-year, 24-hour peak discharges that enter the EPICENTER parcel at the three main inflow locations were determined from the modified PPS ADMS FLO-2D model. They include 635 cfs through the dual barrel 10'x4 box culvert under Trailside View, 310 cfs through the triple barrel 10'x5' box culvert underneath 91st Street, and 85 cfs through the 6'x4' box culvert under Pima Road. These offsite flows combine with the onsite runoff and flow in a southerly direction towards Bell Road. But since the existing washes do not all convey the offsite flows to the existing Bell Road box culvert, much of the runoff flows southerly in shallow washes that spill directly into Bell Road between the Loop 101 Freeway and 91st Street.

From the FLO-2D model it was found that only about 520 cfs, approximately half of the 1,035 cfs culvert design flow, is conveyed through the Bell Road box culvert under existing conditions. The remaining flows spill directly into Bell Road. As can be seen in the exhibit in Attachment I, approximately 175 cfs spills into Bell Road just west of 91st Street, 50 cfs spills in at the 90th Street alignment and 135 cfs spills in just east of the existing box culvert. Therefore, it can be concluded that past flooding on Bell Road between the Loop 101 Freeway and 91st Street was likely caused

by these flows that spill directly into Bell Road and not because the existing box culvert is undersized.

FUTURE DEVELOPED CONDITIONS

Since much of the existing conditions runoff does not reach the Bell Road box culvert, conceptual channels were incorporated into the FLO-2D model to estimate the combined 100-year peak discharge that will be directed to the box culvert in the future when the EPICENTER parcel is developed. These channels were added to the model by depressing grid cells to create conveyance corridors that capture all of the 100-year runoff and prevent the flows from spilling into Bell Road. The estimated total combined 100-year peak discharge, under future developed conditions, at the Bell Road box culvert is 750 cfs. This peak discharge is governed by the breakout flow from Reata Wash at Deer Valley Road (extended) which enters the EPICENTER site through the existing Trailside View box culvert. The peak of the flood hydrograph associated with the breakout flow occurs much later than the peak time of the other two inflows and therefore they do not add directly. Refer to the Developed Condition Flows Exhibit in Attachment II for the conceptual channels that were added to the FLO-2D model.

CONCLUSIONS/RECOMMENDATIONS

1. **Updated Hydrologic Analysis** – The hydrologic analysis performed as part of this drainage investigation was based on the Pinnacle Peak South ADMS 100-year, 24-hour FLO-2D model. This model, which uses a 2-dimensional rainfall-runoff analysis is a more accurate, physically based method of estimating peak discharges as compared to the previous CVL HEC-1 model. In general, the peak discharges that are obtained with FLO-2D models are lower, and more representative of actual conditions as compared to the peak discharges calculated using HEC-1 models.
2. **Existing Conditions Flow vs. Future Developed Conditions Flow** – Under existing conditions, during the 100-year, 24-hour storm event approximately 520 cfs flows through the Bell Road box culvert at the Loop 101 Freeway. Runoff also spills into Bell Road under existing conditions between the existing culvert and 91st Street. Under future developed conditions, once the EPICENTER development is built and the offsite flows are routed to the Bell Road box culvert, the estimated peak discharge at the culvert will increase to 750 cfs. The existing culvert and downstream channel were designed for 1035 cfs. Therefore, under future developed conditions the four barrel 10'x3' Bell Road box culvert at the Loop 101 Freeway has sufficient capacity to convey the upstream flows without flooding Bell Road or the adjacent developments.
3. **Detention Basin at the DC Ranch Neighborhood Park Parcel** – The estimated peak discharge at the Bell Road box culvert under future developed conditions (750 cfs) is less than the design flow for the culvert and downstream channel (1035 cfs). Therefore, the

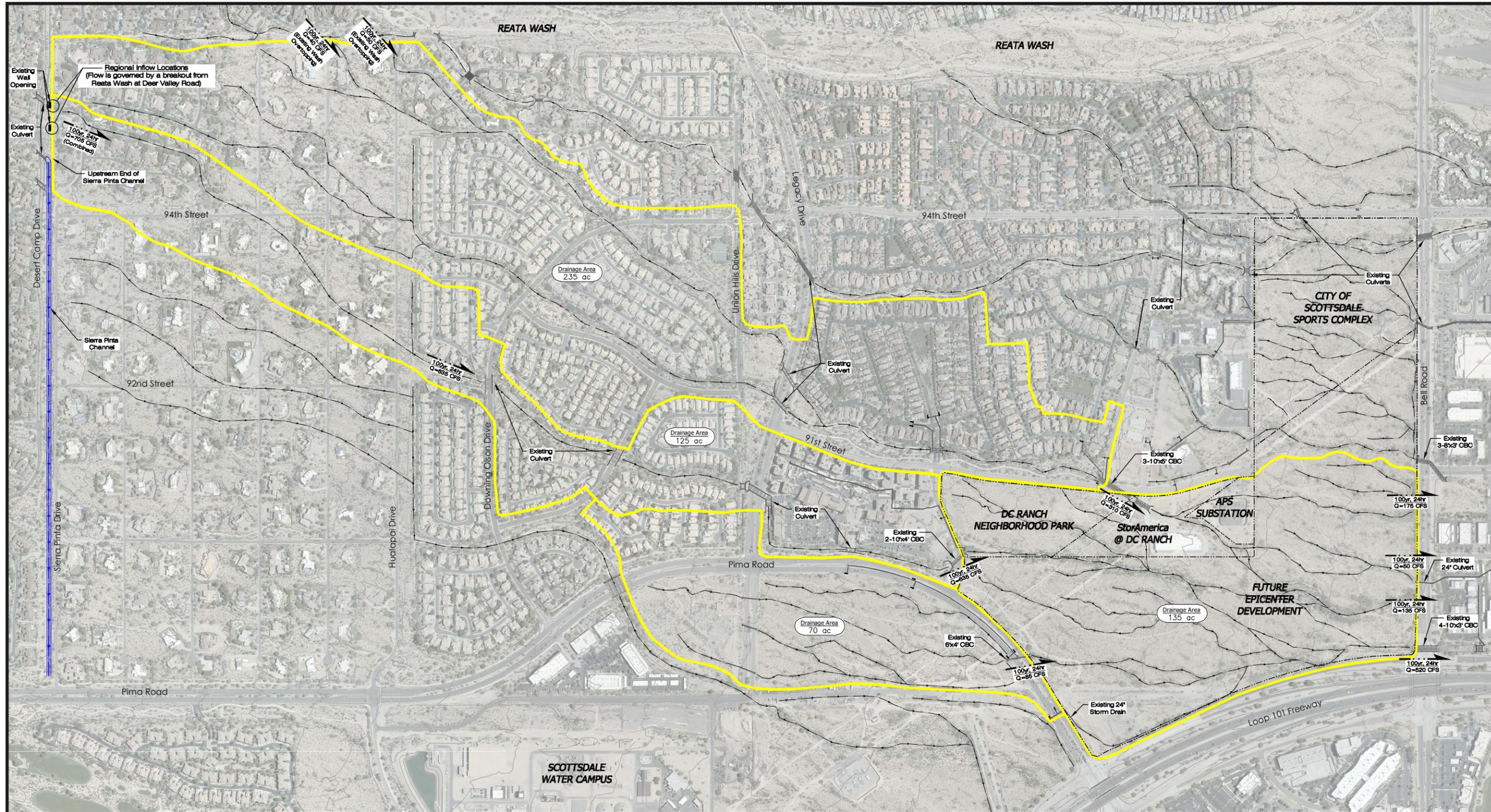
previously planned detention basin at the DC Ranch Neighborhood Park is no longer needed.

- 4. Future Reata Wash Flood Control Improvements** – The City of Scottsdale is currently planning flood control improvements along Reata Wash that will eliminate the breakout flow that occurs at Deer Valley Road (extended). This breakout flow is a significant contributor to the peak discharge that enters the EPICENTER parcel. Therefore, in the future, once the Reata Wash improvements are implemented, the peak discharge that enters the EPICENTER parcel underneath Trailside View will be further reduced.
- 5. Past Flooding on Bell Road** – City staff have observed past flooding on Bell Road in the area just east of Loop 101 Freeway. This observation is consistent with the hydrologic analysis of the existing conditions wherein significant flow was found to spill directly into Bell Road from the undeveloped EPICENTER parcel. This problem will be corrected in the future with the development of the EPICENTER parcel when all flood flows on the property will be directed to the existing Bell Road box culvert which will eliminate flow spilling into the roadway.
- 6. Existing 24” Culvert** – There is an existing 24-inch culvert underneath Bell Road, approximately 500 feet east of the existing four barrel 10’x3’ concrete box culvert. The capacity of this small culvert was ignored for purposes of this drainage investigation.

Attachment I:
Existing Condition Drainage Area Map

Project :

Drainage Investigation
Bell Road at Loop 101 Freeway
 CITY OF SCOTTSDALE

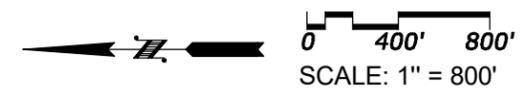


LEGEND

- Local Drainage Area Boundary
- Major Flow Paths
- 100-yr, 24-hr Peak Flows
- Property Boundary

EXISTING CONDITION DRAINAGE AREA MAP

- NOTES:**
- The flows that concentrate at Bell Road, between the Loop 101 Freeway (Pima Road) and 91st Street were determined from the 100-year, 24-hour Pinnacle Peak South FLO-2D model prepared by TY Lin International. The model was modified by Gavan & Barker Inc to better represent the upstream flow conditions. Click on this [LINK](#) to download the modified FLO-2D model.
 - The peak discharge of 705 cfs that enters the upstream drainage area just east of the Sierra Pinta Channel primarily consists of flow that breaks out from Reata Wash, just downstream of Deer Valley Road (extended). This breakout flow is the governing component of the peak discharge that concentrates along Bell Road between the Loop 101 Freeway and 91st Street.

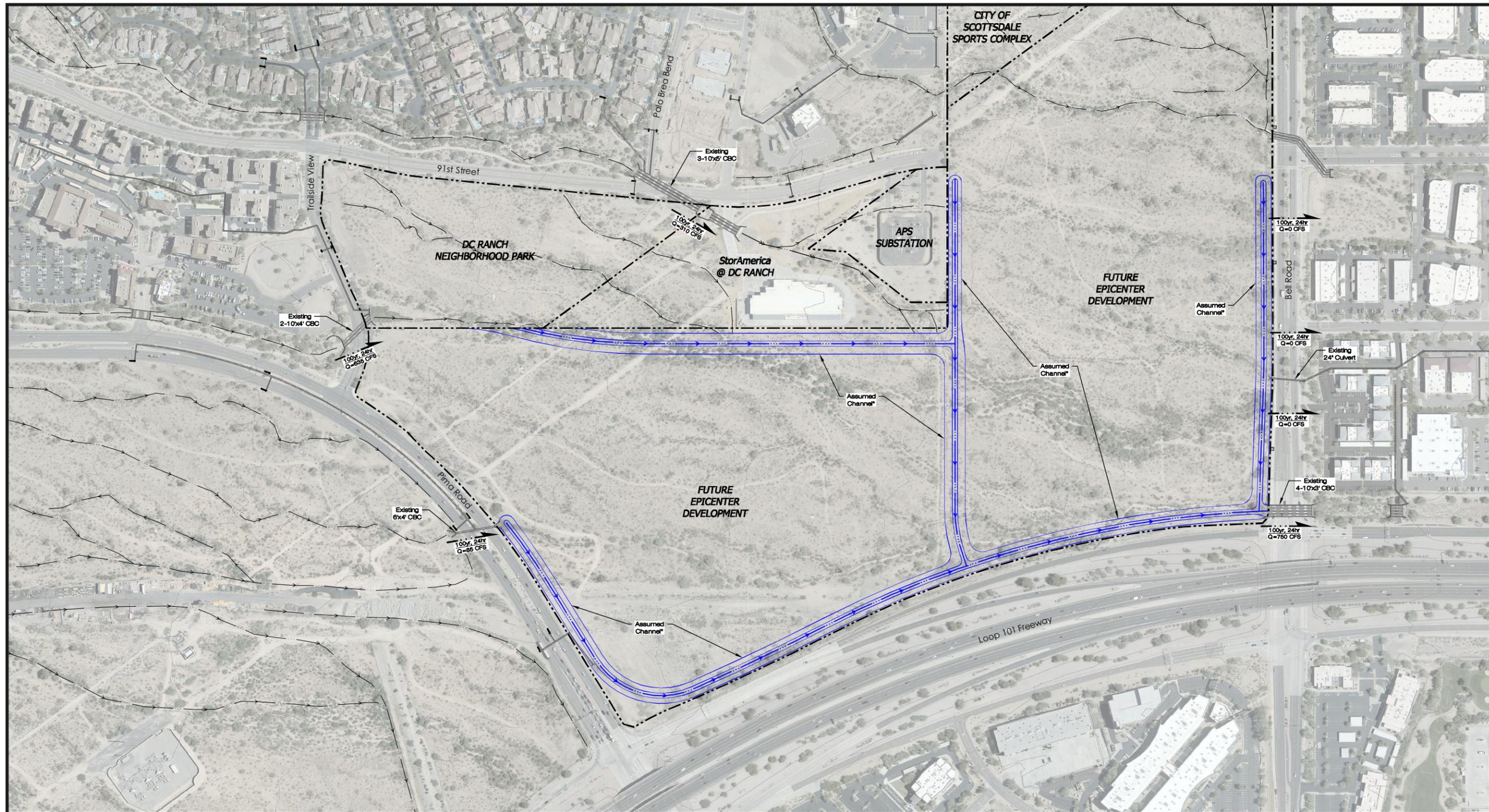


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 Checked By: MITG

Sheet Title :
Existing Condition Drainage Area Map

Sheet Number:
1
 1 of 1

Attachment II:
Developed Condition Flows Exhibit



- LEGEND**
- Major Flow Paths
 - 100-yr, 24-hr Peak Flows
 - Property Boundary

PEAK FLOWS UNDER DEVELOPED CONDITION

CHANNEL NOTE:
*The assumed channels shown hereon do not reflect any land development plan associated with the future Epicenter development. Their sole purpose is for hydrologic modeling to route flows to the Bell Road box culvert. Future land development plans will establish the actual channel locations.

