# 3 DRAINAGE AND FLOOD MANAGEMENT

## 3.1 INTRODUCTION

This Drainage Infrastructure Technical Appendix provides information in support of the EIR for the proposed 75-acre West Davis Active Adult Community development by David Taormino.

This Technical Appendix presents the results of a preliminary, feasibility-level hydrology and hydraulics analysis related to the development of the project. The primary purpose of this effort is to identify feasible stormwater/flood management mitigation measures for the project, and to provide a first approximation of sizing for such facilities in support of the project EIR. The analysis considers the project's potential stormwater impacts (including those to the existing floodplain on and near the project site), and provides a general description of the mitigation measures that that the project could implement to mitigate those impacts.

It is anticipated that at a later date (during Tentative Map application and the initial design of site improvements) this preliminary analysis will be developed further as part of a detailed Master Drainage Plan (MDP) for the project. The purpose of that MDP will be to further define the configuration and sizing of the mitigation measures recommended herein, and to provide more detail on how they will be integrated into the final project site plan.

## 3.2 EXISTING CONDITIONS AND DRAINAGE INFRASTRUCTURE

The site is located within the Covell Drain Watershed, with approximately 17 sq. mi. of the watershed lying upstream of the site. The site lies immediately north of the Covell Drain channel, which conveys stormwater and agricultural runoff from western portions of the City of Davis and from portions of unincorporated Yolo County west of the site. In the vicinity of the site, the Covell Drain flows east along the north side of Covell Blvd toward Highway 113, turning north along the west edge of Highway 113 and then discharging to an existing 3-10'w x 5'h box culvert under the freeway. East of Highway 113, the Covell Drain continues to the northeast along the north edge of Davis, through the Wildhorse Golf Course and eventually discharges to Willow Slough Bypass northeast of the City.

A substantial portion of the project site is currently located within FEMA Zone A (see Attached FEMA Maps), which are areas determined to flood during the 1% annual flood event. Since Zone A floodplains do not have a published Base Flood Elevation, the depth of floodwater onsite during the 100-year event is undetermined. However, anecdotal information suggests that large-storm flooding on and near the project site is expected to be characterized by shallow (possibly 1' to 2'-deep), slow-moving flows. A portion of the project adjacent to John Jones Road at the northeast edge of the project site is mapped within FEMA Zone X, which are areas determined to be outside the 500-year floodplain.

The Covell Drain system has a history of flooding issues, including areas west of Highway 113. During larger storm events, peak flows may exceed the conveyance capacity of the existing Covell Drain and that of the existing box culvert beneath Highway 113. This contributes to an

area of shallow flooding immediately west of Highway 113, as described above. In the past, conceptual studies have been undertaken to identify ways to improve conveyance capacity of both the Covell Drain and North Davis Drain west of Highway 113 (Borcalli & Associates, 1993). At the time of this writing, no specific plan has been adopted. Further, the West Davis Active Adult Project applicant is not aware that any funding has been identified to plan, design and build any such project.

The existing hydrology of the Covell Drain channel has been quantified in an existing regional HEC-1 model for the entire Covell Drain system. That HEC-1 analysis, originally developed for FEMA Flood Insurance Study (FIS) purposes, was most recently updated as part of a hydrology and hydraulics analysis performed in support of the new Cannery Development in Davis. This recent version of the HEC-1 model was provided to the project applicant by the City of Davis, and is the basis for the hydrologic evaluations presented herein. The HEC-1 models consist of rainfall-runoff analyses for a number of storm events, including 10-year/24-hour, 100-year/24-hour, 100-year/10-day, and 200-year/10-day storms.

The City of Davis maintains a storm drain pipe network in the area which discharges to the Covell Drain. This network collects water from the south side of Covell Blvd. and pipes to the north into the existing channel. Storm drain pipes ranging from 15" to 42" provide collection and conveyance of stormwater throughout the Sutter Hospital Facility and along John Jones Road, tying into the Covell Drain parallel to Highway 113.

The City of Davis also maintains a stormwater detention pond adjacent to the West Davis Water Tank site. The pond provides attenuation for the stormwater associated with the water tank site and the Sutter Davis Hospital site.

## 3.3 PROPOSED DRAINAGE INFRASTRUCTURE

A guiding stormwater management principle for project should be that it does not result in new impacts to properties downstream or upstream. Potential impacts include considerations of both stormwater quantity and quality. With regard to stormwater quality, the project will be designed to conform with current City of Davis standard requirements, as discussed below. For water quantity, the objective of this preliminary analysis will be to identify the basic post-project storage volumes needed onsite in order to limit post-project peak discharges and associated peak water surface elevations (WSEs) to estimated existing levels in the Covell Drain on its approach to the Highway 113 box culvert.

As such, the proposed project will provide stormwater storage and conveyance facilities that will likely consist of the following components:

### 3.3.1 WATER QUALITY MITIGATION

The project intends to integrate Low Impact Development (LID) measures throughout the project to provide stormwater quality treatment. These LID measures will likely include both volume-based BMPs (bioretention, infiltration features, pervious pavement, etc.) and flow-based BMPs (vegetated swales, stormwater planter, etc.). The use of these features will be dependent upon the location and setting within the project. These treatment measures will be designed in accordance with the City of Davis Storm Water Quality Control Standards. Sizing and

configuration of these treatment measures will be determined with the future development of the tentative map and improvement plans for the project.

### 3.3.2 MITIGATION FOR INCREASE IN PROJECT SITE DISCHARGE DUE TO DEVELOPMENT

In addition to the water quality treatment measures, the project proposes to provide mitigation for the expected increase in the site's post-project peak discharge relative to pre-project conditions. As a result of the project development, the effective impervious area for the site will increase, which in turn will increase the peak rate of runoff from the site. In order to estimate the increased peak discharge associated with development of the proposed project, a local HEC-HMS model was constructed to simulate the pre- and post-project runoff conditions for the site in the 100-year/24-hour storm, in accordance with the City of Davis design standards.

The existing site was modeled using 75 acres of site area and an SCS Curve Number (CN) of 65 (consistent with the existing regional HEC-1 model). Under these conditions, the HMS model computed a 100-year 24-hour peak discharge of approximately 15.5 cfs from the existing 75-acre site area.

A proposed-conditions local HEC-HMS model of the site was also developed, using the same 75-acre area. However, the site's post-project SCS CN was adjusted using a weighted average of the proposed land uses on the site. The project is proposing 12.7 acres of open space/landscaping around the perimeter of and throughout the project. The remainder of the project area is the Residential or Recreation land use. Below is a summary of the land uses and curve numbers assumed for the proposed condition.

| Land Use | Acres | CN | Notes |
|---|---|---|---|
| MDR | 53.47 | 92 | Urban Res 1/8 ac or less |
| HDR | 5.11 | 92 | Urban Res 1/8 ac or less |
| AG | 4.10 | 85 | Agricultural |
| GB | 8.60 | 80 | OS: Grass cover > 75% |
| CH | 3.72 | 89 | OS: Grass Cover < 50% |
| TOTAL: | 75.00 | | |
| | WEIGHTED CN: | 90.1 | |

The Hydrologic Soil Group "D" used for the evaluation is based on the NRCS Web Soil Survey mapped value. The resulting 100-year peak discharge from the proposed development was computed at 53.2 cfs.

Proposed mitigation for the pre-to-post increment in peak discharge will be accomplished by integrating of detention storage into the site, with the design goal of limiting the site's post-development peak flow to exiting levels. As such, an onsite detention storage component was added to the post-project HEC-HMS model in order to provide an initial estimate of the detention volume that would be required to limit the project site's peak discharge to no more than 15.5 cfs. The HMS model estimated that a detention basin approximately 450' x 150' with a maximum water depth of 3.4 feet (5.75 ac-ft) to satisfy this criterion.

This detention basin will be located offsite of the north east of the project site adjacent to the existing City of Davis detention basin. The existing ground elevations adjacent to John Jones road are at approximately EL 47, and the elevation at the bottom of the existing tank site detention basin is approximately EL 38. The proposed project detention basin will be significantly more shallow than the existing City detention basin and appears feasible in this location.

### 3.3.3 MITIGATION FOR FLOODPLAIN DISPLACEMENT

Evaluation of the effects of floodplain displacement due to new development is usually informed by a hydraulic analysis of pre- and post-project conditions, and a comparison of pre/post peak flows and local water surface elevations. Post-project mitigation, if appropriate, often consists of incorporating replacement storage within the project plan.

In order to provide a preliminary estimate of pre- and post-project hydraulic conditions on and around the project site, an unsteady-state local hydraulic routing model was constructed using the EPA Storm Water Management Model v 5.1 (SWMM). Flow inputs to the SWMM routing model were imported from the regional HEC-1 models identified above, with appropriate adjustments made to the local pot-project site hydrology for input to the post-project SWMM model.

As is typical with analyses involving large catchment areas, the project evaluation considered multiple durations for the largest (100-yr and/or 200-yr) storm events: a 24-hour duration and a 10-day duration. Two previous hydrologic studies (prepared for Covell Village and the Cannery respectively) of the Covell Drain in Davis concluded that the long-duration (10-day) event is the critical storm event for flooding considerations. This was confirmed through the modeling effort conducted herein for the West Davis Active Adult Community. As a result, the 10-day duration storm event was the basis for the preliminary floodplain evaluation herein. The City of Davis has also requested that the project evaluate and mitigate for the 200-year storm event. Thus the 200-year/10-day storm event was also analyzed and the results described herein.

For the purposes of hydrologic modeling, the existing regional HEC-1 models consider the runoff impacting the existing project site to be derived from two primary sources: The major source is the large upstream watershed of the Covell Drain to the west, which includes much of the rural area of unincorporated Yolo County, plus most of West Davis. The second source is the contribution of runoff directly from the agricultural fields abutting the local project area plus the land within the project site itself. This shed comprises a ±780-acre area north of Covell Blvd., most of which lies between County Road 99 and Highway 113.

For the SWMM routing model, the runoff hydrograph associated with the ±17 sq mi upstream shed area was extracted directly from the existing HEC-1 model and was input as an upstream flow condition for the SWMM simulation. In the 100-year/10-day storm, this upstream peak flow is on the order of 1200-1300 cfs. The runoff hydrograph for the local 780-acre shed was generated using a HEC-HMS model, based on the HEC-1 modeling parameters for that shed. This included the existing HEC-1 model's local precipitation input data, shed area, shed response time and effective SCS CN. The HEC-HMS model platform was used for the local shed analysis in order to facilitate comparison of the differences in runoff between the pre- and post-project conditions. The local HMS results are expected to be consistent with HEC-1 results.

For low to moderate flows (<10-year±), runoff from the upstream shed is routed through the existing Covell Drain channel located north of Covell Blvd, which continues east toward Sutter Davis Hospital, at which h point is routed through a series of box culverts and open channel segments to the existing box culvert under Highway 113. At high flows, the limited conveyance capacity in both the Covell Drain channel and in the Highway 113 box culvert results in overbank spill from the Covell Drain channel (producing shallow flooding which spreads out on the existing agricultural lands north of Covell Blvd), and elevated headwater at the box culvert (manifested as pooling of floodwaters immediately upstream of Highway 113).

#### 3.3.3.1 Topographic Survey Considerations for Hydraulic Modeling

A new site topographic survey has not yet been performed for the project site and its environs. Therefore, the preliminary hydraulic routing analysis described herein is based upon on available historical topo mapping for the area. Our office located historical topo mapping from three sources, collected over the past 30 years. This includes aerial topography for the western and central portions of the site, dating back 25 years, combined with somewhat newer topographic data and limited as-built grading/drainage information for Sutter Davis Hospital and along a portion of John Jones Road. In the absence of vertical datum information, approximate datum correlations between the various maps were simply made by visual comparison of elevations within overlapping areas on the map edges. The Sutter Davis mapping was used as the basis for the vertical datum (thought to be NGVD 29), with the other two mapping sources visually adjusted to correlate with that.

The 'correlated' topo information was then assembled into an informal composite topo base map, bounded by Highway 113 on the east, Covell Blvd on the south, CR 99 on the west, and the north edge of the Binning Ranch on the north. West of Highway 113, the geometric elements of the SWMM hydraulic model have been fully defined from this topo base. In the absence of current topo mapping, this approach is considered adequate for a preliminary planning-level hydraulic analysis such as this, whose purpose is to inform the general scale and nature of the project's proposed mitigation measures. It is not intended, however, that the preliminary hydraulic results be relied upon as a source of formal floodplain mapping for the site and surrounding properties. For the future MDP that will accompany project tentative maps and improvements plans, the final hydraulic analysis (including floodplain determination) will be based upon a current, single-source topo map with verifiable vertical datum and additional detail where required.

#### 3.3.3.2 Existing Conditions Drainage/Flood Routing

For the existing-conditions SWMM routing model, the Covell Drain channel and the existing floodplain ground surface on and near the project site were represented by cross-sections located at approximately 600-foot intervals and at major changes in geometry (based on 'best available' topographic data described above). The attached Figure 2.1 identifies the sections through the existing ground used to generate the SWMM model. Figure 2.2 attached is the SWMM routing schematic which identifies the cross-section locations and connectivity through the project area.

The SWMM modeling is based on the upstream runoff hydrograph, extracted from HEC-1, input at the western edge of the local watershed located at CR99. This is routed across the existing topography toward the project site, at which point the runoff associated with the local

watershed west of the project is input into the model. The model continues to route the flow across the existing topography at which point the flow is split around the Sutter Davis Hospital. Flow continues to the south through the existing Covell Drain channel and culvert system which conveys approximately 200 cfs of runoff. The remaining runoff is routed north of Sutter Davis Hospital as shallow flow across the existing farmland. The second local watershed, which includes the undeveloped project area and the developed Sutter Davis Hospital area, is input into the model at the eastern edge of the local watershed at John Jones Road. Runoff at this point then flows to the existing culvert under John Jones Road; however, due to capacity constraints within this culvert, runoff during the 100 year and 200 year storm events overtops the roadway. East of John Jones Road, the runoff converges with the runoff from the south and discharges to the existing culvert under Highway 113. The model continued downstream, through the existing Covell Drain Channel to F Street in order to provide a normalized head at the downstream boundary condition.

The limits of the floodplain calculated with this evaluation differ from the limits published on the effective FEMA map. However, given the source of the base topo mapping for this analysis, these limits should not be considered a revision to the FEMA floodplain map. It does however provide a basis for comparing local pre- and post-project flooding conditions and for preliminary definition of mitigation measures that are appropriate for the project. The approximate depths of flooding found on the site average between 0.5 feet to 1.0 feet with certain lower-lying areas experiencing deeper water depths on the order of 2.5 feet.

#### 3.3.3.3 Proposed Conditions Drainage/Flood Routing

The pre-project SWMM routing model was then modified to create a post-project model reflecting a proposed conceptual mass grading scheme for the site. That proposed drainage concept is shown on Figure D1 along with the proposed cross-section locations. The basis for this conceptual grading matches the existing grade at the perimeter of the project site, depresses the 150-foot agricultural buffer at the perimeter of the site and elevates the proposed development area 1 foot above the elevations of the 200-year floodplain. Based on the pre-project SWMM model's existing floodplain depth computations, this grading concept would result in an estimated displacement of approximately 79 ac-ft of floodplain storage within the site during the 200-year/10-day storm. In order to mitigate for this displaced volume, the proposed 150-foot agricultural buffer at the site's perimeter will be depressed to generate replacement storage. It is expected that the buffer zone depression will range from about 6 feet below existing grade at the southwest corner to about 9 feet near the existing water tank detention basin.

The post-project site geometry, including the depressed buffers, was then modeled with the SWMM program in order to evaluate the effectiveness of the replacement storage in preventing an increase in the floodplain WSE's across the development area or adjacent properties. Specifically, the proposed project will seek to not exceed the computed pre-project peak 200 year-10 day WSE at the boundary of the project with Sutter Davis Hospital site, and at the entrance to the Highway 113 culvert. The project will also seek to not exceed the computed existing 200 year-10 day peak discharge at the Highway 113 culvert entrance.

## 3.4 CONCLUSION

Based on the preliminary hydrology and hydraulic modeling effort described herein, construction of the proposed project without appropriate drainage/flood mitigations may increase peak discharges in the Covell Drain, and would most likely increase the maximum water surface elevations in the floodplain on and near the site.

However, through a combination of proposed detention storage near the existing water tank site and around the perimeter of the project site, mitigation can be provided for these impacts.

It should be reiterated that the modeling effort conducted to-date constitutes a preliminary, planning-level analysis suitable for identifying the general nature and extent of such mitigation measures. Detailed evaluation of these measures will be addressed at the Tentative Map stage, via a Master Drainage Plan analysis that will utilize updated single-source topographic mapping as the basis of analysis.

## Attachments:

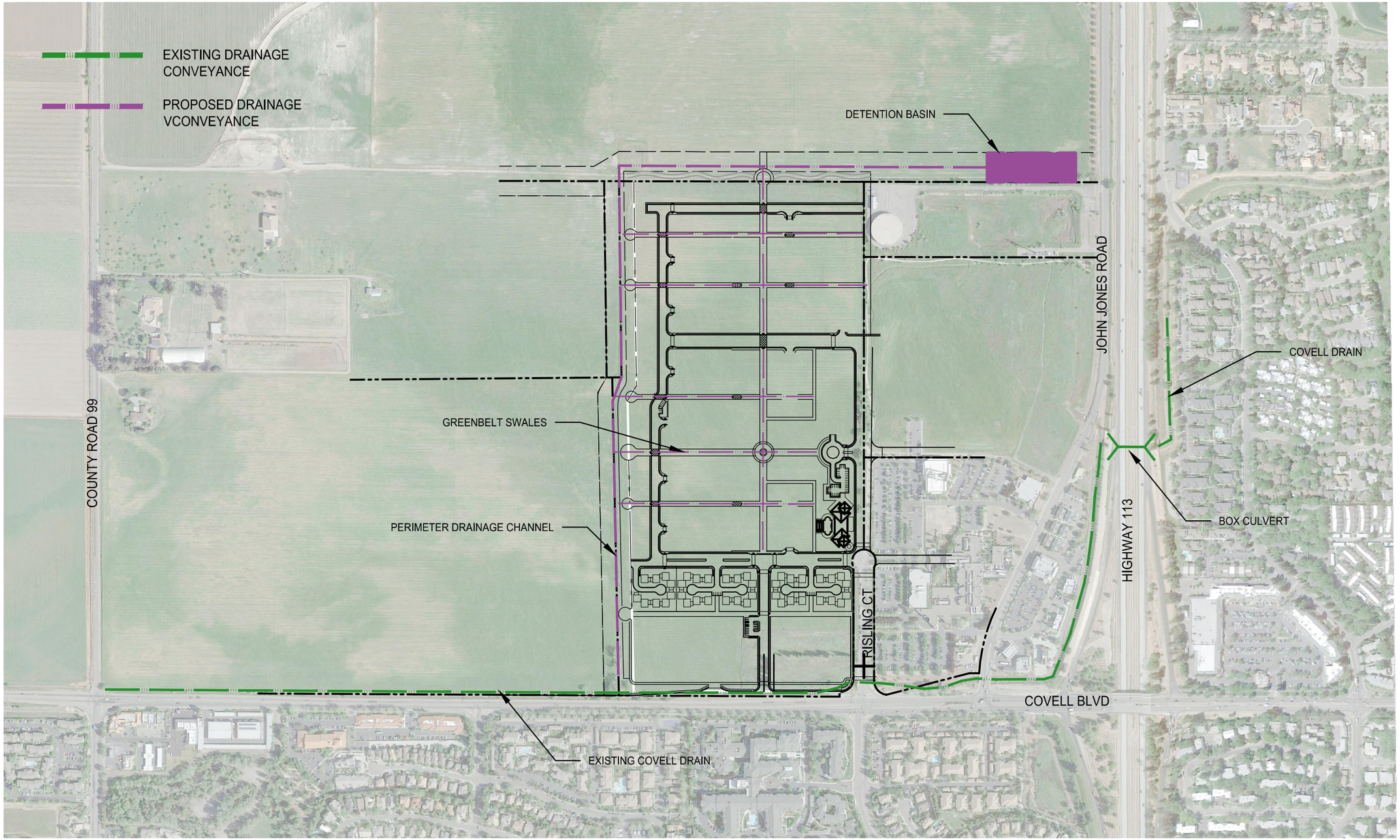
- Figure D1 – Proposed Drainage

# LEGEND:

PROPOSED
DETENTION BASIN

EXISTING DRAINAGE
CONVEYANCE

PROPOSED DRAINAGE
VCONVEYANCE





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Project Planning ■ Civil Engineering ■ Landscape Architecture

■ Davis Office
2940 Spafford Street, Suite 200
Davis, CA 95618
(530) 758-2026

■ Sacramento Office
2120 20th Street, Suite Three
Sacramento, CA 95818
(916) 455-2026

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**WEST DAVIS ACTIVE ADULT COMMUNITY**
**DRAINAGE INFRASTRUCTURE EXHIBIT**

DAVIS CALIFORNIA

| | |
|---|---|
| DESIGNED | BF |
| DRAWN | BF |
| CHECKED | BF |
| SCALE | 1" = 200' |
| FIGURE | D1 |
| DATE: | 10/25/16 |
| JOB No: | 1594.01 |

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