# APPENDIX F

*Drainage Study*

# SUD-B NORTHEAST QUADRANT SPECIFIC PLAN

MASTER DRAINAGE STUDY

DRAFT

## PLACER COUNTY, CALIFORNIA

November 9, 2016

Prepared By:


**FRAYJI DESIGN GROUP, INC.**

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**JOB # 17300**

This document prepared under the supervision of:


Signature dated:

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The status of this report is PRELIMINARY unless the appropriate signature is provided to the left. Signature will not be provided until review is complete.

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## I. INTRODUCTION

The purpose of this report is to support the Environmental Impact Report (EIR) and determine the magnitude of the runoff expected from the post project condition of the Special Use District B Northeast Quadrant (SUD-B NEQ) project. This information will be used to size proposed improvements and determine the size of mitigation measures. These calculations will be performed to satisfy the requirement of the City of Lincoln improvement standards for the 10-year and 100-year flood events and the requirements of the Small Municipal Separate Storm Systems (MS4s) general permit as outlined by the County of Placer.

The SUD-B NEQ Specific Plan Area (SPA) is approximately 200 acres with current use primarily agricultural and is located north of the Highway 65 Bypass, along and east of Nelson Lane and south of Nicolaus Road (see Vicinity Map, Exhibit 1). This SPA is bordered by existing rural residential land uses to the west and Highway 65 Bypass to the south with existing agricultural uses planned for mixed development south of Highway 65. To the east are a current residential neighborhood and a planned residential project, both within the City of Lincoln limits.

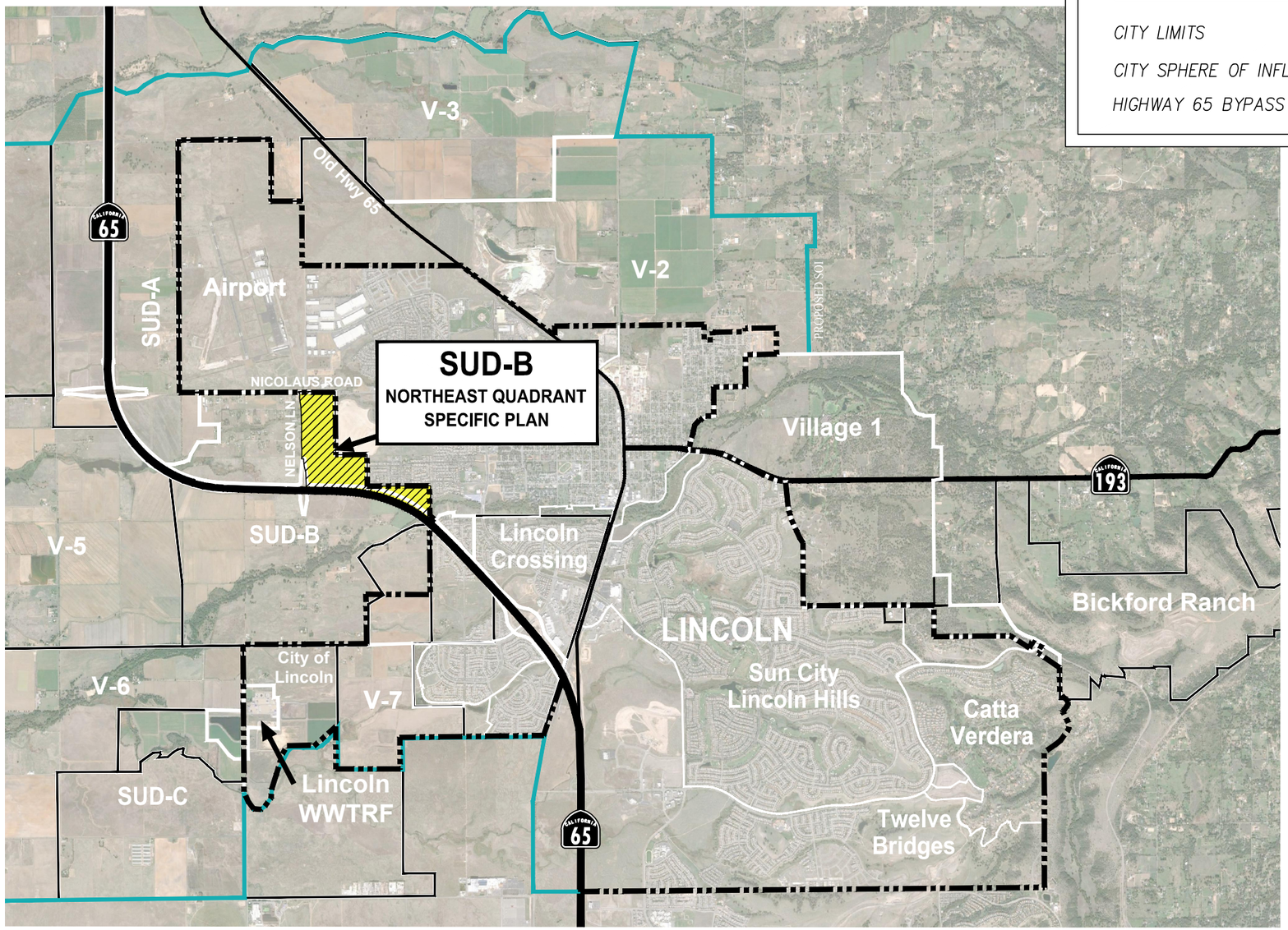
As shown on Exhibit 2, this Specific Plan boundary contains four parcels consisting of two property owners and the Nelson Lane right-of-way which fronts this Specific Plan on Nelson Lane to the west and Nicolaus Road to the north. This SPA lies within an unincorporated portion of Placer County near the City of Lincoln and within the City of Lincoln's Sphere of Influence with the exception of a one acre parcel Assessor's Parcel Number: 009-031-028, which is within the City limits.

The SUD-B NEQ Specific Plan is designed to respond to the anticipated long-term demand for housing and services within the City of Lincoln's Sphere of Influence over the next 10-15 years and is in conformance with the City's 2050 General Plan. This Specific Plan ensures that adequate backbone infrastructure, public facilities and essential services needed to support the proposed development will be available and in place to serve project residents.

This Specific Plan is proposed as a mixture of residential and commercial development. SUD-B NEQ Specific Plan will allow for commercial, light industrial and residential neighborhoods that are anticipated to be single family homes and will include parks, open space and public streets. Residential densities will be compliant with airport compatibility zones of the Placer County Airport Land Use Compatibility Plan. This project will preserve open space for Markham Ravine and Auburn Ravine that flow through this SPA. This Specific Plan's land uses and street system are similar to the City of Lincoln's General Plan and the Specific Plan Land Use & Street Layout Plan is provided as Exhibit 3.

As shown on Exhibit 3, the SUD-B NEQ Specific Plan proposes a development of approximately 425 residential dwelling units across 85.0 acres with 72.5 acres of commercial space within the 198.7 acre Specific Plan Area. The Specific Plan also proposes 3.2 acres of parks, 21.8 acres of open space, and 4.0 acres of onsite and 12.2 acres of offsite major roads.

All of this SPA drains into the Markham Ravine and Auburn Ravine watersheds. Pursuant to this SPA development, runoff will drain through existing and new underground pipes through water quality features and detention basins and ultimately into Markham Ravine and Auburn Ravine.




## LEGEND

- CITY LIMITS
- CITY SPHERE OF INFLUENCE (SOI)
- HIGHWAY 65 BYPASS

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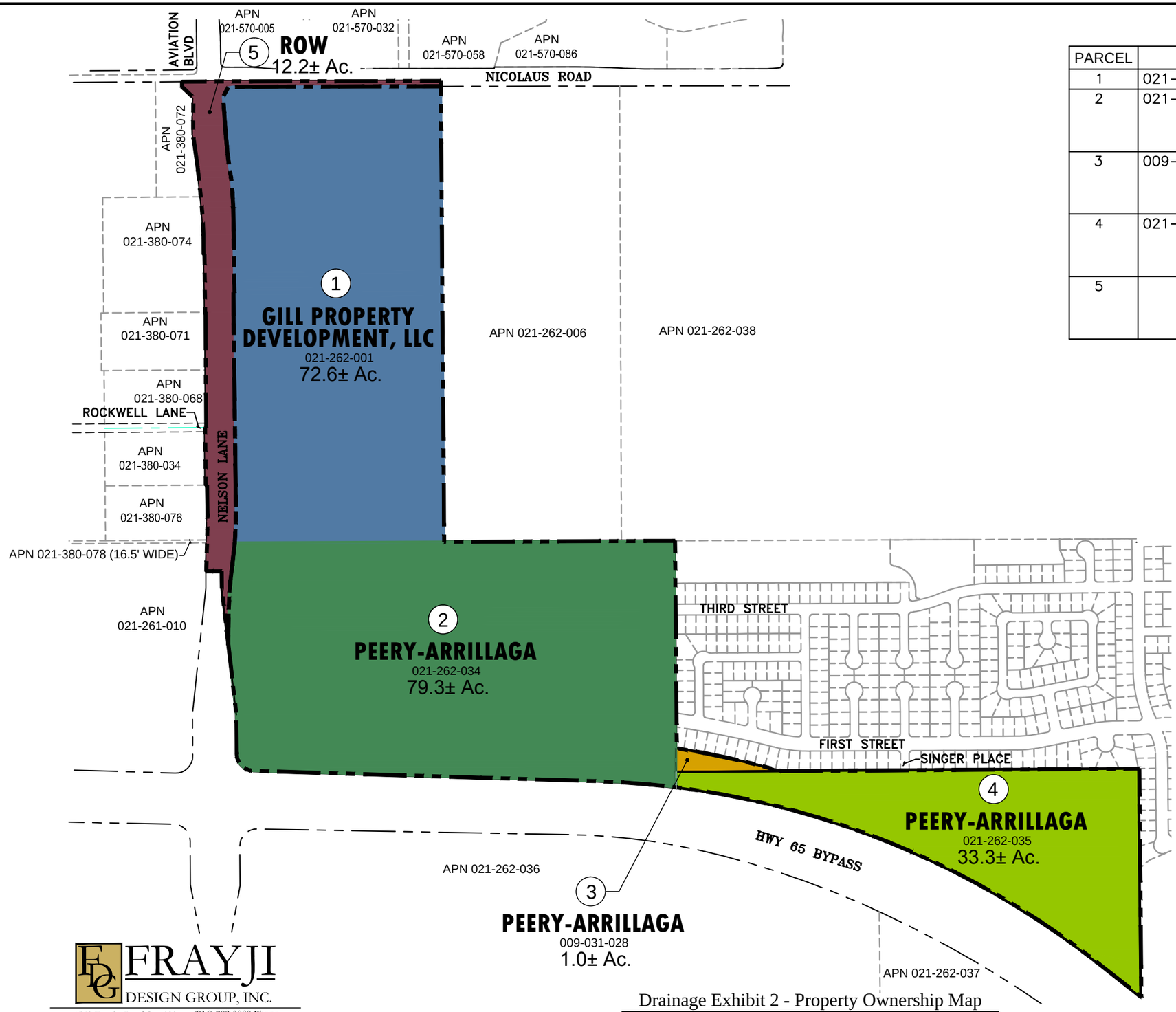
Drainage Exhibit 1 - Vicinity Map

# SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016




| PARCEL | APN | OWNER | ACRES |
|---|---|---|---|
| 1 | 021–262–001 | Gill Property Development, LLC | 72.6± |
| 2 | 021–262–034 | John Arrillaga Survivor's Trust & Richard T. Peery Separate Property Trust (Peery–Arrillaga) | 79.3± |
| 3 | 009–031–028 | John Arrillaga Survivor's Trust & Richard T. Peery Separate Property Trust (Peery–Arrillaga) | 1.0± |
| 4 | 021–262–035 | John Arrillaga Survivor's Trust & Richard T. Peery Separate Property Trust (Peery–Arrillaga) | 33.3± |
| 5 | | Nelson Lane Right Of Way | 12.2± |
| | | TOTAL: | 198.4± |

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Drainage Exhibit 2 - Property Ownership Map

# SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

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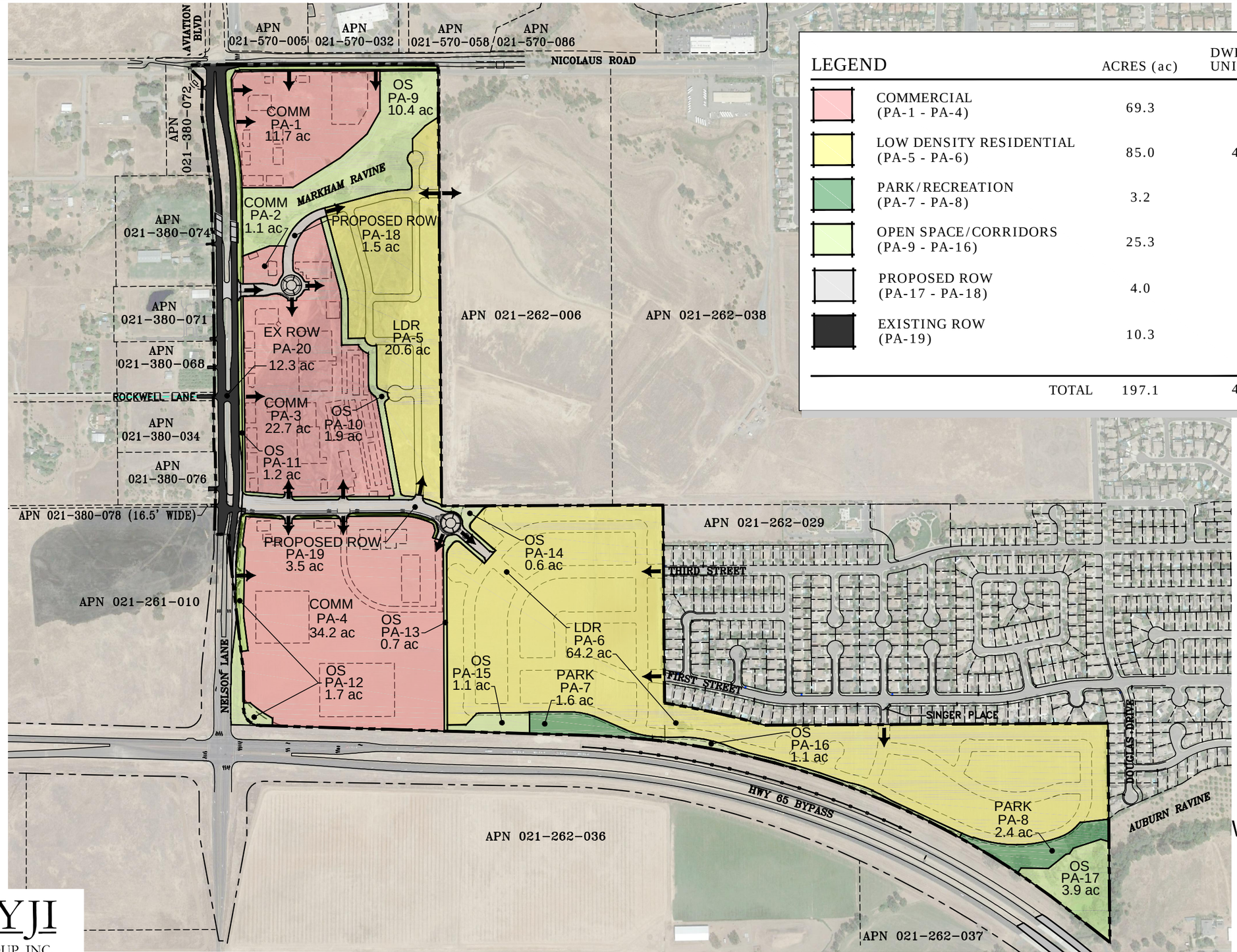


## LEGEND

| | ACRES (ac) | DWELLING UNITS (du) |
|---|---|---|
| COMMERCIAL (PA-1 - PA-4) | 69.3 | - |
| LOW DENSITY RESIDENTIAL (PA-5 - PA-6) | 85.0 | 425 |
| PARK/RECREATION (PA-7 - PA-8) | 3.2 | - |
| OPEN SPACE/CORRIDORS (PA-9 - PA-16) | 25.3 | - |
| PROPOSED ROW (PA-17 - PA-18) | 4.0 | - |
| EXISTING ROW (PA-19) | 10.3 | - |
| TOTAL | 197.1 | 425 |

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Land Use Plan

# SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

## I.A Regional Watershed Description

The Specific Plan Area flows into two different watersheds with the northwest portions of the project flowing into the Markham Ravine watershed and the southeast portions of the project flowing into the Auburn Ravine watershed. Both Auburn and Markham Ravine watersheds are part of the larger Natomas Cross Canal watershed of northwestern Placer County and southeastern Sutter County. The Auburn and Markham Ravine watersheds drain westerly into the North Canal, to the Natomas Cross Canal, and then to the Sacramento River.

## I.B Auburn Ravine

Auburn Ravine, a perennial stream, crosses the southeastern end of the project and then under State Route 65 (SR-65). Auburn Ravine within this SPA flows year-round due to supplemental waters added by Nevada Irrigation District (NID), which are delivered to downstream agricultural users. Adjacent to Auburn Ravine is a basin that was previously used as storage for irrigation waters for use on site and empties into Auburn Ravine through an existing 12-inch drainage pipe. The 12-inch drainage pipe was placed by Caltrans when the SR-65 bypass was constructed to drain the storage pond and it has a one-way flapper valve on the downstream size to prevent high flows from backing up into the basin.

The pre-project floodplain for Auburn Ravine is shown in Exhibit 4.

## I.C Markham Ravine

Markham Ravine, an intermittent stream, crosses under Nicolaus Road, through the northern portion of the project and then west under Nelson Lane. A portion of the existing drainage flows west from this SPA and crosses under Nelson Lane through culvert crossings, through several poorly defined channels to meet at SR-65 approximately half a mile west of the project. This project will use the existing culverts in Nelson to maintain flows for existing vegetation with larger flows diverted directly to Markham Ravine via a proposed storm drain along Nelson Lane. SR-65 travels along the southern boundary of the project, a part of the southern commercial and residential parcels flows into existing and proposed pipes crossing into the Caltrans Right-of-Way, then along the existing drainage ditch west that runs parallel to SR-65 and into Markham Ravine.

This SPA accepts only a small amount of offsite flow from the existing subdivision to the west and north of the proposed residential sites. The proposed Lewis home residential site north and west of the project also flows north into Markham Ravine and through the north side of this SPA.

The pre-project floodplain for Markham Ravine are shown in Exhibit 4.

AVIATION BLVD

100 YEAR HGL 110.6±

NICOLAUS ROAD

100 YEAR FLOODPLAIN

APN 021-380-072

100 YEAR HGL 110.3±

100 YEAR HGL 110.3±

RAVINE

MARKHAM

100 YEAR HGL 108.3±

APN 021-380-074

APN 021-380-071

APN 021-380-068

ROCKWELL LANE

APN 021-380-034

APN 021-380-076

NELSON LANE

APN 021-380-078 (16.5' WIDE)

APN 021-262-006

APN 021-262-038

APN 021-261-010

THIRD STREET

FIRST STREET

SINGER PLACE

PARK

65 BYPASS (R8)

APN 021-262-036

APN 021-262-037

100 YEAR HGL 127.9±

RAVINE

AUBURN

DOUGLAS DRIVE

100 YEAR FLOODPLAIN

100 YEAR HGL 129.9±

## ABBREVIATIONS

| | |
|---|---|
| COM | COMMERCIAL |
| DET | DETENTION |
| HP | HIGH POINT |
| LSC | LANDSCAPE CORRIDOR |
| NEQ | NORTH EAST QUADRANT |
| SD | STORM DRAIN |
| WQ | WATER QUALITY |

## LEGEND

### FEATURE

SUD-B NEQ SPECIFIC PLAN BOUNDARY

EXISTING SWALE

### FLOODPLAIN

ZONE A/AE

100-YEAR FLOODWAY

100-YEAR FLOODPLAIN

ZONE X

500-YEAR FLOODPLAIN

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Drainage Exhibit 4 - Pre Project 100 Year Floodplain

SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016



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## I.D FEMA Flood Mapping

The preliminary Flood Insurance Study (FIS) for the project area is presently being updated by BakerAECOM to include new elevations for "Pleasant Grove Creek and its Tributaries in Placer County" project. This report includes amendments to the hydrology and hydraulic models for Auburn Ravine. The new model elevations are available and will be approved in 2017. They have been incorporated into this report.

In Zone A areas, the project is required to develop models and mapping based on "Best Available Information" to establish "Base Flood Elevations" to be used in the design of the projects. For this study's modeling of Auburn Ravine and Markham Ravine, existing models were used created by Civil Solutions in July 2011 for Auburn Ravine and May 2014 for Markham Ravine, respectively.

## I.E Stormwater Quality

The SUD-B Northeast Quadrant project has the potential to impact water quality in Auburn Ravine and Markham Ravine. In order to satisfy the requirements of the Municipal Small Storm Sewer System (MS4) Phase II requirements it will be necessary to utilize Best Management Practices (BMPs) and Low Impact Development (LID) measures. These requirements are outlined in the West Placer Storm Water Quality Design Manual. A draft Storm Water Quality Plan is provided in Appendix A and will need to be completed in greater detail by individual projects as improvement plans are finalized.

## I.F Project Analysis

The SUD-B Northeast Quadrant project watershed modeling consists of two sections, one model for portions of the project that drains to Auburn Ravine and one model for areas that drain to Markham Ravine. The hydrology models (HEC-1) are spatially representative of the watershed locations (via ELTROID.DAT file). ELTROID.DAT provides special data for Placer County and is used by the PDP2 program for storm centering calculations. See section II.A.4 Storm Centering for a detailed description of storm centering.

The model for Auburn Ravine from the Lincoln Village 1 Specific Plan (V1SP), prepared by Civil Solutions in July 2011, was the basis for Auburn Ravine calculations and was originally developed for the South Lincoln Master Plan in 1998, and enhanced by the Lincoln Hills, Twelve Bridges, and Lincoln Crossing developments. The model is based on the methodologies outlined in the Placer county Flood control and Water Conservations District's (PCFCWCD) "Stormwater Management Manual" (SWMM-1994 with 1997 Addendum). The South Lincoln Master Plan identified 10 storm centering/storm angle conditions for all locations within Auburn Ravine in the City of Lincoln (DS108, DS168, DS190, DS252, DS404, DS434, DS444, AU2, AU4 and AU10). Each storm centering/storm angle was modeled for 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 200-year and 500-year events. The results of each storm centering for each event are compared and the largest value obtained for each location in the model. This largest value was then used in the hydraulic

analysis. The PDP2.EXE program provided precipitation generation based on the storm centering conditions.

The model for Markham Ravine is from the project drainage study for the Nelson Lane Roadway Improvements and Bridge Replacement Project. Storm centering was not used for the original completed analysis. The SWMM however requires that watersheds containing more than one square mile use storm centering. Storm centering was conducted and the calculations indicated that the peak flows in Markham Ravine occurred with 4 storm centering/storm angle conditions (FSMK2, MA2A11, MA2B2 and MA4C). Each storm centering/storm angle was modeled for; 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 200-year and 500-year events. The results from the storm centering for each event are compared and the largest value obtained for the locations chosen. This largest value was then used in the hydraulic analysis. The PDP2.EXE program was used for precipitation generation based on the storm centering conditions.

Exhibit 4 delineates the pre-project floodplain limits and elevations for the 100-year flood event. Exhibit 5 delineates the proposed post-project mitigated floodplain limits and elevations for the 100-year flood event.

This project will include Low Impact Development (LID) and treatment "Best Management Practices" (BMPs) to mitigate and treat the discharge of the development into the existing creeks and streams.

AVIATION BLVD

100 YEAR HGL 110.6±

NICOLAUS ROAD

100 YEAR FLOODPLAIN

APN 021-380-072

100 YEAR HGL 108.3±

100 YEAR HGL 110.3±

RAVINE

MARKHAM

100 YEAR HGL 108.3±

APN 021-380-074

APN 021-380-071

APN 021-380-068

ROCKWELL LANE

APN 021-380-034

NELSON LANE

APN 021-380-076

APN 021-380-078 (16.5' WIDE)

APN 021-262-006

APN 021-262-038

APN 021-261-010

THIRD STREET

FIRST STREET

SINGER PLACE

DOUGLAS DRIVE

65 BYPASS (R8)

APN 021-262-036

100 YEAR HGL 127.9±

RAVINE

AUBURN

APN 021-262-037

100 YEAR HGL 129.9±

100 YEAR FLOODPLAIN

## ABBREVIATIONS

| | |
|---|---|
| COM | COMMERCIAL |
| DET | DETENTION |
| HP | HIGH POINT |
| LSC | LANDSCAPE CORRIDOR |
| NEQ | NORTH EAST QUADRANT |
| SD | STORM DRAIN |
| WQ | WATER QUALITY |

## LEGEND

### FEATURE

SUD-B NEQ SPECIFIC PLAN BOUNDARY

EXISTING SWALE

### FLOODPLAIN

ZONE A/AE

100-YEAR FLOODWAY

100-YEAR FLOODPLAIN

ZONE X

500-YEAR FLOODPLAIN

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Drainage Exhibit 5 - Post Project 100 Year Floodplain

# SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016



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## II. Hydrology:

The Army corps HEC-1 software was utilized to develop the models for the SUD-B Northeast Quadrant Specific Plan Project. The precipitation used in the calculations were derived using the PDP2 software provided by the Placer County Flood Control and Water Conservation District with storm centering applied to the Auburn Ravine watershed.

### II.A Standards:

Master watershed modeling for Markham Ravine has been adapted from the version contained in the project drainage study for Nelson Lane Roadway Improvements and Bridge Replacement Project. That model was originally created in 2001 by Civil Solutions, Inc. for regional calculations and updated in 2003 for Foskett Ranch, further updated in 2004 to add Modified-Puls Routing and routing through the airport, and in 2012 for the Nelson Lane Roadway Improvements and Bridge Replacement. The flood routing methods simulate the movement of water through a channel and is used to predict the magnitudes, volumes, and temporal patters of the flow as it translates down a channel. Modified-Puls Routing treats storage as a nonlinear function of flow and calculates the outflow from a given inflow and the storage versus outflow characteristics of the location.

Master watershed modeling for Auburn Ravine has been adapted from the version contained in the V1SP Master Drainage Study. It was adapted from the original South Lincoln Master Plan Models from 1998, as updated by the Lincoln Hills, Lincoln crossing, Twelve Bridges and V1SP.

These models assembled the various data into a comprehensive Auburn Ravine and Markham Ravine hydrology model (Kinematic Wave) per the Placer County Flood Control and Water conservation District "Stormwater Management Manual (SWMM)" dated February 1994 and the SWMM Addendum 1, dated October 1997.

*II.A.1 Soils:*

Soils are classified into four hydrologic Categories:

Group A: Consist of soils that have a high infiltration rate when thoroughly wet. These soils have a high rate of water transmission and low runoff potential. They are deep, well drained or excessively drained, and consist chiefly of sand, gravel, or both.

Group B: Consist of soils having a moderate infiltration rate when thoroughly wet. These soils have a moderate runoff potential. They are moderately deep, well drained, and are medium in texture to moderately course in texture.

Group C: Consist of soils having a slow infiltration rate when thoroughly wet. These soils have a slow rate of water transmission and high runoff potential. They have soil layers that impede downward movement of water and have a slow infiltration rate.

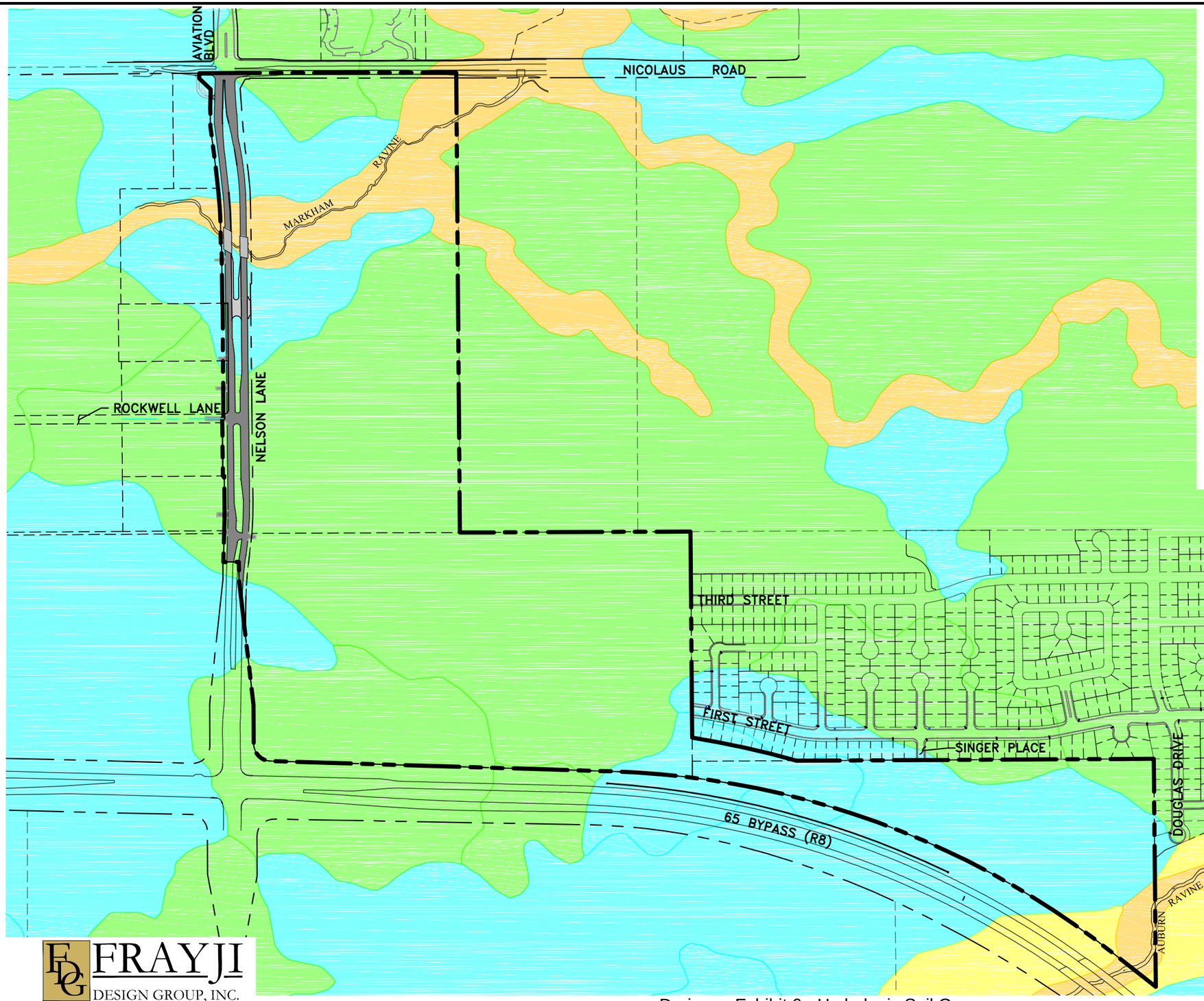
Group D: Consist of soils having a very slow infiltration rate when thoroughly wet. The rate of water transmission is very slow, and runoff potential is very high. This group includes:

a. clay soils that have high shrink-swell potential
b. soils that have a permanent high water table
c. soils that have a clay pan or clay layer at or near the surface and
d. soils that are shallow over nearly impervious material

Exhibit 6 shows the hydrologic soils group delineations as provided by the National Resources Conservation Service (NRCS – Formerly Soils Conservation Service). Section 10 prescribes infiltration rates for various land uses these range from 0.12 inches per hour in landscaped areas to 0.04 inches per hour in the roadside ditch areas. The majority of the Specific Plan Area are Soils Group "D" and an infiltration rate of 0.12 inches per hour was used in disturbed areas. This area of Lincoln is predominantly Soils Group "D". Three areas consist of Soils Group "C" with two in the north of the project on either side of Markham Ravine and third area north of Auburn Ravine. Some Soils Group "B" occur around Markham Ravine and into the northern residential area. The open space area used as irrigation storage in the past is also Soils Group "B" with some Soils Group "A" as shown on Exhibit 6.

Two geotechnical investigations were completed by MatriScope Engineering Laboratories, Inc. in the project area. Both studies show that the soils in the area are predominantly clay with sand overlaying clay in one area close to Markham Ravine. When fully wet it is expected that all areas will have little infiltration due to the underlying clay of the area and these results confirm that the soils in the plan area are type "D".

While the soil maps from the NRCS show an area of Soils Group "A" and "B" near Auburn Ravine, test borings taken for the bridge constructed with the new SR-65 over Auburn Ravine show clayey sand (SC) and Clay (CL) as the predominant soil type. These soils would be considered type Soils Group "C" and "D" and this study will treat them as Soils Group "C". If some of the soils are Soils Group "A" and "B", infiltration will occur in the basin during low flow. These boring logs are included in Appendix B.




## LEGEND

### FEATURE

- SUD-B NEQ SPECIFIC PLAN BOUNDARY
- EXISTING RIGHT OF WAY
- EXISTING PROPERTY LINE

### HYDROLOGIC SOIL GROUP

- TYPE A
- TYPE B
- TYPE C
- TYPE D

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Drainage Exhibit 6 - Hydrologic Soil Group

SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

*II.A.2 Land Use:*

A proposed land use map for SUD-B NEQ project areas is shown on Exhibit 3. For the areas which are proposed for development with this project, separate watersheds were created in the post-project analysis. Hydrologic factors for the Land Use were developed as shown in Table II.B.1A and II.C.1A

*II.A.3 Watershed Delineation:*

The Specific Plan Area is contained within the Markham Ravine Auburn Ravine and watersheds (see Exhibit 7 and 8) for pre-development watershed delineation. The "natural" watershed boundaries have been modified by existing roadways, agricultural and public use operations. The pre-project drainage sheds (Exhibit 9) identifies how the existing sheds relate with the site boundary and existing improvements.

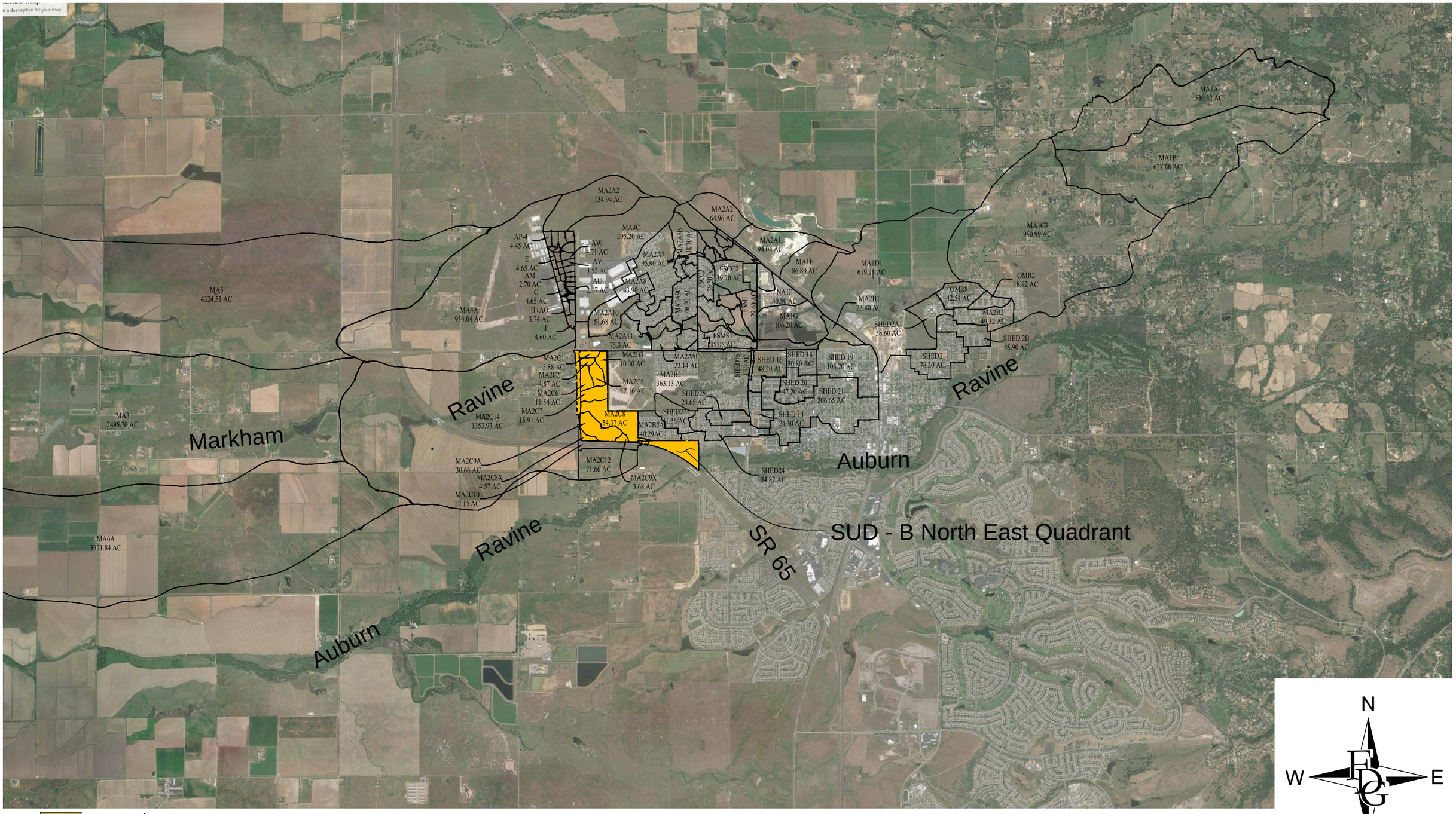
The SUD-B NEQ Master Drainage (see Exhibit 10) shows the preliminary storm drain system layout used for the post development watershed delineation. For the Post-Project analysis, watershed boundaries were adjusted to conform to this Specific Plan's proposed land use map. Sub-watersheds were further subdivided to account for the proposed site alterations including: changes in impermeability due to roofs and paving, changes in boundary locations due to the proposed grading, detention and piping. Existing flows need to be maintained, to protect the flora and fauna in the area, and the drainage calculations have accounted for maintenance flows. Flow paths through and off the site for the post-project are identified on Exhibit 11. The post-project local watershed delineations including this SPA and the area immediately adjacent to it are shown on the Exhibit 12 and 13.

*II.A.4 Storm Centering:*

The watershed models used for the SUD-B Northeast Quadrant include more than 1 square mile of area, and therefore, the effects of spatial distribution of a storm may have an impact on the computed peak flow rates. Storm centering is using those spatial distributions to calculate their impact on peak flow rates. The Placer County Flood Control and Water Conservation District provides a software tool called "PDP2", for use in generating HEC-1 precipitation for storm centering per the SWMM specifications.

For Auburn Ravine, storm centering will be computed for DS108, DS168, DS190, DS252, DS404, DS434, DS444, AU2, AU4 and AU10 locations. The results tables and values used in the analysis represent the largest value obtained from any of these centering locations.

For Markham Ravine, storm centering will be computed for MA2B2, MA2A11, MA4C AND FSMK2 locations. These results tables and values used in the analysis represent the largest value obtained from any of these centering locations. These centering locations were used due to their proximity to the project and the likelihood that they would affect the calculations. More locations were calculated, they had less affect when compared to the locations listed above.

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Drainage Exhibit 7 - Markham Ravine Existing Watershed Map

SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

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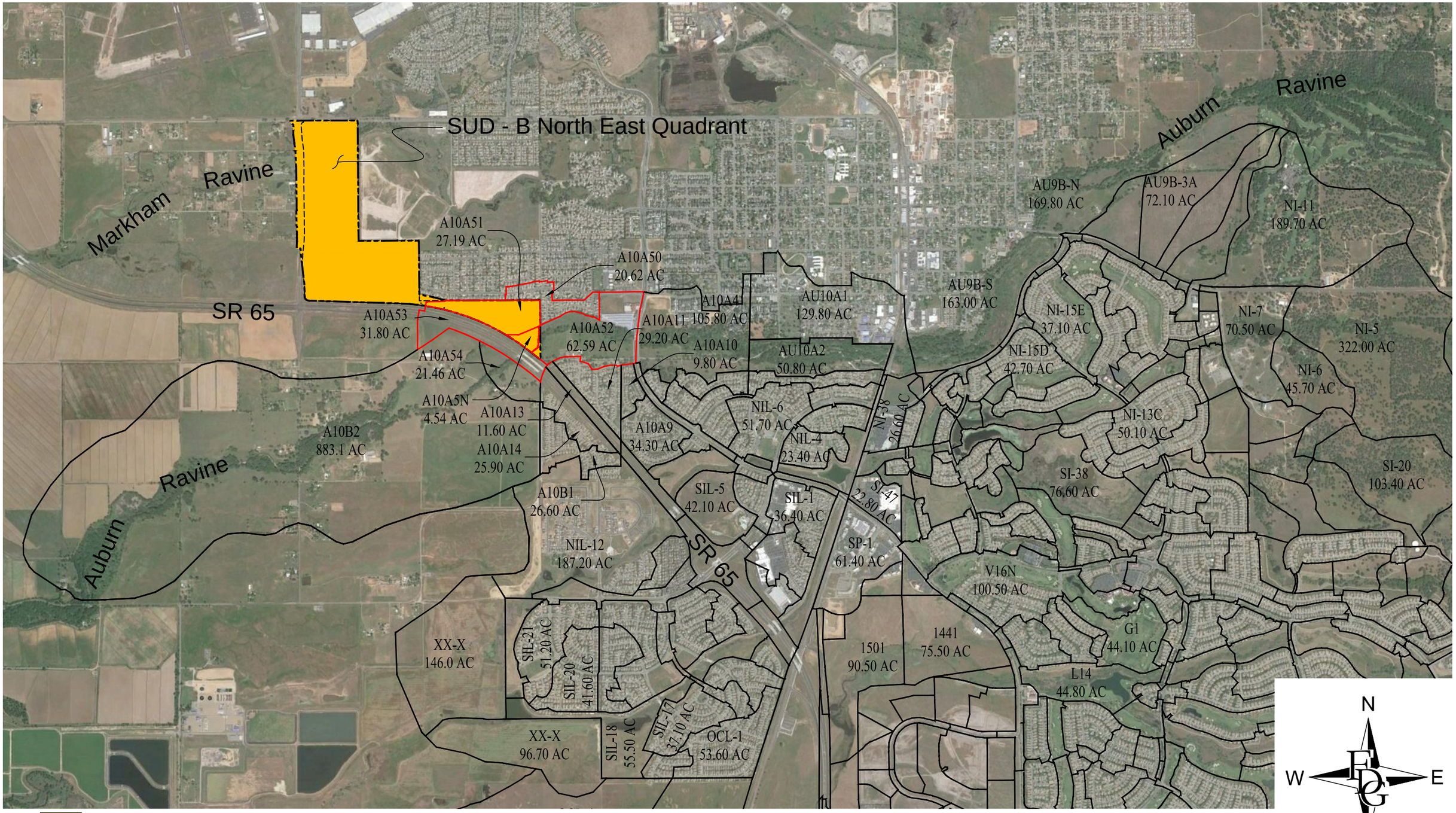


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Drainage Exhibit 8 - Auburn Ravine Existing Watershed Map

SUD-B Northeast Quandrant Specific Plan

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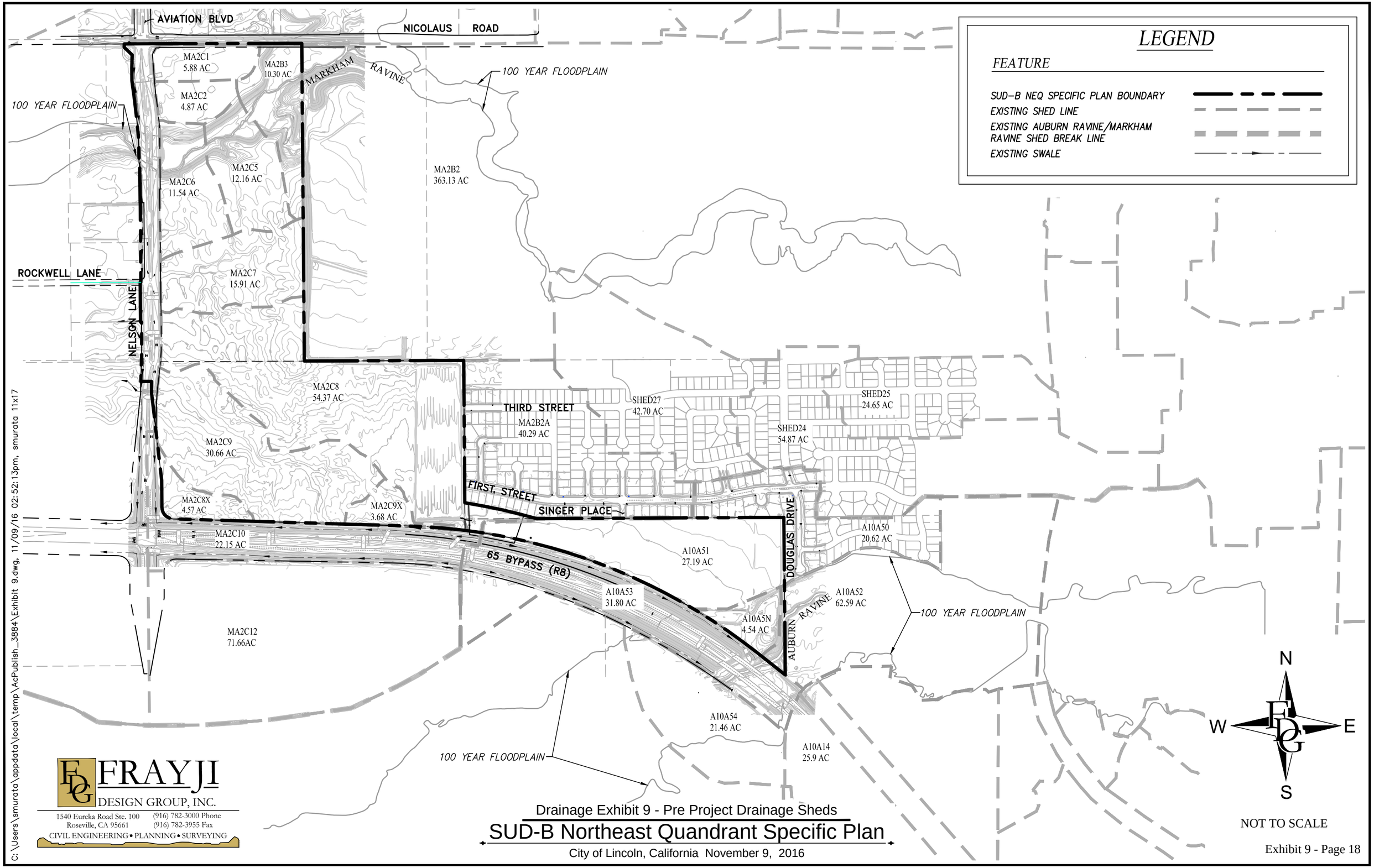


## LEGEND

FEATURE

- SUD–B NEQ SPECIFIC PLAN BOUNDARY
- EXISTING SHED LINE
- EXISTING AUBURN RAVINE/MARKHAM RAVINE SHED BREAK LINE
- EXISTING SWALE

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Drainage Exhibit 9 - Pre Project Drainage Sheds

# SUD-B Northeast Quandrant Specific Plan

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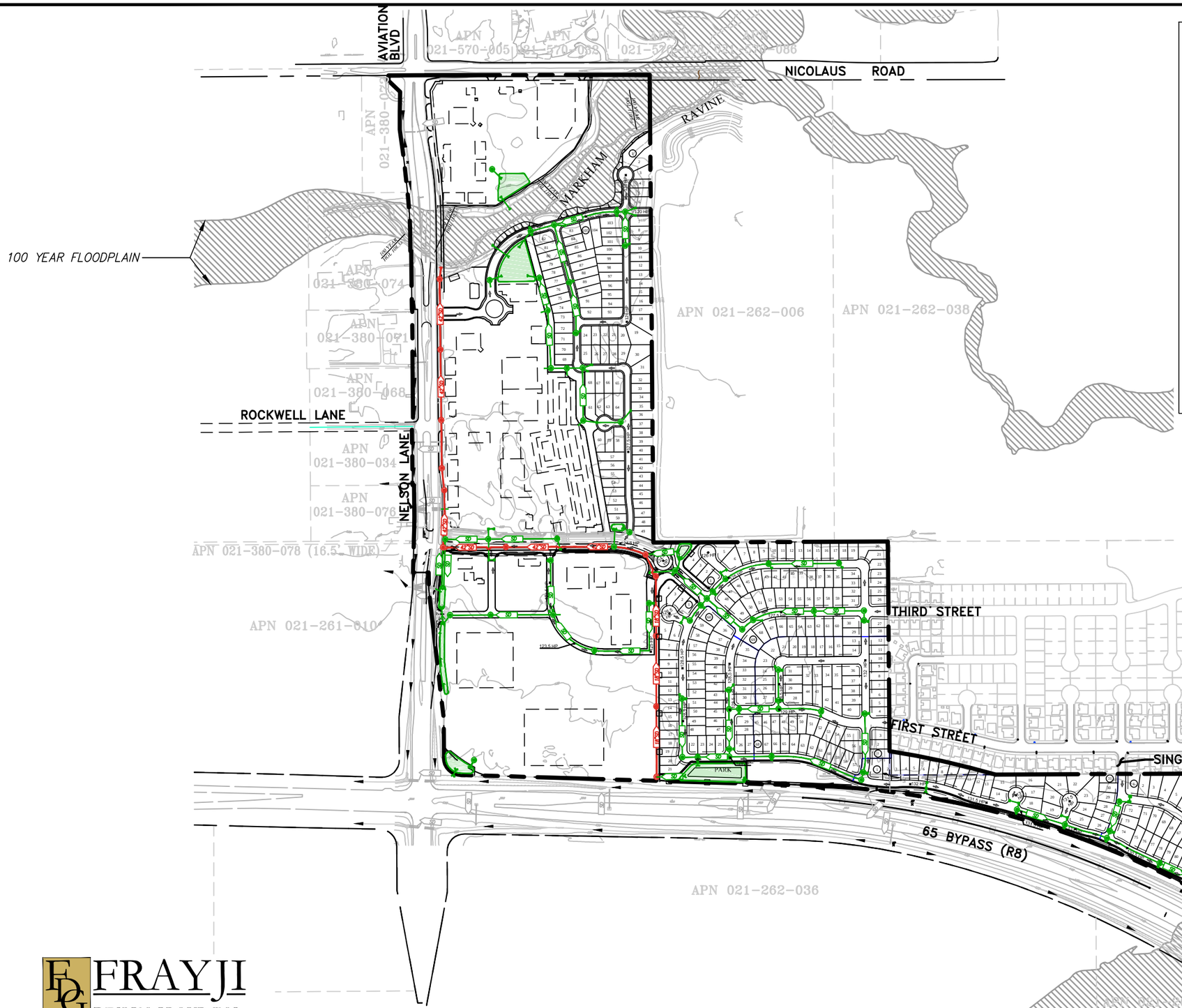


## LEGEND

| FEATURE | |
|---|---|
| SUD-B NEQ SPECIFIC PLAN BOUNDARY | |
| PROPOSED STORM DRAIN PIPE | |
| PROPOSED TRUNK STORM DRAIN PIPE | |
| EXISTING STORM DRAIN PIPE | |
| PROPOSED SHED LINE | |
| EXISTING SHED LINE | |
| EXISTING AUBURN RAVINE/MARKHAM RAVINE SHED BREAK LINE | |
| EXISTING SWALE | |
| PROPOSED DETENTION/WATER QUALITY BASIN | |
| PROPOSED STORM DRAIN MANHOLE | |
| PROPOSED SPOT-GRADE | ×120 HP |
| PROPOSED STORM DRAIN INLET | |
| RUNOFF DIRECTION | |

## ABBREVIATIONS

| | |
|---|---|
| COM | COMMERCIAL |
| HP | HIGH POINT |
| NEQ | NORTH EAST QUADRANT |
| SD | STORM DRAIN |

100 YEAR FLOODPLAIN

N
W E
S

NOT TO SCALE

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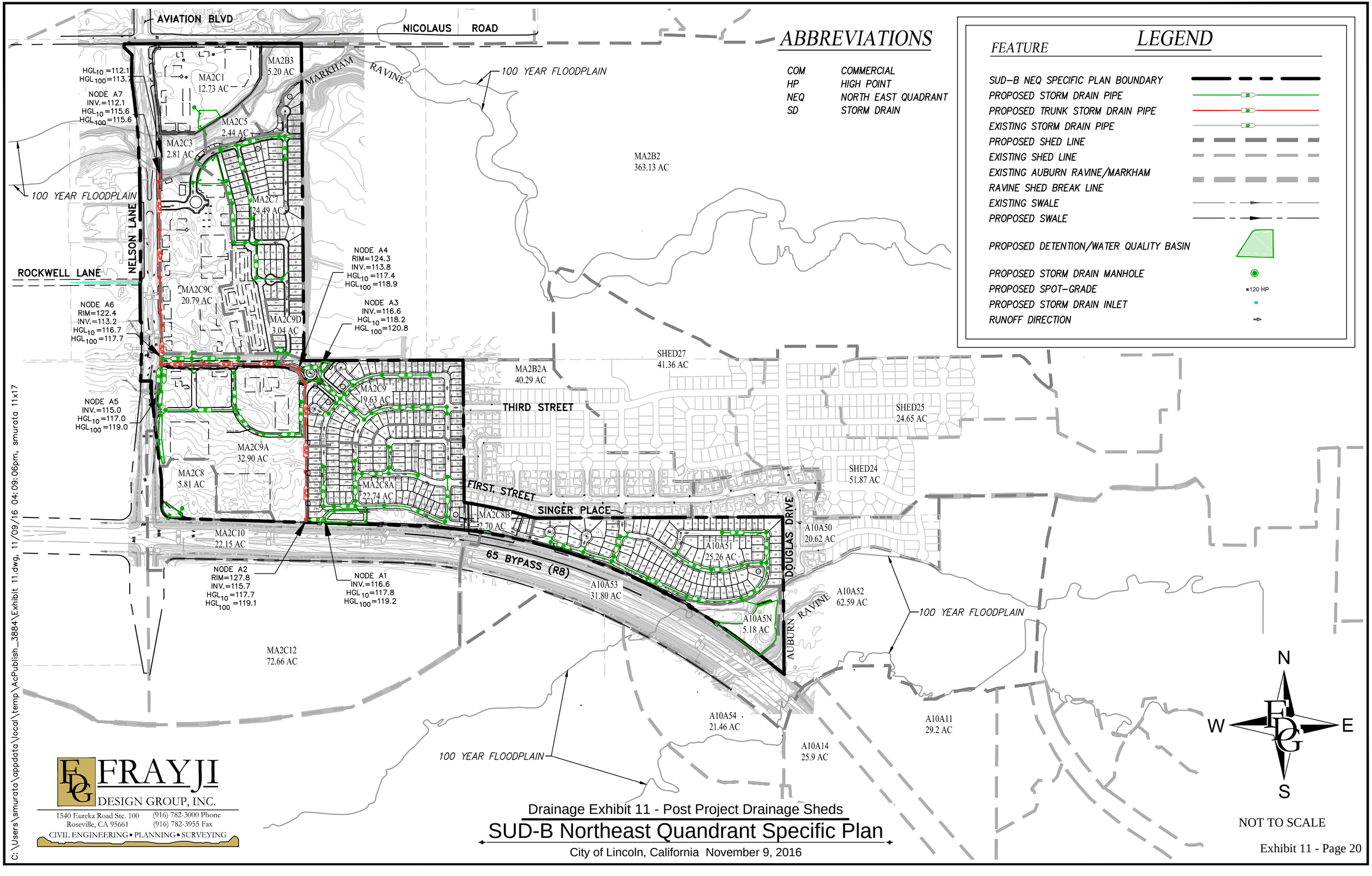
Drainage Exhibit 10 - Master Drainage

# SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

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Drainage Exhibit 11 - Post Project Drainage Sheds

# SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

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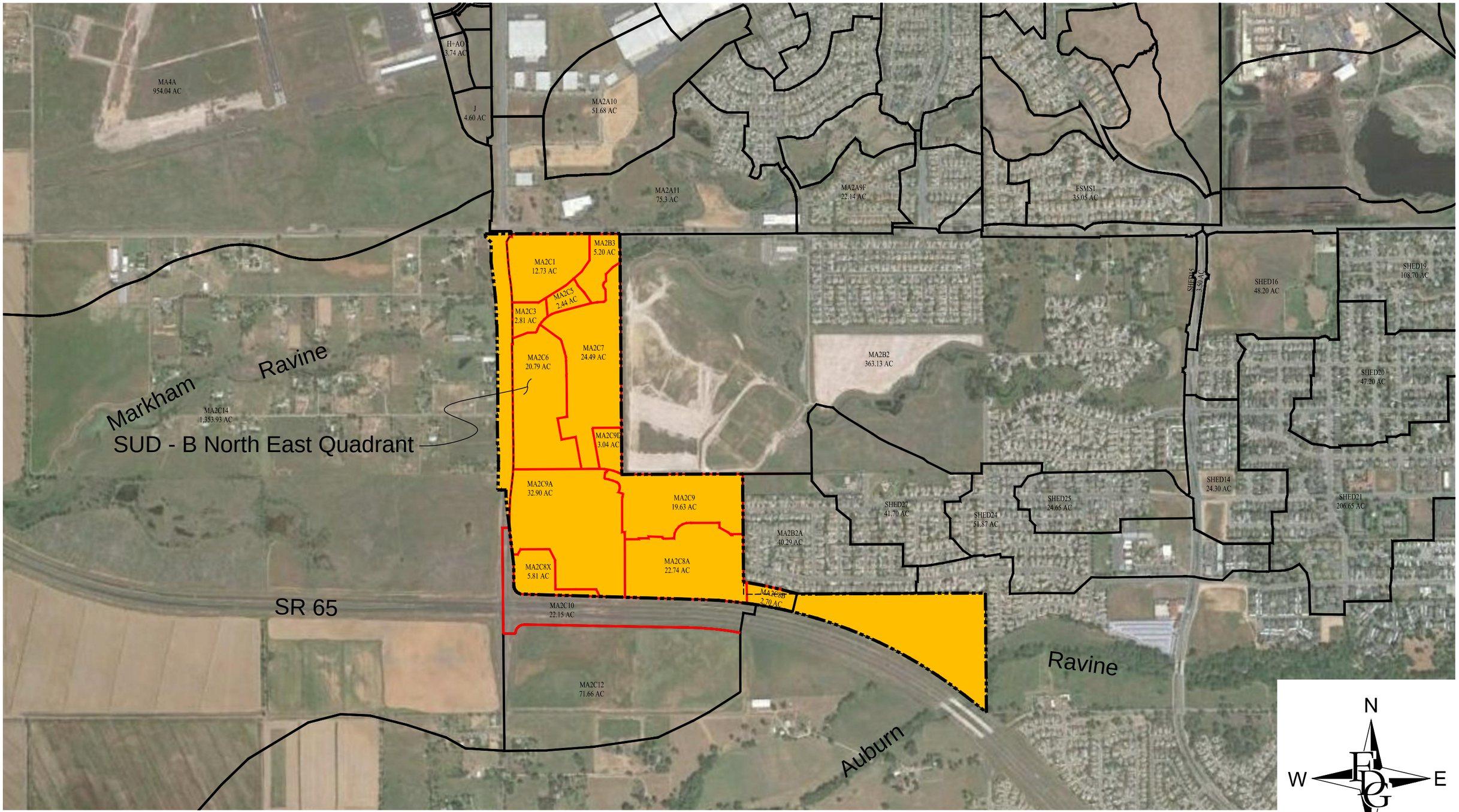


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Drainage Exhibit 12 - Markham Ravine Proposed Local Watershed Map

SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

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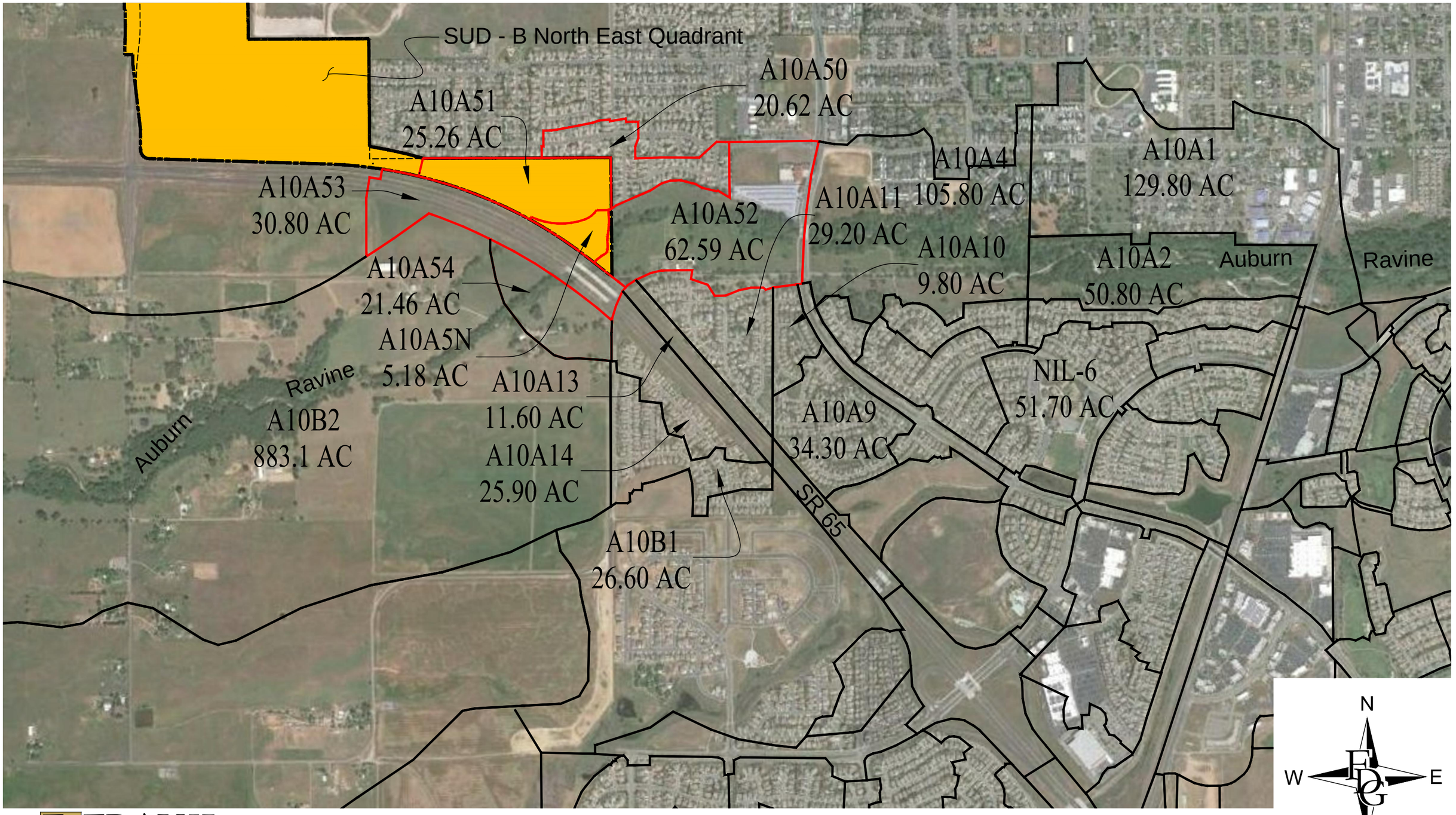


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Drainage Exhibit 13 - Auburn Ravine Proposed Local Watershed Map

SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

NOT TO SCALE

## II.B Pre-Project Model:

*II.B.1 Base Model:*

Table II.B.1.A shows the hydrologic values input for only those watershed elements of the SUD-B Northeast Quadrant project area and the surrounding vicinity. The hydrologic values were modified from the original model to fit the existing conditions found during analysis of the Specific Plan Area. Exhibit 10 - The Pre Project Drainage Sheds shows the existing shed layout prior to the project.

**TABLE II.B.1A - Pre-Project Base Model Hydrologic Factors**

| | | Hydrologic Input for Plane 1 | | | | | | | Hydrologic Input for Plane 2 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shed Name | Area (MI^2) | Initial Infiltration Rate (in/hr) | Constant Infiltration Rate (in/hr) | % Impervious | Overland Length (ft) | Overland Slope (ft/ft) | Overland 'n' Value | Percent of Watershed (%) | Initial Infiltration Rate (in/hr) | Constant Infiltration Rate (in/hr) | % Impervious | Overland Length (ft) | Overland Slope (ft/ft) | Overland 'n' Value | Percent of Watershed (%) |
| Markham Ravine | | | | | | | | | | | | | | | |
| MA2B2A | 0.06295 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2B2 | 0.56739 | 0.1 | 0.075 | 2 | 150 | 0.01 | 0.4 | 8 | 0.1 | 0.088 | 60.8 | 120 | 0.01 | 0.11 | 92 |
| MA2B3 | 0.01609 | 0.1 | 0.075 | 2 | 150 | 0.01 | 0.4 | 8 | 0.1 | 0.088 | 60.8 | 120 | 0.01 | 0.11 | 92 |
| MA2C5 | 0.01898 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 98 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 2 |
| MA2C1 | 0.00919 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 89 | 0.1 | 0.093 | 56.7 | 200 | 0.01 | 0.24 | 11 |
| MA2C2 | 0.00761 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 84 | 0.1 | 0.093 | 56.7 | 200 | 0.01 | 0.24 | 16 |
| MA2C6 | 0.01803 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 98 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 2 |
| MA2C12 | 0.11197 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 98 | 0.1 | 0.93 | 56.7 | 120 | 0.01 | 0.24 | 2 |
| MA2C9X | 0.00656 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2C10 | 0.04175 | 0.1 | 0.09 | 2 | 300 | 0.01 | 0.4 | 70 | 0.1 | 0.02 | 90 | 100 | 0.01 | 0.24 | 30 |
| MA2C9 | 0.04791 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 96 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 4 |
| MA2C8 | 0.08067 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 96 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 4 |
| MA2C7 | 0.02373 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 92 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 8 |
| MA2C8X | 0.00714 | 0.1 | 0.088 | 2 | 100 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2C14 | 2.11550 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 97 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 3 |
| Auburn Ravine | | | | | | | | | | | | | | | |
| A10A10 | 0.01531 | 0.1 | 0.08 | 2 | 120 | 0.01 | 0.24 | 50 | 0.1 | 0.01 | 100 | 120 | 0.01 | 0.24 | 50 |
| A10A11 | 0.04569 | 0.1 | 0.08 | 2 | 120 | 0.01 | 0.24 | 50 | 0.1 | 0.01 | 100 | 120 | 0.01 | 0.024 | 50 |
| A10A50 | 0.03222 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A52 | 0.09778 | 0.1 | 0.09 | 2 | 300 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A51 | 0.04261 | 0.1 | 0.12 | 2 | 300 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A5N | 0.00709 | 0.1 | 0.12 | 2 | 300 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A53 | 0.04953 | 0.1 | 0.09 | 2 | 100 | 0.01 | 0.24 | 72 | 0.1 | 0.02 | 90 | 100 | 0.01 | 0.11 | 28 |
| A10A54 | 0.03353 | 0.1 | 0.09 | 2 | 300 | 0.01 | 0.24 | 100 | | | | | | | |

TABLE Note: A watershed may contain two overland routing planes in Kinematic Wave methodology. Frayji Design Group uses plane 1 to represent the non-urbanized watershed area group, and plane 2 is used to represent the urbanized portion of the watershed area. This is distinguished because non-urbanized areas tend to have much different runnoff timing than urbanized areas. HEC-1 requires that Plane 1 always has values; so in some instances where no non-urban plane exists, the urban plane values are put solely into Plane 1.

**II.C Post-Project "Future, Fully Developed, Unmitigated" Model (FFDU):**

Frayji Design Group prepared a post-project model based on the proposed land use information and the boundaries shown on Exhibit 11. Factors for the developing watershed areas were added as shown in Table II.C.1.A. The table shows only those factors changed in the post-project and pre-project model; there are many more factors in the complete model. Directly connected impervious area percentage was computed based on average coverage rates assumed for the various contributing area types as follows:

| **Land Use Type:** | **% Impervious** |
|---|---|
| Low Density Residential (LDR) | 40% |
| Commercial (Comm) | 90% |
| Park | 5% |
| Roadway | 85% |

If a shed has multiple uses, a composite factor was computed for that shed using a weighted area average. The factors shown in Table II.C.1A are for the SUD-B NEQ post-project model with all elements from just upstream to just downstream of the project shown. Some factors have not changed as they are outside of this SPA.

## TABLE II.C.1A - Post-Project Base Model Hydrologic Factors

| | | Hydrologic Input for Plane 1 | | | | | | | Hydrologic Input for Plane 2 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shed Name | Area (MI^2) | Initial Infiltration Rate (in/hr) | Constant Infiltration Rate (in/hr) | % Imperviou s | Overland Length (ft) | Overland Slope (ft/ft) | Overland 'n' Value | Percent of Watershe d (%) | Initial Infiltration Rate (in/hr) | Constant Infiltration Rate (in/hr) | % Impervious | Overland Length (ft) | Overland Slope (ft/ft) | Overland 'n' Value | Percent of Watershed (%) |
| Markham Ravine | | | | | | | | | | | | | | | |
| MA2B2A | 0.06295 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2B2 | 0.56739 | 0.1 | 0.075 | 2 | 150 | 0.01 | 0.4 | 8 | 0.1 | 0.088 | 60.8 | 120 | 0.01 | 0.11 | 92 |
| MA2B3 | 0.00813 | 0.1 | 0.075 | 2 | 150 | 0.01 | 0.4 | 8 | 0.1 | 0.088 | 60.8 | 120 | 0.01 | 0.11 | 92 |
| MA2C5 | 0.00381 | 0.1 | 0.07 | 2 | 100 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2C7 | 0.03827 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.24 | 83 | 0.1 | 0.12 | 90 | 100 | 0.01 | 0.11 | 17 |
| MA2C6 | 0.03248 | 0.1 | 0.12 | 90 | 100 | 0.01 | 0.11 | 100 | | | | | | | |
| MA2C1 | 0.01989 | 0.1 | 0.12 | 90 | 100 | 0.01 | 0.11 | 100 | | | | | | | |
| MA2C8A | 0.03553 | 0.1 | 0.09 | 2 | 150 | 0.01 | 0.24 | 16 | 0.1 | 0.12 | 40 | 135 | 0.1 | 0.24 | 84 |
| MA2C9 | 0.03067 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.24 | 100 | | | | | | | |
| MA2C9D | 0.00475 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.24 | 100 | | | | | | | |
| MA2C9A | 0.05140 | 0.1 | 0.12 | 90 | 150 | 0.01 | 0.11 | 100 | | | | | | | |
| MA2C3 | 0.00439 | 0.1 | 0.07 | 2 | 300 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2C8X | 0.00908 | 0.1 | 0.12 | 90 | 100 | 0.01 | 0.24 | 100 | | | | | | | |
| MA2C8B | 0.00422 | 0.1 | 0.12 | 40 | 120 | 0.01 | 0.4 | 100 | | | | | | | |
| MA2C12 | 0.11197 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 98 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 2 |
| MA2C10 | 0.03458 | 0.1 | 0.09 | 2 | 300 | 0.01 | 0.4 | 70 | 0.1 | 0.02 | 90 | 120 | 0.01 | 0.24 | 30 |
| MA2C14 | 2.11550 | 0.1 | 0.088 | 2 | 300 | 0.01 | 0.4 | 98 | 0.1 | 0.093 | 56.7 | 120 | 0.01 | 0.24 | 2 |
| Auburn Ravine | | | | | | | | | | | | | | | |
| A10A10 | 0.01531 | 0.1 | 0.08 | 2 | 120 | 0.01 | 0.24 | 50 | 0.1 | 0.01 | 100 | 120 | 0.01 | 0.24 | 50 |
| A10A11 | 0.04569 | 0.1 | 0.08 | 2 | 120 | 0.01 | 0.24 | 50 | 0.1 | 0.01 | 100 | 120 | 0.01 | 0.024 | 50 |
| A10A50 | 0.03222 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A52 | 0.09778 | 0.1 | 0.09 | 2 | 300 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A51 | 0.03947 | 0.1 | 0.12 | 40 | 100 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A5N | 0.00809 | 0.1 | 0.12 | 2 | 300 | 0.01 | 0.24 | 100 | | | | | | | |
| A10A53 | 0.04953 | 0.1 | 0.09 | 2 | 100 | 0.01 | 0.24 | 72 | 0.1 | 0.02 | 90 | 100 | 0.01 | 0.11 | 28 |

**II.D Post-Project Mitigated Model:**

Hydrologic (HEC-1) watershed factors for the post-project future fully developed, unmitigated (FFDU) match the post-project mitigated drainage model. The post-project models incorporate the effects of detention basins and other drainage improvements.

This analysis and design of the floodplain areas, low flow channel and attenuation features accounts for the type of vegetation which may develop in these areas as a result of added nuisance waters and nutrients known to occur with the types of development planned in this project. These should be attenuated by the water quality measures required by the Municipal Small Storm Sewer System (MS4) Phase II requirements.

The post project models for the unmitigated and mitigated conditions do not include adjustments for the proposed use of Low Impact Development (LID) measures that are required by the MS4 Phase II requirements. This is a conservative methodology as LID will decrease runoff.

A diversion has been added just after shed MA2C9A to provide for maintenance flows from the site to properties across Nelson Lane. The flow is being diverted back into Shed MA2C14 immediately across Nelson Lane and back into the existing surface system. These flows will be diverted into the existing culvert crossings under Nelson Lane from surface sources on site after the water passes through water quality features.

Table II.F.1A1 summarizes the peak pre-project flow rates at several key locations within the project.

Table II.F.1A2 summarizes the findings of the post-project non-mitigated analysis studies and compares them to the pre-project peak flow rates for the same events. The differences between the pre and post conditions are also summarized on this table. The post-project non-mitigated analysis shows the flows without the benefit of any mitigation for increased flow due to development.

Table II.F.1A3 summarizes the findings of the post-project mitigated analysis studies and compares them to the pre-project peak flow rates for the same events. The differences between the pre and post conditions are also summarized in this table. The post-project mitigated analysis shows the flows with the benefit of mitigation to attenuate increased flow due to development. It is possible that flow rates in the center of the project will be higher than the existing, however when the water leaves the site and downstream of the site, the flow rates must be lower than the existing by 10% of the difference between existing and mitigated.

Table II.F.1A4 summarizes the required mitigation facilities in order to mitigate peak flow rates to less than the pre-project values. The preliminary locations of the basins are shown on Exhibit 10, Master Drainage.

## II.F Summary of Findings:

### TABLE II.F.1A1 - PRE-PROJECT PEAK FLOW SUMMARY

**Summary of Peak Flow Rates - SUD-B North East Quadrant - Pre-project Condition**

| Node | Description | Stream | 2-YEAR | 10-YEAR | 100-YEAR | 200-YEAR | 500-YEAR |
|---|---|---|---|---|---|---|---|
| **Markham Ravine** | | | | | | | |
| MA2B2A | Areas East of SUD-B NEQ | Markham Ravine | 15 | 35 | 68 | 79 | 97 |
| MA2B2 | Areas East of SUD-B NEQ | Markham Ravine | 160 | 325 | 586 | 679 | 808 |
| MA2B3 | Areas East of SUD-B NEQ | Markham Ravine | 162 | 327 | 590 | 678 | 808 |
| MA2B2C | Combine | Markham Ravine | 272 | 687 | 1261 | 1404 | 1680 |
| COMB | Combine | Markham Ravine | 396 | 968 | 1778 | 1982 | 2372 |
| NICHOL | Nicholas Road | Markham Ravine | 395 | 963 | 1761 | 1971 | 2340 |
| MA2C5 | Markham Ravine | Markham Ravine | 397 | 967 | 1766 | 1978 | 2350 |
| MA2C1 | Open Space | Markham Ravine | 1 | 3 | 8 | 9 | 11 |
| MA2C2 | Open Space | Markham Ravine | 1 | 3 | 6 | 8 | 9 |
| YCMA2N | Combine | Markham Ravine | 398 | 970 | 1774 | 1986 | 2359 |
| MA2C6 | Open Space | Markham Ravine | 399 | 974 | 1779 | 1992 | 2368 |
| NELSON | Nelson Lane | Markham Ravine | 399 | 969 | 1772 | 1974 | 2356 |
| MA2C12 | South of SR 65 | Markham Ravine | 8 | 37 | 88 | 103 | 127 |
| MA2C9X | North of SR 65 | Markham Ravine | 1 | 2 | 4 | 5 | 6 |
| MA2CMB | Combine | Markham Ravine | 9 | 39 | 93 | 108 | 133 |
| MA2C8X | North of SR 65 | Markham Ravine | 1 | 4 | 10 | 11 | 13 |
| MA2C10 | State Route 65 | Markham Ravine | 4 | 19 | 44 | 51 | 61 |
| MA2CMC | Combine | Markham Ravine | 13 | 57 | 135 | 156 | 192 |
| MA2C9 | Agricultrual | Markham Ravine | 4 | 16 | 38 | 44 | 54 |
| MA2C8 | Agricultrual | Markham Ravine | 14 | 28 | 67 | 79 | 97 |
| MA2C7 | Open Space | Markham Ravine | 2 | 8 | 20 | 23 | 29 |
| YCMA2S | Combine | Markham Ravine | 423 | 1036 | 1896 | 2125 | 2518 |
| MARR09 | Route Flow to Dowd Road | Markham Ravine | 376 | 836 | 1453 | 1618 | 1877 |
| MA2C14 | Shed West of SUD-B NEQ | Markham Ravine | 106 | 436 | 944 | 1082 | 1288 |
| MA2CC | Combine | Markham Ravine | 478 | 1169 | 2116 | 2375 | 2777 |
| MARR11 | Route to Pleasant Grove Road | Markham Ravine | 472 | 1147 | 2071 | 2325 | 2717 |
| **Auburn Ravine** | | | | | | | |
| A10A10 | South of Orchard Parcel | Auburn Ravine | 6 | 13 | 26 | 30 | 37 |
| 10A10C | Combine | Auburn Ravine | 2264 | 5943 | 10007 | 11034 | 12083 |
| A10A11 | South of Orchard Parcel | Auburn Ravine | 18 | 39 | 79 | 90 | 109 |
| A10A50 | Residential North of Orchard | Auburn Ravine | 12 | 29 | 57 | 66 | 81 |
| A10A52 | Orchard, Open Space and Residential | Auburn Ravine | 33 | 79 | 155 | 186 | 225 |
| A10A51 | Agricultural | Auburn Ravine | 8 | 21 | 43 | 50 | 62 |
| A10A5N | Open Space | Auburn Ravine | 9 | 24 | 49 | 57 | 71 |
| COMBP | Combine | Auburn Ravine | 41 | 102 | 203 | 243 | 297 |
| A10A53 | Agricultural and SR 65 | Auburn Ravine | 55 | 132 | 252 | 299 | 362 |
| A10A54 | Agricultural south of SR 65 | Auburn Ravine | 61 | 147 | 284 | 337 | 409 |
| 10A12C | Combine | Auburn Ravine | 2267 | 5952 | 10031 | 11065 | 12115 |
| 10A11R | Route to near SR 65 Crossing | Auburn Ravine | 2206 | 5904 | 9965 | 11060 | 12095 |
| A10A13 | State Route 65 | Auburn Ravine | 10 | 21 | 41 | 47 | 58 |
| A10A14 | West Areas of Three D Project | Auburn Ravine | 16 | 34 | 69 | 79 | 96 |
| 10A14C | Combine | Auburn Ravine | 2208 | 5907 | 9970 | 11067 | 12102 |

## TABLE II.F.1A2 -POST-PROJECT UNMITIGATED PEAK FLOW SUMMARY

**Summary of Peak Flow Rates - SUD-B North East Quadrant - Post-project Unmitigated Condition**

| Node | Description | Stream | 2-YEAR | 10-YEAR | 100-YEAR | 200-YEAR | 500-YEAR | Diff-2 | Diff-10 | Diff-100 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Markham Ravine** | | | | | | | | | | |
| MA2B2A | Areas East of SUD-B NEQ | Markham Ravine | 15 | 35 | 68 | 79 | 97 | 0 | 0 | 0 |
| MA2B2 | Areas East of SUD-B NEQ | Markham Ravine | 160 | 325 | 586 | 679 | 808 | 0 | 0 | 0 |
| MA2B3 | Portion of MA2B2 as part of SUD-B NEQ | Markham Ravine | 161 | 325 | 587 | 673 | 802 | -1 | -2 | -3 |
| MA2B2C | Combine | Markham Ravine | 271 | 686 | 1259 | 1402 | 1677 | -1 | -1 | -2 |
| COMB | Combine | Markham Ravine | 395 | 967 | 1776 | 1980 | 2369 | -1 | -1 | -2 |
| NICHOL | Nicholas Road | Markham Ravine | 395 | 962 | 1759 | 1970 | 2339 | 0 | -1 | -2 |
| MA2C7 | Open Space | Markham Ravine | 6 | 27 | 64 | 74 | 88 | 4 | 19 | 44 |
| MA2C6 | Open Space | Markham Ravine | 8 | 28 | 57 | 64 | 76 | | | |
| MA2CMB | Combine | Markham Ravine | 14 | 55 | 121 | 138 | 164 | 5 | 16 | 28 |
| MA2C1 | Open Space | Markham Ravine | 5 | 20 | 47 | 54 | 69 | 4 | 17 | 39 |
| GCOMB | Combine | Markham Ravine | 19 | 75 | 159 | 180 | 214 | | | |
| NICOMB | Combine | Markham Ravine | 403 | 976 | 1782 | 1995 | 2364 | | | |
| MA2C5 | Markham Ravine | Markham Ravine | 403 | 975 | 1773 | 1985 | 2352 | 6 | 8 | 7 |
| MA2C3 | Markham Ravine | Markham Ravine | 403 | 971 | 1774 | 1979 | 2353 | | | |
| MA2C8A | Agricultural | Markham Ravine | 5 | 22 | 49 | 58 | 70 | | | |
| RTDB2 | Route Flow | Markham Ravine | 5 | 17 | 36 | 42 | 51 | | | |
| MA2C9 | Agricultrual | Markham Ravine | 5 | 21 | 47 | 56 | 68 | 1 | 5 | 9 |
| COMP1 | Combine | Markham Ravine | 9 | 36 | 79 | 95 | 116 | | | |
| MA2C9D | Agricultural | Markham Ravine | 1 | 3 | 8 | 9 | 11 | | | |
| COMP2 | Combine | Markham Ravine | 10 | 40 | 86 | 103 | 127 | | | |
| RTDB2 | Route Flow | Markham Ravine | 9 | 33 | 73 | 86 | 98 | | | |
| MA2C9A | Agricultural | Markham Ravine | 12 | 44 | 96 | 105 | 121 | | | |
| DIVERT | Diversion | Markham Ravine | 12 | 26 | 26 | 26 | 26 | | | |
| MA2C9Z | Diversion Remainder | Markham Ravine | 0 | 18 | 70 | 79 | 95 | | | |
| PCOMB2 | Combine | Markham Ravine | 9 | 46 | 141 | 163 | 194 | | | |
| RTNORT | Route Flow | Markham Ravine | 9 | 45 | 121 | 138 | 164 | | | |
| MARKC2 | Combine | Markham Ravine | 409 | 985 | 1801 | 2009 | 2391 | | | |
| NELSON | Nelson Lane | Markham Ravine | 408 | 982 | 1788 | 2000 | 2374 | 9 | 13 | 16 |
| MA2C8 | Agricultural | Markham Ravine | 4 | 8 | 16 | 19 | 22 | -10 | -20 | -51 |
| MA2C8B | Agricultrual | Markham Ravine | 1 | 3 | 7 | 8 | 10 | | | |
| MA2C12 | South of SR 65 | Markham Ravine | 8 | 37 | 88 | 103 | 127 | 0 | 0 | 0 |
| COMBCT | Combine | Markham Ravine | 10 | 44 | 105 | 121 | 149 | | | |
| MA2C10 | State Route 65 | Markham Ravine | 13 | 58 | 134 | 155 | 192 | 9 | 39 | 90 |
| YCMA2S | Combine | Markham Ravine | 421 | 1014 | 1851 | 2068 | 2457 | -2 | -22 | -45 |
| MARR09 | Route Flow to Dowd Road | Markham Ravine | 376 | 826 | 1430 | 1591 | 1847 | 0 | -10 | -23 |
| MA2C14 | Shed West of SUD-B NEQ | Markham Ravine | 105 | 435 | 941 | 1077 | 1288 | -1 | -1 | -3 |
| MA2CC | Combine | Markham Ravine | 476 | 1149 | 2071 | 2325 | 2719 | -2 | -20 | -45 |
| MARR11 | Route to Pleasant Grove Road | Markham Ravine | 470 | 1128 | 2031 | 2278 | 2663 | -2 | -19 | -40 |
| **Auburn Ravine** | | | | | | | | | | |
| A10A10 | South of Orchard Parcel | Auburn Ravine | 6 | 13 | 26 | 30 | 37 | 0 | 0 | 0 |
| 10A10C | Combine | Auburn Ravine | 2264 | 5943 | 10007 | 11034 | 12083 | 0 | 0 | 0 |
| A10A11 | South of Orchard Parcel | Auburn Ravine | 18 | 39 | 79 | 90 | 109 | 0 | 0 | 0 |
| A10A50 | Residential North of Orchard | Auburn Ravine | 12 | 29 | 57 | 66 | 81 | 0 | 0 | 0 |
| A10A52 | Orchard, Open Space and Residential | Auburn Ravine | 33 | 79 | 154 | 186 | 225 | 0 | 0 | -1 |
| A10A51 | Residential | Auburn Ravine | 15 | 35 | 70 | 81 | 100 | 7 | 14 | 27 |
| A10A5N | Open Space | Auburn Ravine | 17 | 37 | 74 | 85 | 107 | 8 | 13 | 25 |
| COMBP | Combine | Auburn Ravine | 49 | 115 | 220 | 260 | 317 | 8 | 13 | 17 |
| A10A53 | Agricultural and SR 65 | Auburn Ravine | 63 | 147 | 277 | 325 | 392 | 8 | 15 | 25 |
| A10A54 | Agricultural south of SR 65 | Auburn Ravine | 70 | 160 | 309 | 360 | 441 | 9 | 13 | 25 |
| 10A12C | Combine | Auburn Ravine | 2267 | 5952 | 10032 | 11066 | 12116 | 0 | 0 | 1 |
| 10A11R | Route to near SR 65 Crossing | Auburn Ravine | 2207 | 5905 | 9966 | 11061 | 12096 | 1 | 1 | 1 |
| A10A13 | State Route 65 | Auburn Ravine | 10 | 21 | 41 | 47 | 58 | 0 | 0 | 0 |
| A10A14 | West Areas of Three D Project | Auburn Ravine | 16 | 34 | 69 | 79 | 96 | 0 | 0 | 0 |
| 10A14C | Combine | Auburn Ravine | 2208 | 5908 | 9971 | 11068 | 12103 | 0 | 1 | 1 |

# TABLE II.F.1A3 -POST-PROJECT MITIGATED PEAK FLOW SUMMARY

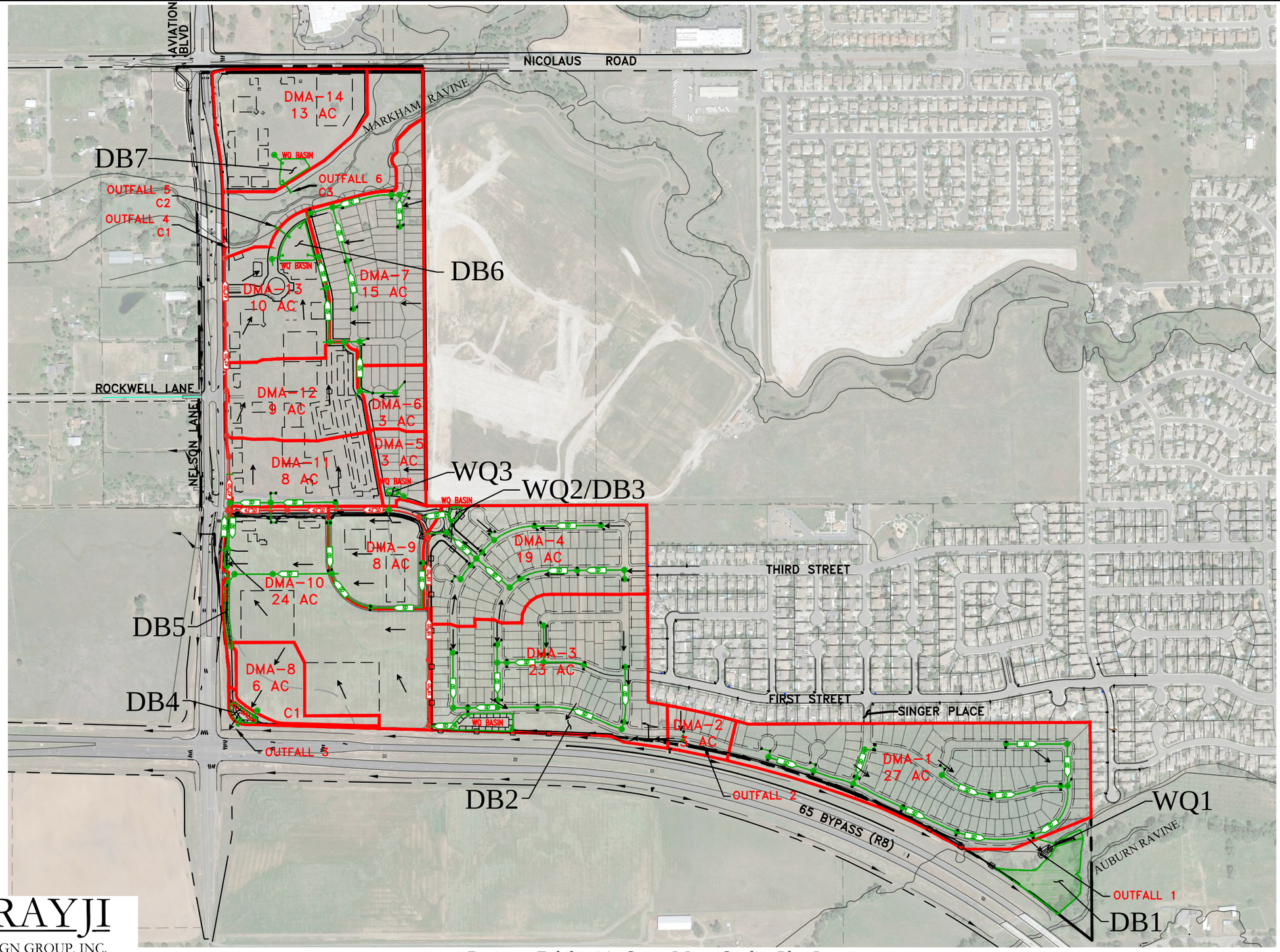
**Summary of Peak Flow Rates - SUD-B North East Quadrant - Post-project Mitigated Condition**

| Node | Description | Stream | 2-YEAR | 10-YEAR | 100-YEAR | 200-YEAR | 500-YEAR | Diff-2 | Diff-10 | Diff-100 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Markham Ravine** | | | | | | | | | | |
| MA2B2A | Areas East of SUD-B NEQ | Markham Ravine | 15 | 35 | 68 | 79 | 97 | 0 | 0 | 0 |
| MA2B2 | Areas East of SUD-B NEQ | Markham Ravine | 160 | 325 | 586 | 679 | 808 | 0 | 0 | 0 |
| MA2B3 | Portion of MA2B2 as part of SUD-B N | Markham Ravine | 161 | 325 | 587 | 673 | 802 | -1 | -2 | -3 |
| MA2B2C | Combine | Markham Ravine | 271 | 686 | 1259 | 1402 | 1677 | -1 | -1 | -2 |
| COMB | Combine | Markham Ravine | 395 | 967 | 1776 | 1980 | 2369 | -1 | -1 | -2 |
| NICHOL | Nicolaus Road | Markham Ravine | 395 | 962 | 1759 | 1970 | 2339 | 0 | -1 | -2 |
| MA2C7 | Residential | Markham Ravine | 6 | 27 | 64 | 74 | 88 | | | |
| MA2C6 | Commercial | Markham Ravine | 8 | 30 | 60 | 68 | 87 | | | |
| MA2CMB | Combine | Markham Ravine | 15 | 57 | 124 | 142 | 167 | | | |
| MA2C1 | Commercial | Markham Ravine | 5 | 19 | 39 | 44 | 53 | | | |
| GCOMB | Combine | Markham Ravine | 5 | 7 | 11 | 13 | 14 | | | |
| NICOMB | Combine | Markham Ravine | 399 | 968 | 1770 | 1982 | 2352 | | | |
| MA2C5 | Makrkham Ravine | Markham Ravine | 399 | 967 | 1763 | 1969 | 2340 | 2 | 0 | -3 |
| MA2C3 | Makrkham Ravine | Markham Ravine | 399 | 961 | 1759 | 1960 | 2329 | | | |
| MA2C8A | Residential | Markham Ravine | 5 | 22 | 49 | 58 | 70 | | | |
| RTDB2 | Route Flow | Markham Ravine | 0 | 1 | 1 | 1 | 1 | | | |
| MA2C9 | Residential | Markham Ravine | 5 | 22 | 51 | 59 | 68 | | | |
| COMP1 | Combine | Markham Ravine | 5 | 19 | 27 | 31 | 37 | | | |
| MA2C9D | Residential | Markham Ravine | 1 | 3 | 8 | 9 | 11 | | | |
| COMP2 | Combine | Markham Ravine | 6 | 22 | 32 | 36 | 43 | | | |
| RTPER2 | Route Flow | Markham Ravine | 5 | 18 | 28 | 31 | 37 | | | |
| MA2C9A | Commercial | Markham Ravine | 12 | 44 | 96 | 105 | 121 | | | |
| DIVERT | Diversion to Maintain Flow | Markham Ravine | 12 | 20 | 20 | 20 | 20 | | | |
| MA2C9Z | Flow Remainder After Diversion | Markham Ravine | 0 | 24 | 76 | 85 | 101 | | | |
| PCOMB2 | Combine | Markham Ravine | 5 | 19 | 32 | 35 | 42 | | | |
| RTNORT | Route Flow to Nelson | Markham Ravine | 5 | 18 | 31 | 33 | 39 | | | |
| MARKC2 | Combine | Markham Ravine | 403 | 969 | 1785 | 1989 | 2363 | | | |
| NELSON | Nelson Road | Markham Ravine | 402 | 966 | 1768 | 1977 | 2342 | 3 | -3 | -4 |
| MA2C8X | Commercial | Markham Ravine | 4 | 8 | 16 | 19 | 22 | 3 | 4 | 6 |
| MA2C8B | Residential | Markham Ravine | 0 | 1 | 3 | 4 | 5 | | | |
| MA2C12 | Agricultural | Markham Ravine | 8 | 37 | 88 | 103 | 127 | 0 | 0 | 0 |
| COMBCT | Combine | Markham Ravine | 10 | 40 | 94 | 109 | 134 | | | |
| MA2C10 | Sstate Route 65 | Markham Ravine | 13 | 52 | 121 | 140 | 172 | 9 | 33 | 77 |
| DFLOW1 | Return Diverted Flow | Markham Ravine | 12 | 20 | 20 | 20 | 20 | | | |
| YCMA2S | Cjombine | Markham Ravine | 419 | 1006 | 1843 | 2060 | 2442 | -4 | -30 | -53 |
| MARR09 | Route flow Nelson to Dowd | Markham Ravine | 375 | 817 | 1402 | 1558 | 1804 | -1 | -19 | -51 |
| MA2C14 | Shed West of SUD-B NEQ | Markham Ravine | 105 | 435 | 941 | 1077 | 1288 | -1 | -1 | -3 |
| MA2CC | Combine at Dowd | Markham Ravine | 474 | 1130 | 2020 | 2263 | 2642 | -4 | -39 | -96 |
| MARR11 | Route to Pleasant Grove Road | Markham Ravine | 468 | 1110 | 1980 | 2216 | 2585 | -4 | -37 | -91 |
| **Auburn Ravine** | | | | | | | | | | |
| A10A10 | South of Orchard Parcel | Auburn Ravine | 6 | 13 | 26 | 30 | 37 | 0 | 0 | 0 |
| 10A10C | Combine | Auburn Ravine | 2264 | 5943 | 10007 | 11034 | 12083 | 0 | 0 | 0 |
| A10A11 | South of Orchard Parcel | Auburn Ravine | 18 | 39 | 79 | 90 | 109 | 0 | 0 | 0 |
| A10A50 | Residential North of Orchard | Auburn Ravine | 12 | 29 | 57 | 66 | 81 | 0 | 0 | 0 |
| A10A52 | Orchard, Open Space and Residenti | Auburn Ravine | 33 | 79 | 154 | 186 | 225 | 0 | 0 | -1 |
| A10A51 | Agricultural | Auburn Ravine | 15 | 35 | 70 | 81 | 100 | 7 | 14 | 27 |
| A10A5N | Open Space | Auburn Ravine | 17 | 37 | 74 | 85 | 107 | 8 | 13 | 25 |
| COMBP | Combine | Auburn Ravine | 33 | 80 | 155 | 187 | 226 | -8 | -22 | -48 |
| A10A53 | Agricultural and SR 65 | Auburn Ravine | 47 | 111 | 208 | 245 | 295 | -8 | -21 | -44 |
| A10A54 | Agricultural south of SR 65 | Auburn Ravine | 54 | 126 | 240 | 283 | 346 | -7 | -21 | -44 |
| 10A12C | Combine | Auburn Ravine | 2267 | 5952 | 10029 | 11063 | 12114 | 0 | 0 | -2 |
| 10A11R | Route to near SR 65 Crossing | Auburn Ravine | 2207 | 5904 | 9963 | 11057 | 12093 | 1 | 0 | -2 |
| A10A13 | State Route 65 | Auburn Ravine | 10 | 21 | 41 | 47 | 58 | 0 | 0 | 0 |
| A10A14 | West Areas of Three D Project | Auburn Ravine | 16 | 34 | 69 | 79 | 96 | 0 | 0 | 0 |
| 10A14C | Combine | Auburn Ravine | 2208 | 5907 | 9969 | 11065 | 12100 | 0 | 0 | -1 |

## TABLE II.F.1A4 - REQUIRED ATTENUATION CREATION AREAS (100-YEAR)

| Attenuation Location Name | Description | Pre-Project Net 100-yr Storage (AF) | Post-Project Net 100-yr Storage (AF) | Net Added 100-year Storage (AF) |
|---|---|---|---|---|
| Auburn Ravine | | | | |
| DB1 | Detention Basin to the south of the Peery eastern residential property | 5.6 | 5.6 | 0 |
| Markham Ravine | | | | |
| DB2 | Detention Basin to the south of the Peery western residential Property | 0 | 3.6 | 3.6 |
| DB3 | Detention Basin to the north west of the Peery western residential Property | 0 | 0.6 | 0.6 |
| DB4 | Detention Basin in the south west corner of the Peery commercial | 0 | 0.8 | 0.8 |
| DB5 | Detention Basin adjacent to Nelson Lane and the Peery Commercial Property | 0 | 1.5 | 1.5 |
| DB6 | Detention Basin in the center of the northern portion of the Gill Property | 0 | 5.3 | 5.3 |
| DB7 | Detention Basin in the south of the Gill northern commercial property | 0 | 3 | 3 |
| | | Total Onsite Storage Change = | | 14.8 AF |

Table II.F.1A4 identifies the estimated change in the amount of 100-year floodplain storage volume that would occur throughout the project. The pre-project conditions represented in this table are representative of the Auburn Ravine existing detention basin created by previous farming operations within this SPA and the construction of the SR-65 Bypass. Exhibit 14, Storm Water Quality Layout Plan, shows the proposed basin approximate locations.

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Drainage Exhibit 14 - Storm Water Quality Plan Layout

SUD-B Northeast Quandrant Specific Plan

City of Lincoln, California November 9, 2016

NOT TO SCALE

# III. Hydraulics:

## III.A Flood Plain Analysis:

There are two major streams where flood plains exist within the SUB-B NEQ Area: Markham Ravine in the northern portion of the project and Auburn Ravine to the southeast of the project.

Most of the Auburn Ravine limits within this SPA are currently designated on the Flood Insurance Rate Map (FIRM) as ZONE "A". Zone A is defined by Federal Emergency Management Agency (FEMA) as:

> *Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.*

As the project will be built outside of the floodplain on Auburn Ravine, except for outfalls and water quality facilities, and as the existing project will not be increasing the existing peak flow, the existing floodplain should not be increased by this Specific Plan development. The existing Auburn Ravine HEC-RAS model used for calculation of the flood elevations is from the Village 1 Drainage Master Plan and was not adjusted for this study.

The proposed improvements near Markham Ravine may necessitate a Conditional Letter of Map Revision (CLOMR) which is typically applied for once a project planning document is approved and the grading concept (for areas within the floodplain) is designed to a point where substantial revisions are not expected. Once all work is completed within the floodplain, a Letter of Map Revision (LOMR) application will need to then be required including certified As-Built information for FEMA. The CLOMR and LOMR applications provide FEMA with detailed hydraulic analyses, Base Flood Elevation Data and revised floodplain maps showing the new floodplain and floodway limits. These applications should also detail the proposed and completed modifications made to the floodplain. Floodway analysis was not performed for SUD-B NEQ and it will need to be completed with FEMA CLOMR and LOMR application studies.

## III.B Storm Drain System:

A preliminary storm drainage system layout is shown on Exhibit 10, Master Drainage.

Based on Table 10-1 from Section 10 of the City of Lincoln Design Criteria and Procedures Manual, floodwaters are not allowed to encroach into vehicle lanes during the 100-year event for arterial and the center 12-feet for major collector streets. Storm drain pipes will be sized accordingly to satisfy these requirements. Floodwaters will be allowed to flood parking areas in commercial zones, if necessary.

Section 10 of the City of Lincoln Design Criteria and Procedures Manual requires that all residential lots adjacent to a designated floodplain have pad elevations a minimum of two feet above the 100-

year flood plain and that non-residential projects shall have finish floor elevations a minimum of two feet above the 100-year flood plain. This SPA will comply with this requirement. FEMA is in the process of updating the flood maps in Placer County and this SPA will need to demonstrate compliance with Section 10 prior to improvement plan approval. These detailed calculations shall be completed with improvement plans and are beyond the scope of this report.

The post-project drainage system will concentrate flows and pass them through water quality features before the flows pass through outfalls and into existing drainage ways. Runoff from this SPA exits this Specific Plan boundary or outfalls directly into Markham Ravine and Auburn Ravine. There are nine locations that flow into the Markham Ravine watershed and one location into the Auburn Ravine watershed.

The outfalls to Markham Ravine are further divided into three groups, one group that outfalls directly into Markham Ravine as it passes through the north side of the project, the second group to the south that outfalls to the existing ditch within Caltrans Right-of-Way for State Route 65 and the third group that drains across Nelson Lane and carries the existing Nelson Lane runoff.

The first group that outfalls directly to Markham Ravine consists of two proposed detention basins and outfall pipes with the other outfall from a major outfall system. The major outfall system, shown on Exhibit 11, Post Project Drainage Sheds, which contains inverts and hydraulic grade lines for the post-project 10-year and 100-year event, redirects flow away from existing residential areas to the west of the project and sends it directly to Markham Ravine. This trunk drainage includes flow from sheds MA2C9, MA2C9D and after detention the flow from sheds MA2C8A and MA2C9A. This trunk drainage system allows for development of the portions of this SPA owned by Peery-Arrillaga before the portions owned by Gill develop (see Exhibit 2 for land ownership). This outfall is the only trunk drainage identified on the site. The trunk drainage system is summarized below:

**TABLE III.B.1 – Trunk Drainage System Pipe Data**

| Upstream Node | Downstream Node | Total Flow (cfs) | Convey Size (in) | Pipe Slope (ft/ft) | Pipe Length (ft) | Preliminary Ground Elevation (ft) | Upstream HGL (ft) | Downstream HGL (ft) | Upstream Invert (ft) | Downstream Invert (ft) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10-yr Event | | | | | | | | | | |
| A1 | A2 | 1 | 18 | 0.0015 | 600 | 127.0 | 117.8 | 117.7 | 116.6 | 115.7 |
| A2 | A4 | 1 | 18 | 0.0015 | 1,300 | 127.8 | 117.7 | 117.5 | 115.7 | 113.8 |
| A3 | A4 | 19 | 24 | 0.0005 | 170 | 126.0 | 118.2 | 116.9 | 116.6 | 113.8 |
| A4 | A6 | 22 | 42 | 0.0005 | 1,165 | 124.3 | 117.4 | 116.7 | 113.8 | 113.2 |
| A5 | A6 | 2 | 12 | 0.0015 | 435 | 122.3 | 117.0 | 116.8 | 115.0 | 114.4 |
| A6 | A7 | 24 | 42 | 0.0007 | 1,540 | 122.4 | 116.7 | 115.6 | 113.2 | 112.1 |
| 100 yr Event | | | | | | | | | | |
| A1 | A2 | 1 | 18 | 0.0015 | 600 | 127.0 | 119.2 | 119.1 | 116.6 | 115.7 |
| A2 | A4 | 1 | 18 | 0.0015 | 1,300 | 127.8 | 119.1 | 118.9 | 115.7 | 113.8 |
| A3 | A4 | 26 | 24 | 0.0005 | 170 | 126.0 | 120.8 | 117.8 | 116.6 | 113.8 |
| A4 | A6 | 27 | 42 | 0.0005 | 1,165 | 124.3 | 118.9 | 117.7 | 113.8 | 113.2 |
| A5 | A6 | 5 | 18 | 0.0026 | 435 | 122.3 | 119.0 | 117.7 | 115.0 | 114.4 |
| A6 | A7 | 32 | 42 | 0.0007 | 1,540 | 122.4 | 117.7 | 115.6 | 113.2 | 112.1 |

The second group of outfalls on Markham Ravine is located south of the project and flow into the Caltrans State Route 65 Right-of-Way. Two existing outfall pipes, a 12" Corrugated Metal Pipe (CMP) and a 18" Reinforced Concrete Pipe (RCP), along with one proposed outfall pipe will carry flow to the existing drainage ditch along the north side of State Route 65, then along that ditch for approximately one mile and which ultimately outfalls into Markham Ravine. These outflows from this Specific Plan boundary will be treated prior to entering the existing Caltrans ditch and the calculations for this treatment are included in Appendix A. These post-project outfalls flow into the existing Caltrans ditch will not increase the post-project flows relative to pre-project conditions.

The last outfall group on Markham Ravine is a combination of existing culverts along and under Nelson Lane where these existing culverts will continue to be utilized to maintain flows to existing drainage paths. There are four of these crossings and this brings the total number of outfalls to nine. These post-project flows will be less than or equal to the existing 10-year flows at each culvert.

There is one single outfall to Auburn Ravine from this SPA where an existing basin followed by an existing 12" CMP outfall with a flapper gate to prevent backflow that will be used in the post-project system.

The existing roadways on the north, west and south sides of the project flow into existing drainage features. The drainage on the west in Nelson Lane is in the center median for most of its length due to the super-elevation slope to the center of the road, all of the other drainage flows into the existing drainage ditches and eventually into Markham Ravine. The SR-65 drainage channels to the south of the property take the drainage west into Markham Ravine. There are ditches along SR-65 that flow into Auburn Ravine, but this SPA does not use them. Nicolaus Road drains to existing ditches along the frontage and then around the corner south and into Markham Ravine.

No flow from the subdivision from the east including First and Third Streets will be collected into this SPA with none of this SPA flow going into that existing subdivision pre and post development. Lastly, none of the runoff from this SPA will flow onto the neighboring property to the northeast, APN 021-262-006. Moreover, when that property develops, no runoff will flow into this SPA.

## IV Water Quality:

The City of Lincoln is a Phase II community and is subject to the Nationwide Pollution Discharge Elimination System (NPDES) regulations. The NPDES permit includes requirements that hydrograph modification impacts be addressed.

### IV.A Stormwater Management During Construction Activities

The release of on-site stormwater runoff during Construction activities is regulated by the State General Construction Permit issued by the Regional Water Quality Control Board (RWQCB) for all commercial and residential construction sites greater than one acre. The General Construction permit requires that a Storm Water Pollution Prevention Plan (SWPPP) be developed and implemented to prevent the transport of pollution and sediments from the site by runoff.

The SWPPP identifies the Best Management Practices (BMPs) that will be implemented during the construction process. Erosion and sediment control BMPs typically include such things as applying straw mulch to disturbed areas, the use of fiber rolls and silt fences, sedimentation basins, drain inlet protection, stabilized construction accesses, and construction equipment fuel and maintenance requirements. The final sizing and selection of BMPs will consider requirements specific to the Auburn Ravine and Markham Ravine watersheds and proposed construction activities.

A Stormwater Pollution Prevention Plan (SWPPP) will be required to describe the BMPs which will be used to prevent erosion and to clean site discharge waters before entering State Waters. A permit with the Central Valley RWQCB of the State of California will be obtained for the proposed construction activities. If construction occurs during the wet season, additional winterization improvements will be required to stabilize the disturbed areas of the site, prevent erosion, and clean discharge waters. All construction related BMP improvements must comply with the "NPDES General Permit for Storm Water Discharges Associated with Construction Activities, NPDES No. CAS000004, Order No. 2013-0001-DWQ".

### IV.B Post Construction Stormwater Management

Post construction stormwater management is intended to treat in perpetuity the urban runoff generated on-site. The BMP techniques within the SUD-B Northeast Quadrant area will reduce and/or eliminate the pollutants from the urban stormwater runoff and prevent the contamination of receiving waters. SUD-B Northeast Quadrant will work with the then current permit criteria applicable at the time of development and in conformance with the City of Lincoln's Improvement Standards, the Placer County Flood Control Agency's Stormwater Management Manual, the West Placer Storm Water Quality Design Manual, the open space preserve Operations and Maintenance (O&M) Plan, to design and address post construction stormwater treatment.

Post construction stormwater treatment is composed of three general elements: source control, runoff reduction and treatment of runoff. All three elements will be used in the SUD-B Northeast Quadrant stormwater management plan. The basic practice of source control is to minimize the potential for

constituents to enter runoff at the source. An example of a source control BMP would be stamping of drainage inlets to inform residents that waters flow to the creeks.

### IV.C Low Impact Development Measures

Low impact development (LID) is an approach to stormwater management that emphasizes the use of small-scale, natural, constructed and proprietary drainage features integrated throughout a development site. The intent of LID measures is to slow, clean, infiltrate and evapo-transpire runoff, to reduce the quantity of urban runoff entering the storm drain systems. The added opportunities for infiltration offered by the use of LID can add water to local aquifers, increasing water reuse. It is a sustainable practice that benefits water quality protection, stream stability and can contribute to water supply. Unlike traditional storm water management, which collects and conveys storm water runoff through storm drains, pipes, or other conveyances to a centralized storm water facility, LID within SUD-B NEQ will use site design elements to minimize changes to the site's pre-development runoff rates and volumes. SUD-B NEQ LID elements will assist with the goal of optimizing to the site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to where it originates.

Key principles of low impact development include:

- Decentralize and manage urban runoff to integrate storm water management throughout the watershed.
- Preserve the ecosystem's natural hydrological functions and cycles.
- Account for a site's topographic features in its design.
- Reduce directly connected impervious surfaces to slow runoff and provide additional infiltration opportunities.
- Reduce impervious ground cover and maximize infiltration on-site.

The State Water Resources Control Board has adopted a General Construction Permit that will govern for this project. Part of that permit addresses requirements for the use of permanent LID measures to mitigate runoff volume increases from development for the 85$^{th}$ percentile runoff event. The currently anticipated guidelines of the permit are presented at:

http://www.swrcb.ca.gov/water_issues/programs/stormwater/constpermits.shtml

The construction permit computational methodology offers a good diversity of LID measures, and therefore has been used for the LID calculations included with this project.

**TABLE IV.C.1A – Applicable LID Measures By Development Type:**

| LID Measure Descriptions | Benefits Description | Development Land Use Type which is applicable to LID Measure |
|---|---|---|
| Disconnected roof drains | Water running off of the impervious roof system is treated by biological filtration, and the runoff gains an opportunity to partially infiltrate. | Low Density Residential<br>Medium Density Residential<br>High Density Residential<br>Commercial, Public/Quasi Public, Parks |
| * Pervious or partially paved driveways & Porous pavement areas, and soil confinement | Pavement alternatives offer the opportunity for partial or complete infiltration of runoff. | Low Density Residential<br>Medium Density Residential<br>High Density Residential<br>Commercial, Public/Quasi Public, Park<br>Roadway |
| Separated sidewalks & Pavement Disconnection and eliminated pavement | Runoff from the impervious sidewalk, driveway, and pavement areas can be treated and infiltrated in landscape areas before entering the gutter pan and storm drain systems. (including residential walkways) In some areas of the development, un-necessary pavement may also be eliminated for stormwater benefit. | Low Density Residential<br>Medium Density Residential<br>High Density Residential<br>Commercial, Public/Quasi Public, Park<br>Roadway |
| Tree Planting and Canopy Preservation | The creation and preservation of tree canopy reduces the rate and amount of total runoff which enters the storm drain systems. | Low Density Residential<br>Medium Density Residential<br>High Density Residential<br>Commercial, Public/Quasi Public, Park<br>Roadway |
| Soil amendments in landscaped areas and Storm water planters. | The addition of organic material to impervious soils can add voids which can absorb runoff preventing it from entering storm drain systems. In residential areas, this may include amending a landscape strip adjacent to the street or pavement areas where large amounts of runoff can be intercepted from the lots. In commercial areas this is likely to be limited to stormwater planter areas. At roadways this will be used where roadway flows are diverted into the landscape areas. | Low Density Residential<br>Medium Density Residential<br>High Density Residential<br>Commercial, Public/Quasi Public, Park<br>Roadway |
| Stream Buffer | Sheet flows can be discharged into the stream corridors (at the surface overbank) directly providing significant treatment and infiltration opportunity prior to entering the streams. | High Density Residential **<br>Commercial **<br>Park **<br>Public/Quasi Public ** |
| Vegetated Swales | *** Discharge of runoff into vegetated swales provides additional treatment in the in the treatment train, and opportunities for additional infiltration of runoff waters | Low Density Residential<br>Medium Density Residential<br>High Density Residential<br>Commercial, Public/Quasi Public, Park<br>Roadway |
| Stormwater Retention | These measures remove stormwater from the system, and trap constituents at the stormwater retention location such that it is not discharged. | These are used in combination with detention basins in this project. They are applicable |

* The use of pervious pavement and other infiltration oriented paving systems are dependent on infiltration capacity of the underlying soils, and may not be used everywhere. Geotechnical investigations are necessary to support the use of these systems.
** Opportunities for the use of this measure and land use combination are extremely limited within this SPA.
***Appendix A - Storm Water Quality Plan shows the location where a Vegetated swale is applicable in this SPA.

## IV.D Hydrograph Modification Benefits from LID:

This SPA has the potential to modify the hydrologic response for given storm recurrences within the Auburn Ravine watershed. It is commonly understood that development generally increases runoff volume and peak flows by increasing the amount of impervious areas within the watershed and by reducing the amount of time over which runoff occurs.

Streams naturally migrate and evolve. Migration is the progression of the stream meanders in a downstream direction. Migration can naturally occur over short time periods or long geological periods, depending on stream factors such as soil types, amount of and type of vegetation present, hydrologic conditions and land use conditions. Evolution is the modification of the stream type or classification, into another stream type or classification. Evolution naturally occurs in streams over long geological periods. Modifications to the hydrologic response of a watershed has the potential in some watersheds to result in downstream modifications to the stream, referred to as an evolutionary response. An evolutionary response can result in considerable additional sediment load within a stream corridor, and ultimately can result in the degradation of water quality, environmental resources, recreational resources, and navigable resources.

The City of Lincoln regulates stormwater discharge in compliance with the U.S. Environmental Protection Agency National Pollutant Discharge Elimination System (NPDES) MS4 permit. Pursuant to this permit, the City requires new projects to mitigate stormwater quality impacts to the "Maximum Extent Practicable". The West Placer Storm Water Quality Design Manual outlines the required modification steps and the SUD-B Northeast Quadrant project has reviewed the potential for hydrograph modification, resulting from the proposed development measures and has incorporated mitigation measures which will reduce the potential as follows:

- The project will incorporate the use of extensive Low Impact Development measures to reduce runoff impacts at the source of runoff from impervious surfaces.

- This project will comply with the West Placer Storm Water Quality Design Manual and a preliminary copy of the Storm Water Quality Plan is included in Appendix A.

## V. Volumetric Impacts:

SUD-B NEQ drains via the Auburn Ravine and Markham Ravine watersheds. Runoff from the SUD-B NEQ area ultimately drains to the Natomas Cross Canal before entering the Sacramento River. The Cross Canal Watershed Study (CH2MHILL 1992-1994) identified that development within these watersheds worsen a flooding problem within Sutter County by increasing the runoff volume. The City of Lincoln has implemented a public facilities fee to collect funds and to ultimately build a mitigation facility, currently partially constructed at the Lakeview Farms site, northwest of SUD-B NEQ. TABLE V.A.1 identifies the estimated 8-day, 100-year storm event runoff volume increases for the SUD-B NEQ project.

**TABLE V.A.1 -SUD-B NORTHEAST QUADRANT VOLUMETRIC IMPACT TYPE D SOIL[1]**

| LAND USE TYPE | LAND USE DESCRIPTION | % IMPERVIOUS | IMPACT RATE (AF/ACRE) | LAND USE AREA (ACRE) | LAND USE IMPACT (ACRE-FT) |
|---|---|---|---|---|---|
| TYPE "D" SOILS | | | | | |
| LDR | Low Density Residential | 40 | 0.072 | 85 | 6.12 |
| Park | Park | 5 | -0.115 | 3.2 | -0.37 |
| ROAD | Roadways | 85 | 0.313 | 4 | 1.25 |
| COMM | Commercial | 85 | 0.313 | 72.5 | 22.69 |
| | | | | | |
| | | | | TOTAL= | 29.70 |

1. Based on Volumetric Calculations completed by Civil Solutions, Inc. for the City of Lincoln

The total computed impact of the SUD-B Northeast Quadrant project development area is 29.70 acre feet of volumetric storage for an 8-day, 100-year event. This impact will be mitigated at the City of Lincoln's Lakeview Farms Facility, once completed. The Lakeview Farms Facility was partially completed with the SR-65 Bypass project and the remainder should be completed by the City of Lincoln once funds are collected for construction.

## VI. Conclusions:

This Drainage Master Plan demonstrates that with implementation of the SUD-B NEQ project:

- Peak flow attenuation using the detention basins as defined in TableII.F.1A4 must be created for this project.
- Peak flows shall conform to the requirements of the City of Lincoln and the Placer County Stormwater Management Manual.
- Flood elevations shall not be increased by the project.
- The project drainage is designed to accommodate and mitigate for the proposed uses.
- The proposed improvements allow for the Peery/Arrillaga portions of the project to develop before the portions owned by Gill.
- Stormwater Quality impacts will be met through the implementation of the West Placer Storm Water Quality Design Manual and its associated spreadsheet.
- A Preliminary Storm Water Quality Plan is included that shows a possible Low Impact Development solution for the site included as Exhibit 14. However the developers may employ other Low Impact Development Measures and the report gives possible examples.
- The project will have an 8-day, 100-year volumetric impact of 29.70 acre-feet and will be required to pay the Public Facilities Element Fees toward mitigating these impacts.

# Appendix A

# Preliminary Storm Water Quality Plan

# Appendix B

## Auburn Ravine State Route 65 Bridge Boring Logs

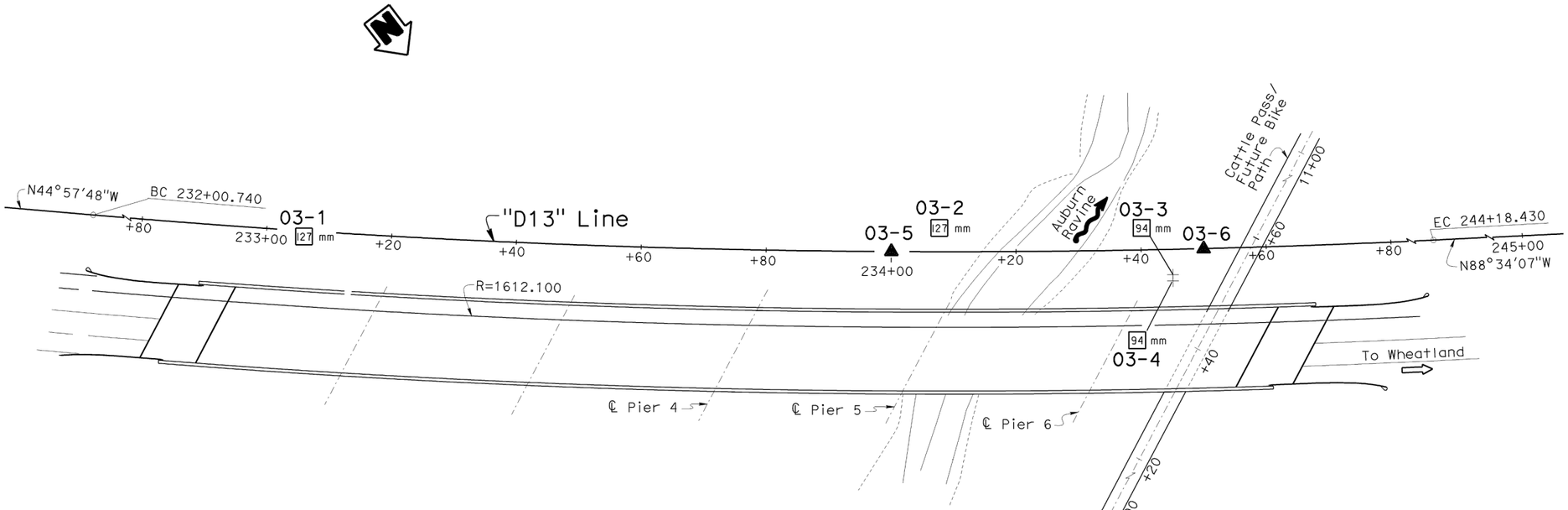
| DIST | COUNTY | ROUTE | KILOMETER POST TOTAL PROJECT | SHEET No | TOTAL SHEETS |
|---|---|---|---|---|---|
| 03 | Pla | 65 | R19.3/R38.3 | 1311 | 1465 |

CERTIFIED ENGINEERING GEOLOGIST — 12-30-05

11-13-07
PLANS APPROVAL DATE

REGISTERED GEOLOGIST — Reid Buell — No. 1481 — Exp. 4-30-09 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.




PLAN
1:400

## BENCH MARK

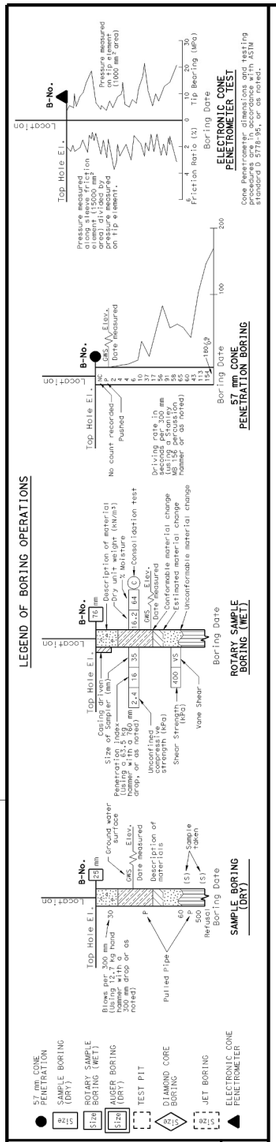
TBM : 03-1 Elev : 38.93 m
Boring locations and elevations provided by District 3 surveys.

TBM : 03-2 Elev : 37.95 m
Boring locations and elevations provided by District 3 surveys.

Borings 03-3, 03-4, 03-5 and 03-6 elevations were estimated from USGS Topographical map.

Note: SPT blow counts were obtained with a Safety Hammer.

LEGEND OF BORING OPERATIONS




LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY · CLAYEY SILT · PEAT and/or ORGANIC MATTER · COBBLES and/or BOULDERS · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

| | SPT N-Value (Blows/0.3m) | Granular | SPT N-Value (Blows/0.3m) | Cohesive |
|---|---|---|---|---|
| | 0-4 | Very Loose | <2 | Very Soft |
| | 5-10 | Loose | 2-4 | Soft |
| | 11-30 | Medium Dense | 5-8 | Firm |
| | 31-50 | Dense | 9-15 | Stiff |
| | >50 | Very Dense | 16-30 | Very stiff |
| | | | >30 | Hard |

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 4/04)

Caltrans Metric

| GEOTECHNICAL SERVICES | |
|---|---|
| DRAWN BY | I. G-Remmen 10/05 |
| CHECKED BY | J.Thorne |

FIELD INVESTIGATION BY: J.Thorne

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH

CU 03
EA 3338U1

BRIDGE NO. 19-0191R
KILOMETER POST 23.30

# AUBURN RAVINE BRIDGE - RIGHT
## LOG OF TEST BORINGS 1 OF 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 12-20-05 | 12-30-05

SHEET 21 OF 23

FILE => 19-0191_z_1otb-1of3.dgn

USERNAME => rtrehard DATE PLOTTED => 16-NOV-2007 TIME PLOTTED => 10:24

| DIST | COUNTY | ROUTE | KILOMETER POST TOTAL PROJECT | SHEET No | TOTAL SHEETS |
|---|---|---|---|---|---|
| 03 | Pla | 65 | R19.3/R38.3 | 1312 | 1465 |

CERTIFIED ENGINEERING GEOLOGIST 12-30-05

11-13-07
PLANS APPROVAL DATE

REGISTERED GEOLOGIST — Reid Buell — No. 1481 — Exp. 4-30-09 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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# FOR PLAN VIEW, SEE "LOG OF TEST BORINGS" 1 OF 3

Note: SPT blow counts were obtained with a Safety Hammer.

## 03-1

0.9 m Rt Sta 233+06 m ℄"D13" Line

38.93

127 mm Fat CLAY (CH), hard, brown, medium to high plasticity, trace fine SAND, dry to moist.

CLAYEY SAND (SC), dense, brown, fine to medium grained, with SILT, medium to low plasticity, moist, qu=431 kPa.

47 35

No recovery.

36 m

36 35

Poorly-graded SAND with GRAVEL (SP), brown, fine to coarse, wet.

CLAYEY GRAVEL with SAND (GC), medium dense, brown, fine to coarse, medium plasticity, moist, qu=239 to 407 kPa.

39 35

33 m

CLAYEY SAND (SC), dense, brown fine to coarse grained, moist to wet, with interbedded CLAY lenses.

24 35

Lean CLAY (CL), very stiff, light brownish gray, low to medium plasticity, moist, qu=239 to 407 kPa.

SANDY lean CLAY (CL), very stiff, yellowish brown, low to medium plasticity, fine to coarse grained, moist to wet, qu=431 kPa.

41 35

30 m

CLAYEY SAND with GRAVEL (SC), dense, yellowish brown, fine to coarse, wet.

GWS EL. 30.23
10-3-03

26 35

Lean CLAY (CL), very stiff, brown, mottled, oxidized, low to medium plasticity, carbon, moist, qu=239 to 287 kPa.

Lean CLAY (CL), very stiff, light reddish brown, low plasticity, possibly expansive, carbon rootlets, moist, qu=287 kPa.

49 35

27 m

Lean CLAY (CL), hard, strong brown, low to medium plasticity, mottled, oxidized, carbon, moist, qu=431 kPa.

35 35

Poorly graded SAND with CLAY (SP-SC), dense, dark yellowish brown, fine grained, carbon, moist.

24 m

24 35

SILT/Lean CLAY (ML-CL), very stiff, light gray to yellowish brown, low to medium plasticity, mottled, micaceous, moist, qu=431 kPa.

45 35

SILTY SAND (SM), dense, brown, very fine grained, micaceous, trace CLAY, carbon, trace oxidation, moist.

21 m

E96 35

Poorly-graded SAND (SP), very dense, pale olive to olive brown, fine grained, wet.

E130 35

Lean CLAY (CL), hard, light yellowish brown, low to medium plasticity, calcium carbonate veins, carbon, moist, qu=431 kPa.

18 m

37 35

Lean CLAY (CL), hard, light yellowish brown, trace strong brown interbeds, mottled, relic structure, low to medium plasticity, moist, qu=431 kPa.

33 35

Lean CLAY/SILT with SAND (CL/ML), hard to medium dense, strong brown, very fine grained, mottled, carbon, micaceous, moist.

15 m

34 35

Well-graded SAND (SW), medium dense, olive brown, wet.

66 35

Lean CLAY with SAND (CL), hard, brown, medium plasticity, fine to very fine grained, trace carbon and trace oxidation, moist, qu=431 kPa.

12 m

E127 35

63 35

Lean CLAY with GRAVEL (CL), hard, light olive gray to a very dark brown, mottled, banded with heavy oxidation, calcium carbonate veins, low plasticity, moist. qu=431 kPa, (MEHRTEN FORMATION).

9 m

74 35

Grading to CLAYEY SAND with GRAVEL (SC), very dense, very dark brown, fine grained SAND and coarse GRAVELS, moist.

55 35

SILTY SAND (SM), very dense, dark yellowish brown, fine grained, mottled, trace carbon, moist.

6 m

Lean CLAY/SILT (CL/ML), hard to dense, pale yellow, low to medium plasticity, trace oxidation, moderately cemented, trace carbon and calcium carbonate nodules, some CLAYEY fine SAND interbeds from 3.53 to 3.23 m, moist, qu=431 kPa.

3 m

CLAYEY SAND (SC), dense, light yellowish brown and pale yellow, low to medium plasticity, grading to SANDY CLAY (CL), fine grained, trace carbon, calcium carbonate veins, light to moderate mottling, moist to wet, qu=335 to 383 kPa.

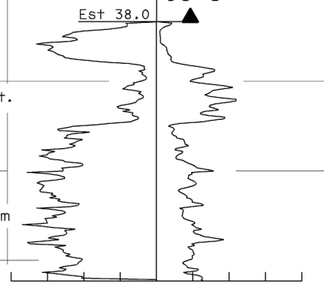
0 m

10-27-03

On C/L Sta 234+00 m ℄"D13" Line

## 03-5

Est 38.0




4-3-03

3.8 m Lt Sta 234+07.7 m ℄"D13" Line

## 03-2

37.95

127 mm Lean CLAY/SILT (CL/ML), hard to medium dense, brown, medium plasticity, with fine SAND, roots, moist.

36 m

37 35

23 35

Lean CLAY (CL), very stiff, yellowish brown, medium to high plasticity, oxidized, carbon, mottled, moist, qu=407 kPa.

33 m

46 35

CLAYEY SAND with GRAVEL (SC), dense, yellowish brown, fine to coarse moist to wet, qu=263 kPa.

47 35

Lean CLAY (CL), hard, light brownish gray, medium plasticity, mottled, trace fine to medium SAND, moist, qu=431 kPa.

30 m

53 35

CLAYEY SAND (SC), very dense, yellowish brown, fine to coarse, moist to wet.

Lean CLAY (CL), hard, yellowish brown, low to medium plasticity, mottled, oxidized lenses, moist, qu=311 to 431 kPa

34 35

qu=431 kPa.

27 m

28 35

SILT (ML), medium dense, dark yellowish brown, low plasticity, carbon, moist, qu=431 kPa

39 35

Lean CLAY (CL), hard, strong brown, low to medium plasticity, some SILT, mottled, trace GRAVEL, carbon, moist, qu=287 to 383 kPa.

24 m

34 35

SILTY SAND (SM), medium dense, strong brown, low plasticity, carbon, calcium carbonate, mottled, fine grained, moist, qu=431 kPa.

59 35

Poorly-graded SAND with SILT, (SP-SM), very dense, yellowish brown, fine grained, trace fine to coarse GRAVEL, moist.

21 m

63 35

Lean CLAY/SILT (CL/ML), hard to very dense, yellowish brown, low to medium plasticity, with fine grained SAND, mottled, carbon, moist, qu=431 kPa

SILTY SAND (SM), very dense, yellowish brown, fine grained grading to fine to coarse SILTY SAND wet.

E125 35

SANDY SILT (ML), very dense, yellowish brown, very fine grained, low plasticity, moist to wet.

18 m

Lean CLAY (CL), hard, grayish brown, low plasticity, moist.

35 35

CLAYEY SAND (SC), medium dense, brown, fine to coarse, moist, qu=359 to 407 kPa.

50 35

Lean CLAY (CL), hard, brown, low to medium plasticity, oxidized, carbon, micaceous, moist, qu=431 kPa.

15 m

Lean CLAY/SILT (CL/ML), dense, strong brown, low to medium plasticity, CLAY binder, micaceous, moist, qu=431 kPa.

30 35

CLAYEY SAND (SC), dense, brown, fine grained, micaceous, moist.

CLAYEY GRAVEL with SAND (GC), very dense, very dark gray, fine to coarse, moist to wet, (MEHRTEN FORMATION).

12 m

COBBLES and BOULDERS.

35

Poorly-graded SAND (SP), dense, olive brown, fine grained, wet.

9 m

36 35

Poorly-graded SAND with GRAVEL (SP), dense, very dark grayish brown, fine grained SAND, fine to coarse well-rounded GRAVEL, wet.

40 35

6 m

Poorly-graded SAND with GRAVEL (SP), dense, dark grayish brown, fine grained, trace CLAY, wet.

CLAYEY SAND with GRAVEL (SC), dense, grayish brown to yellowish brown, varved, fine grained SAND, coarse well-rounded GRAVEL, micaceous, wet.

3 m

Lean CLAY (CL), hard, reddish brown to dark gray , medium plasticity, moist.

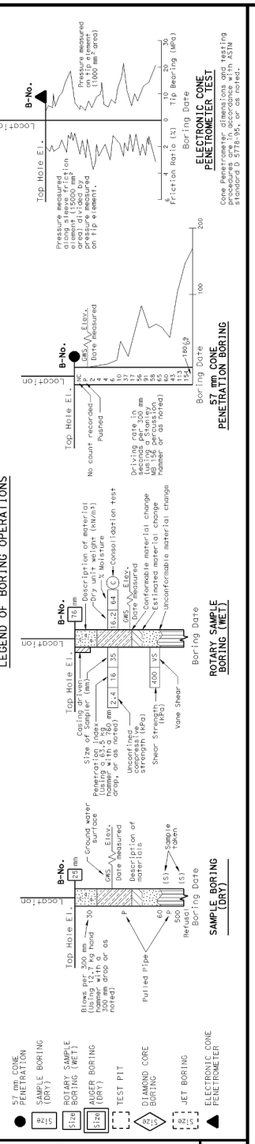
0 m

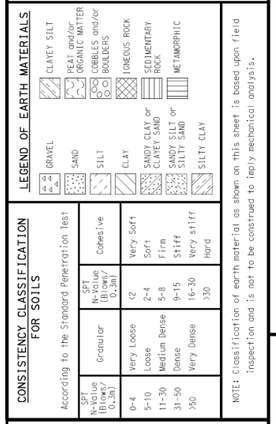
Grading to pale brown at Elev 0.16 m.

10-29-03

PROFILE
HOR. 1:400
VER. 1:100

233+00 233+80 234+60 235+40




CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

| SPT N-Value (Blows/0.3m) | Granular | Cohesive |
|---|---|---|
| 0-4 | Very Loose | Very Soft |
| 5-10 | Loose | Soft |
| 11-30 | Medium Dense | Firm |
| 31-50 | Dense | Stiff |
| >50 | Very Dense | Very stiff |
| | | Hard |

| SPT N-Value (Blows/0.3m) | Granular | Cohesive |
|---|---|---|
| <2 | Very Loose | Very Soft |
| 2-4 | Loose | Soft |
| 5-8 | Medium Dense | Firm |
| 9-15 | Dense | Stiff |
| 16-30 | Very Dense | Very stiff |
| >30 | | Hard |

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 4/04)

Caltrans Metric

| GEOTECHNICAL SERVICES | |
|---|---|
| DRAWN BY | I. G-Remmen 10/05 |
| CHECKED BY | J.Thorne |

FIELD INVESTIGATION BY: J.Thorne

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH

BRIDGE NO. 19-0191R
KILOMETER POST 23.30

# AUBURN RAVINE BRIDGE - RIGHT

## LOG OF TEST BORINGS 2 OF 3

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 03
EA 3338U1

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 12-29-05 12-30-05

SHEET 22 OF 23

FILE => 19-0191_z_lotb-2of3.dgn

USERNAME => rlreinhard DATE PLOTTED => 16-NOV-2007 TIME PLOTTED => 10:24

| DIST | COUNTY | ROUTE | KILOMETER POST TOTAL PROJECT | SHEET No | TOTAL SHEETS |
|---|---|---|---|---|---|
| 03 | Pla | 65 | R19.3/R38.3 | 1313 | 1465 |

CERTIFIED ENGINEERING GEOLOGIST 12-30-05

11-13-07
PLANS APPROVAL DATE

REGISTERED GEOLOGIST — Reid Buell — No. 1481 — Exp. 4-30-09 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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# FOR PLAN VIEW, SEE "LOG OF TEST BORINGS" 1 OF 3

Note: SPT blow counts were obtained with a Safety Hammer.

5.0 m Rt Sta 234+45 m ℄ "D13" Line

**03-4**

Est 37.20

94 mm

CLAYEY SILT with GRAVEL (CL/ML), medium dense, dark yellowish brown, fine to coarse GRAVEL, moist.

SILTY CLAY (ML/CL), soft, dark greenish gray, fine grained, micaceous, wet.

6-19-03

4.0 m Rt Sta 234+45 m ℄"D13" Line

**03-3**

Est 37.20

94 mm CLAYEY SILT with GRAVEL (CL/ML), medium dense, dark yellowish brown, fine to coarse GRAVEL, moist.

SILTY CLAY (ML/CL), soft, dark greenish gray, fine grained, micaceous, wet.

3 35 — GWS El. 34.80 6-19-03

SANDY SILT with GRAVEL (ML), loose to medium dense, brown to dark greenish gray, micaceous, wet to moist, qu=72 to 24 kPa.

15 35

SANDY lean CLAY (CL), greenish gray, fine to medium grained, moist.

56 35

CLAYEY SAND with GRAVEL (SC), very dense, strong brown, fine to medium grained, organics, moist.

CLAYEY SAND and GRAVEL (SC/GC), dense to very dense, yellowish brown, fine to coarse grained, moist to wet.

50 35

CLAYEY SILT (CL/ML), hard to very dense, strong brown, relic structure, with fine SAND and GRAVEL, moist, qu>431 kPa.

E125 35

CLAYEY SAND and GRAVEL (SC/GC), very dense, yellowish brown, fine to coarse grained, moist.

68 35

Lean CLAY/SILT (CL/ML), hard to very dense, yellowish brown, moist, with carbon, qu=168 kPa.

37 35

Lean CLAY (CL), hard, brown, with carbon flecks and carbonized rootlets, moist, qu>431 kPa.

Lean CLAY/SILT (CL/ML), hard to dense, brown, with carbon, moist, qu>431 kPa.

E126 35

Grading to CLAYEY SAND (SC), from Elev 25.0 to 24.4 m.

79 35

Lean CLAY (CL), hard, brown, mottled with bluish gray, carbonized rootlets and carbon flecks, moist, qu>431 kPa.
qu=287 to 431 kPa.

46 35

E100 35

CLAYEY SAND (SC), dense, yellowish brown, fine to medium grained, moist to wet.

CLAYEY SAND (SC), very dense, gray, fine to coarse with fine black SAND lenses, carbonized rootlets, moist.

60 35

Lean CLAY (CL), hard, brown to gray, moist, qu>431 kPa.

SANDY SILT (ML), very dense, olive brown, fine grained, moist.

44 35

Lean CLAY (CL), hard, olive brown, mottled with gray, trace carbon flecks, moist qu=431 kPa, trace coarse SAND.

37 35

Lean CLAY/SILT (CL/ML), hard to dense, light yellowish brown, mottled with carbon flecks, trace, fine to coarse SAND, qu=383 kPa.

SILTY SAND (SM), dense, brown, fine grained, wet.

27 35

Lean CLAY/SILT with SAND (CL/ML), very stiff to medium dense, micaceous, moist to wet, qu=192 to 287 kPa.

REF 35

Poorly graded GRAVEL(GP), very dense, brown with greenish gray ANDESITE fragments, fine to coarse SAND and GRAVEL, moderate to strongly cemented, vesicular ANDESITE in soil matrix, brecciated to conglomeratic, moist.

REF 35

CONGLOMERATE, dark yellowish brown, decomposed to moderately weathered, soft to hard, slightly fractured to unfractured, mud flow, moist, (MEHRTEN FORMATION).

REC=58%
ROD=52%

Weakly to strongly cemented.

57 35

SILTY SAND (SM), very dense, dark grayish brown, fine to coarse grained, grading to fine grained and dark brown, wet.

32 35

Well graded SAND with SILT and GRAVEL, (SW-SM), dense, dark brown, coarse SAND grading to fine SAND with coarse GRAVEL, wet.

90 35

Grading from fine to medium SAND to fine SAND.

77 35

Well graded SAND with GRAVEL (SW), very dense, black to very dark grayish brown, fine to medium SAND with coarse GRAVEL, wet.

Poorly graded SAND with SILT (SP-SM), very dense, olive gray, fine grained, micaceous, weakly to strongly cemented, moist to wet.

57 35

Lean CLAY/SILT (CL/ML), hard, dark reddish gray, trace carbon flecks and mica, moist.

6-18-03

234+45

On C/L Sta 234+50 m ℄"D13" Line

**03-6**

Est 37.0

8 6 4 2 Friction Ratio (%) — 10 20 30 Tip Bearing (MPa)

6-16-03

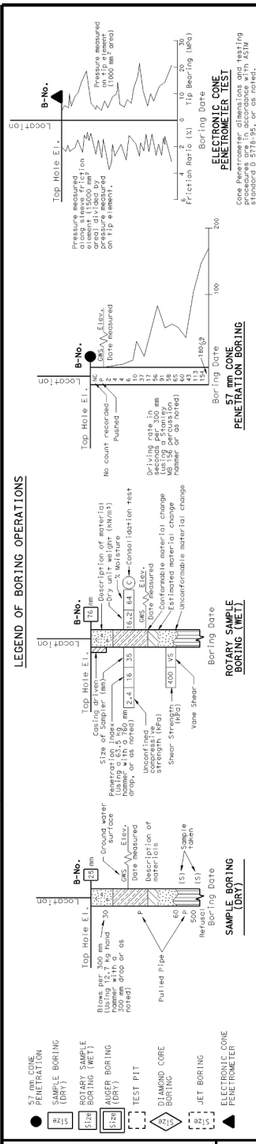
234+50

36 m / 33 m / 30 m / 27 m / 24 m / 21 m / 18 m / 15 m / 12 m / 9 m / 6 m / 3 m / 0 m

PROFILE
HOR. 1:20
VER. 1:100

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

## LEGEND OF BORING OPERATIONS




## LEGEND OF EARTH MATERIALS

GRAVEL; SAND; SILT; CLAY; SANDY CLAY or CLAYEY SAND; SANDY SILT or SILTY SAND; SILTY CLAY; CLAYEY SILT; PEAT and/or ORGANIC MATTER; COBBLES and/or BOULDERS; IGNEOUS ROCK; SEDIMENTARY ROCK; METAMORPHIC

## CONSISTENCY CLASSIFICATION FOR SOILS

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| SPT N-Value (Blows/0.3m) | Granular | SPT N-Value (Blows/0.3m) | Cohesive |
|---|---|---|---|
| 0-4 | Very Loose | <2 | Very Soft |
| 5-10 | Loose | 2-4 | Soft |
| 11-30 | Medium Dense | 5-8 | Firm |
| 31-50 | Dense | 9-15 | Stiff |
| >50 | Very Dense | 16-30 | Very stiff |
| | | >30 | Hard |

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 4/04)

Caltrans Metric

**GEOTECHNICAL SERVICES**

DRAWN BY: I. G-Remmen 10/05
CHECKED BY: J.Thorne

FIELD INVESTIGATION BY: J.Thorne

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF **CALIFORNIA** DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN

DESIGN BRANCH

CU 03
EA 3338U1

FILE => 19-0191_z_lotb-3of3.dgn

BRIDGE NO. 19-0191R
KILOMETER POST 23.30

# AUBURN RAVINE BRIDGE - RIGHT

## LOG OF TEST BORINGS 3 OF 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 12-26-05; 12-30-05

SHEET 23 OF 23

USERNAME => trlenard DATE PLOTTED => 16-NOV-2007 TIME PLOTTED => 10:24

# Appendix C

# DVD: Analysis Files

# Appendix D

# Oversize Exhibits