Appendix HY-1

Drainage Master Plan

STORM DRAINAGE MASTER PLAN

FOR

MATHER SOUTH

COUNTY OF SACRAMENTO, CA

NOVEMBER, 2017

NAVD88

PREPARED FOR:
SACRAMENTO COUNTY
DEPARTMENT OF WATER RESOURCES
827 7TH ST., RM 301
SACRAMENTO, CA 95814

PREPARED BY:
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9216 KIEFER BOULEVARD
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ABBREVIATIONS AND ACRONYMS

Ac	Acres
Approx.	Approximately
CFS	Cubic feet per second
Design standards	Sacramento County Improvement Standards & Sacramento County Hydrology Standards
Det.	Detention
DS	Downstream
FF	Finished floor
Ft	Feet
HEC	Hydrologic Engineering Center
HEC-HMS	Hydrologic Engineering Center- Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center- River Analysis System
HGL	Hydraulic Grade Line
LID	Low Intensity Development
msl	mean sea level
NAVD	North American Vertical Datum
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
Project area	Mather South Project Area
SacCalc	Sacramento County Hydrologic Calculator
SDMP	Storm Drain Master Plan
SAHM	Sacramento Area Hydrology Model
SWQ	Stormwater Quality
US	Upstream
USACE	U.S. Army Corps of Engineers
WS	Watershed
WSEL	Water Surface Elevation

EXECUTIVE SUMMARY

This Storm Drainage Master Plan prepared for the Sacramento County Department of Water Resources (DWR) addresses the drainage requirements for the Mather South Specific Plan (the "Project"). The Project is a planned 940± Ac mixed land use community in eastern Sacramento County, which includes single-family and multi-family residential, commercial/office land uses, parks and open space areas, and future educational uses.

The purpose of this study is to assist Sacramento County DWR in the evaluation of the proposed drainage facilities planned for the Project. This study is a part of the Mather Specific Plan Project. As such, this study is intended satisfy the requirements of Sacramento County for a large-scale drainage master plan for the Project, not design level detail normally intended for review and approval of small lot tentative maps.

This study, however, does include the hydrologic and hydraulic modeling of the flood control and hydromodification aspects of the Project. While the County has not adopted hydromodification standards as of this date, this master plan has been prepared with the understanding that the project must comply with the requirements of the MS4 permit, and that County Standards regarding hydromodification may change over the course of development.

Accordingly, no formal hydromodification analyses is presented in this master plan. Mitigation measures shown in this master plan are based on the un-adopted County Draft Hydromodification Management Plan that provide additional storage, outside of flood control storage. Naturally, the applicant assumes the risk that the County will adopt standards which may be different than the mitigation assumptions contained herein. Any such change may affect this hydromodification analysis . If this occurs, than the hydromodification facilities shown herein may need to be changed over time.

This study analyzes the drainage requirements for the Project to evaluate the ability of the proposed drainage facilities to maintain downstream drainage impacts at or below existing conditions. Based on the current Sacramento County Hydrology Standards, sufficient detail is presented in this study to establish conceptual backbone drainage system, tributary sheds, location drainage facilities, pre-development and post development flows, flood detention and water quality.

In general, this study will demonstrate how the project will:

- Comply with the latest DWR Master Plan requirements
- Establish a baseline for existing peak flows
- Attenuate developed condition peak flows to predevelopment levels
- Meet the minimum requirements for Stormwater Quality assurance
- Establish a Hydromodification Management Plan (HMP), including appropriate LID measures

Since this is a planning level drainage study for the Project, more detailed design calculations will need to be performed in the improvement plans that are approved for

each subdivision map recorded within the Project boundary over time. This level of analysis informs the planning process sufficiently to integrate drainage, water quality, hydromodification and LID features into the land use plan that will result in a comprehensively planned, aesthetically pleasing community.

1. Introduction and Background

1.1 Study Purpose and Objectives

The primary purpose of this storm drainage master plan is to present a planning document for the drainage and flood control system design that will serve the Project. This storm drainage master plan demonstrates how the Project intends to:

- Comply with the latest DWR Master Plan requirements
- Establish a baseline for existing peak flows
- Attenuate developed condition peak flows to predevelopment levels
- Meet the minimum requirements for Stormwater Quality assurance
- Establish a Hydromodification Management Plan (HMP)

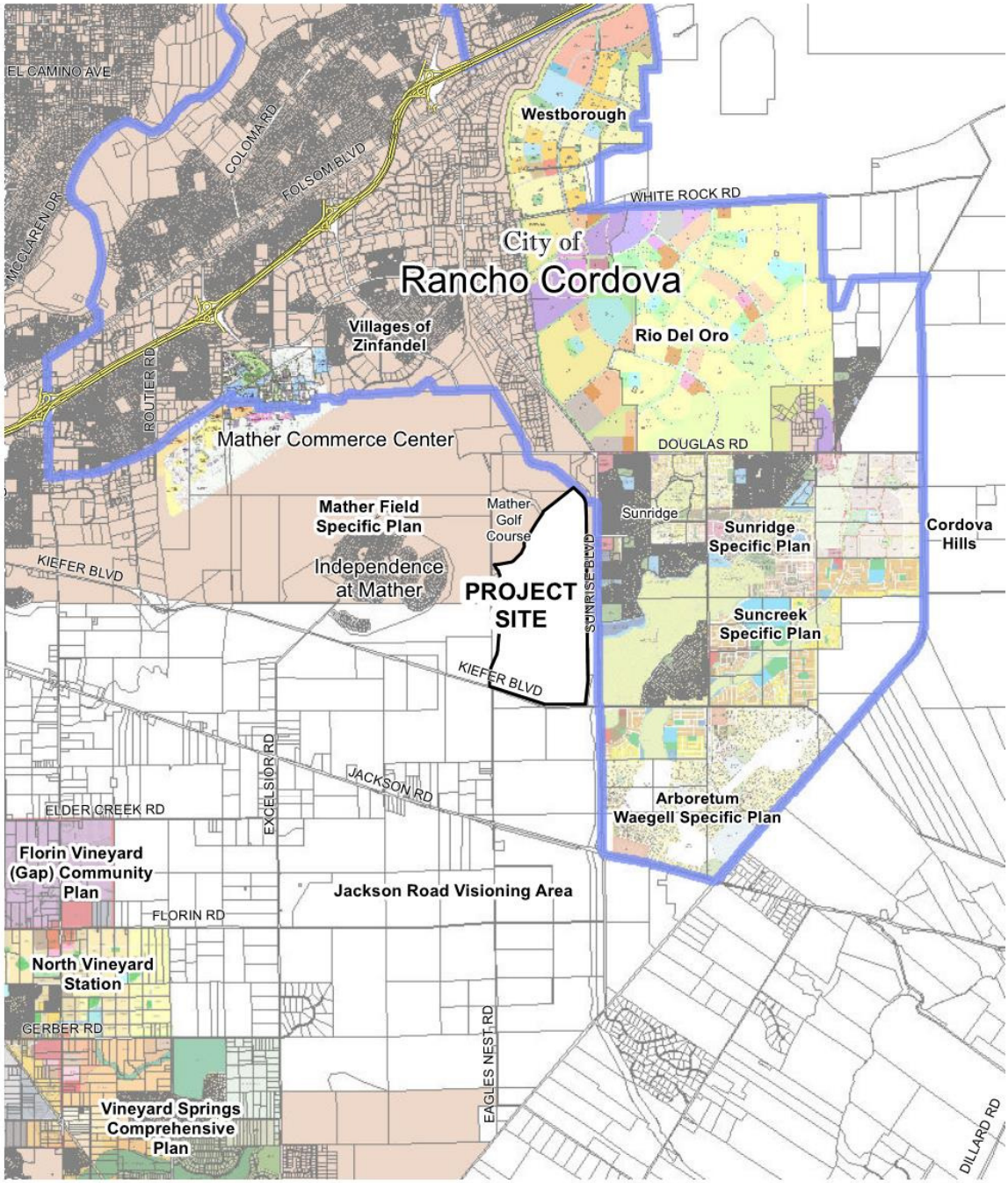
Since this is a planning level drainage study for the Project, more detailed design calculations will be performed prior to the approval of the tentative map level land use entitlements within the Project boundary over time. This level of analysis informs the planning process sufficiently to integrate drainage, water quality, and hydromodification into the land use plan.

1.2 Project Location

The Project is located in eastern portion of the County of Sacramento. The Project consists of a number of contiguous parcels that are bordered by Mather Golf Course and Mather Lake (just south of Douglas Road) on the north, Folsom South Canal and Sunrise Boulevard on the east, on the west by Eagles Nest Road (future Zinfandel Dr. Extension), and on the south by Kiefer Boulevard. South of Kiefer Boulevard is the NewBridge Specific Plan area and west of the Project is the Mather Preserve.

Exhibit A shows the relationship of the Project to other Specific Plans, and Rancho Cordova City Limits. The project is located within Sacramento precipitation Zone 2 and Nolte Zone 3.

EXHIBIT A – VICINITY MAP



1.3 Current Land Use

The property consists of a portion of the former Mather Air Force Base. The site contains abandon buildings, storage bunkers and an airstrip. A significant portion of the property consist of open space grasslands.

Existing zoning and land use per assessor's information is shown in **Table 1**:

Table 1 – Existing Zoning and Land Uses Within Study Area**

APN	Zoning	Land Use	Acreage (Approx.)
067-0030-072 (Ptn)	SPA	Vacant, Mather Field	244.4±*
067-0030-075	SPA	Vacant, Mather Field	2.3±
067-0030-076	SPA	Vacant, Mather Field	179±
067-0030-077	SPA	Vacant, Mather Field	44.3±
067-0030-028	RR	Folsom South Canal	12.8±
067-0030-036	RR	Folsom South Canal	13.3±
067-0090-034	SPA	Vacant, Mather Field	444.2±
		Total	940.3±

Note: Areas may not add due to errors in APN Acreages.
* The total area of the parcel is approximately 358.7 acres.
** Study area consist of east of Eagles Nest Road, west of Folsom South Canal, north of Kiefer Blvd and south of Mather Golf Course.
APN 077,076,075 and portion of 034 acreages are not a part of the future development.

1.4 Topography and Site Specific Design Considerations

The datum for this project is National Geodetic Vertical Datum of 1988 (NAVD88). The Project is described as flat to gently rolling terrain from a high of approximately 170 feet to a low of approximately 135 feet. The highest areas are in the northeastern boundary along the Folsom South Canal. The lowest area starts along Morrison Creek, from the eastern boundary of the site to the southwestern boundary of the site (near Eagles Nest Road and Kiefer).

A small portion of the Project's northern most quadrant drains to Mather Lake. Mather Lake, which is located outside the Project's boundary, drains to the upper reach of Mather Creek. The north central portion of the Project drains westerly to a tributary of Todd Creek. The south-central portions of the Project area sheet flows southerly to Morrison Creek which traverses the site from east to west.

The southern most portions of the Project drains southerly towards Kiefer Boulevard. Part of this area is tributary to Frye Creek and has been accounted for as a part of NewBridge master plan. All sheds (except shed FC21 draining southerly towards Kiefer Boulevard) are tributary to Morrison Creek at a point of confluence farther downstream of the Project area (near westerly Drive and Excelsior Road)

1.5 Proposed Land Use

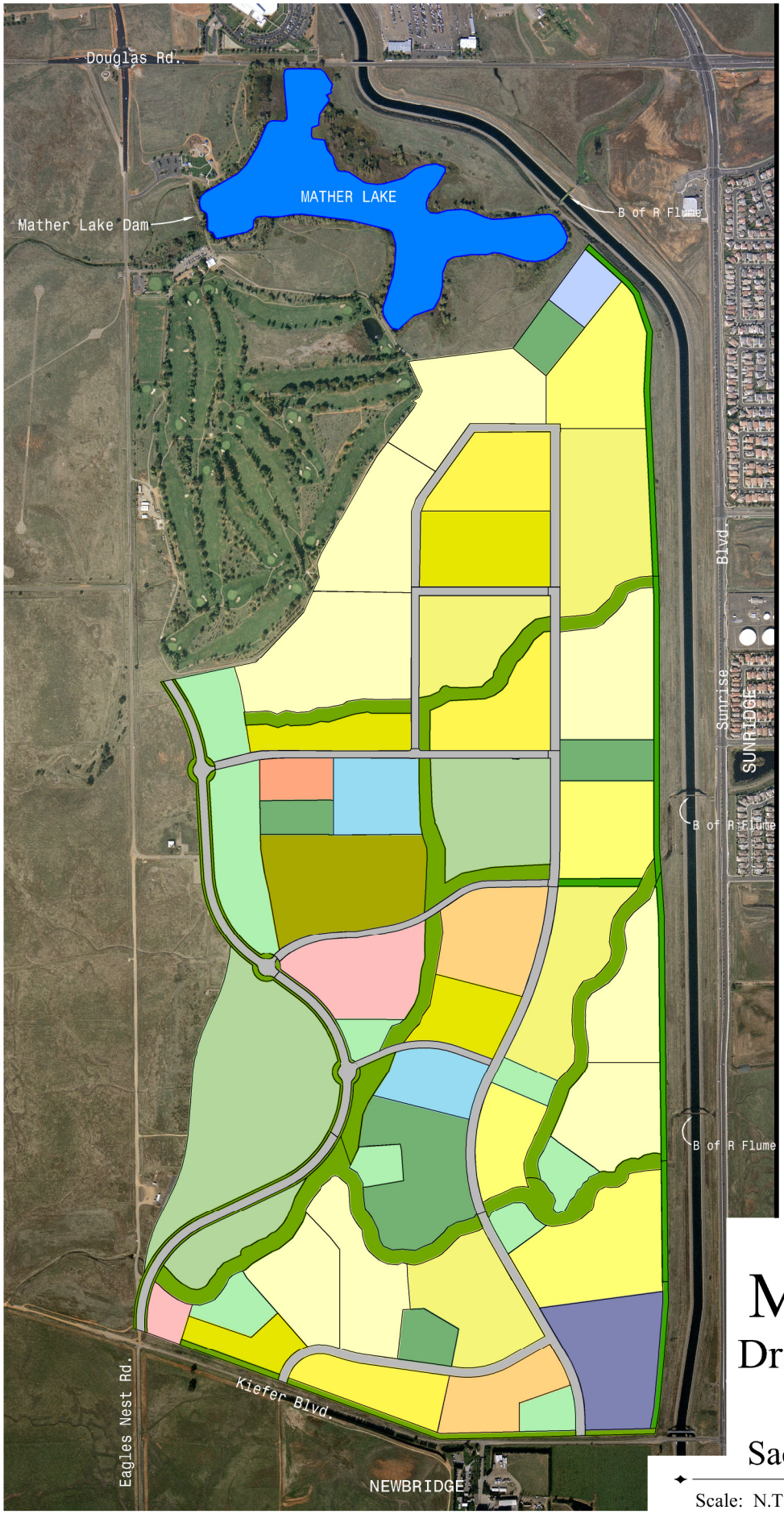
The Project proposes a mix of uses including single and multi-family residential, neighborhood parks, commercial, office, mixed-use, bike/trail system, school, environmental education campus, open space and open space preserves, collector, arterial and local roads. This master plan assumes the Zinfandel Drive Extension will be the western boundary of the development area, and the portion of property westerly thereof, including existing Eagles Nest Road and the proposed Zinfandel Drive Extension, will remain undeveloped. See **Exhibit B**.

The proposed land uses within the project area are shown in **Table 2**. The gross acreage of the project is approximately 940± acres and the net developable area is approximately 640± acres. The land use plan contains preserve, open space, and roadway acreage that may vary from this SDMP. These differences pertain to the gross drainage shed (940 acres) and the net developable land plan (848 acres).

Table 2 - Proposed Land Uses

Land Use Description [1]	Corresponding Land Use	Total Acres
Residential	Single Family	427.3
Mixed use, Commercial & Res	Mixed Use	27.1
Environmental Campus	Public Recreation	27.9
Neighborhood Park	Public Recreation	44.0
Open Space Trail	Public Recreation	13.5
Open Space (Basin)	Vacant	50.1
Open Space (Creek/Drain)	Vacant	55.8
Landscape Corridor	Public Recreation	4.9
Elementary School	Public Recreation	22.2
Plan Area Preserve/OS	Vacant	90.0
Open Space/Preserve	Vacant	86.2
Public	Public	5.3
Major Roads	Vacant	55.5
Zinfandel Landscape Corridor	Vacant	7.4
Research and Development	Public Recreation	21.4
	Sub-Total	938.4
	Less Open Space	295.6
	Net Developable	**642.8**

Note 1. Land Uses provided are based on February 2017 Land Use Plan and other drainage sheds associated with this drainage report. The total drainage of the Project site is approximately 940 acres. Property west of proposed Zinfandel Drive extension is not being developed as a part of this Project.



N

Legend

- Basin
- Commercial / Retail
- Community Center
- Environmental Campus
- Landscape Corridor
- Mather Preserve
- Open Space Drain
- Open Space Trail
- Park
- Public
- Research and Development
- Residential 5 du/ac
- Residential 6 du/ac
- Residential 7 du/ac
- Residential 8 du/ac
- Residential 10 du/ac
- Residential 20 du/ac
- Road
- School

Exhibit B

Mather South

Drainage Master Plan

Land Use Plan

Sacramento County, CA.

Scale: N.T.S.

February, 2017

MacKay & Somps
ENGINEERS PLANNERS SURVEYORS
1552 Eureka Road, Suite 100, Roseville, CA 95661 (916) 773-1189

2. Existing Conditions

2.1 Existing Site Conditions

The Project in its existing condition is primarily open and undeveloped with the exception of some abandoned buildings, minor access roads and under ground bunkers that are legacy features from the site's former use as a portion of Mather Air Force Base (now known as Mather Field). The only soil type is comprised of Hydrologic Soil Group Type C by the Natural Resources Conservation Service (NRCS) in the Soil Survey of Sacramento County.

The Project has fairly uneven topography with low rolling hills. The ground elevations vary from about 170 feet above mean sea level (msl) to about 135 feet above msl. A topographic map with aerial photography and ground contours at 1-foot intervals of the project area is attached as **Exhibit C.** Refer to **Exhibit E** for the existing conditions impervious area map.

During peak storm events, some of the local roads in the vicinity of the Project flood under existing conditions. Kiefer Boulevard (between Eagles Nest Road and Sunrise Boulevard), has experienced flooding at one time or another.

2.2 Existing Drainage Sheds

Based on the topographic information, the Project consists of seventeen (17) on-site existing drainage shed areas. One (1) on-site shed areas, located along the southern perimeter of the site contributes to Frye Creek, South of Kiefer Blvd, as a part of the NewBridge Master Plan. **Exhibit F** defines the approximate boundaries for each of the existing drainage sheds. Each of the sheds are labeled with a two letter prefix to identify which major creek tributary the shed areas drain to, and are follows:

FC – Frye Creek MC – Morrison Creek ML – Mather Lake TC-Todd Creek

An existing and proposed SacCalc model was created using information from GIS and the proposed Land Use Plan. Additionally, for the watersheds upstream Folsom South Canal, the existing and developed models use hydrographs provided by the County of Sacramento. Routing was not modeled in the SacCalc models where it is to be provided in HEC-RAS, instead it was modeled in an unsteady state HEC-RAS model. The basins are modeled using the volume discharge curve from excel files and the discharge hydrograph from each basin was input into the HEC-RAS model.

N

0 300 600

SCALE: 1"=300'

Exhibit C

Mather South

Drainage Master Plan

Existing Topography and Aerial Photography

Sacramento County, CA.

Scale: 1"= 300'

June, 201

MACKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
1552 Eureka Road, Suite 100, Roseville, CA 95661 (916) 773-1189

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[1] P:\27082\SRV\CS\Resolved\Bndy\MS-BNDY.dwg [2] P:\27082\SRV\Topo\MS_MD-E-TOPO-.dwg [3] P:\27082\MstrPln\Issues\FEMAFlood2012.dwg [4] P:\27082\Images\GEOMAPS\2011-12-09\ENR-IMG-2011-12-09.dwg
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Area Summary					
Shed ID	**Developed Area**	**%**	**Pervious Area**	**%**	**Grand Total**
SSP North	663.00	63.6%	379.50	36.4%	**1042.50**
SSP South	476.80	22.9%	1605.20	77.1%	**2082.00**
Grand Total	**1139.80**	**36.5%**	**1984.70**	**63.5%**	**3124.50**

N
W E
S
0 1,000 2,000
Feet

SSP North

SSP South

Legend

- Offsite Shed Area
- Developed Area
- Pervious Area

Exhibit D
Mather South
Drainage Master Plan
Offsite Drainage Sheds
Sacramento County, CA

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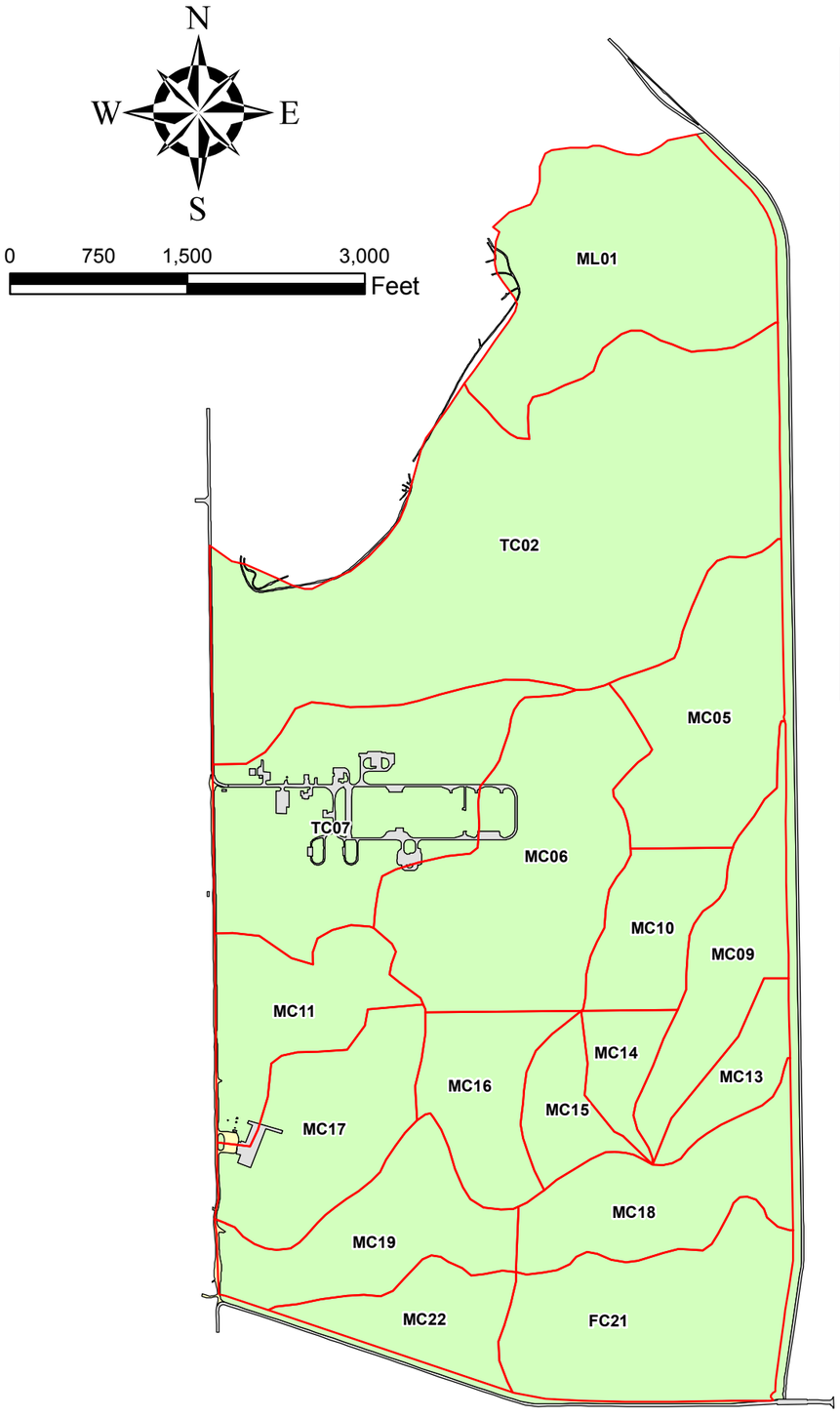
ENGINEERS PLANNERS SURVEYORS
1552 Eureka Road, Suite 100, Roseville CA. 95661
Job Number: 27082.00 Date: May, 2014



Existing Pervious / Impervious Area Summary by Shed							
Shed ID	**70% Impervious Surface**	**%**	**Impervious Surface**	**%**	**Pervious Suface**	**%**	**Grand Total**
FC21		0.00%	0.00	0.00%	69.41	100.00%	**69.41**
MC05		0.00%		0.00%	59.20	100.00%	**59.20**
MC06		0.00%	0.81	0.90%	88.95	99.10%	**89.76**
MC09		0.00%		0.00%	37.40	100.00%	**37.40**
MC10		0.00%		0.00%	26.63	100.00%	**26.63**
MC11	0.83	2.13%	0.33	0.85%	37.78	97.02%	**38.94**
MC13		0.00%		0.00%	16.08	100.00%	**16.08**
MC14		0.00%		0.00%	12.96	100.00%	**12.96**
MC15		0.00%		0.00%	16.53	100.00%	**16.53**
MC16		0.00%		0.00%	31.57	100.00%	**31.57**
MC17	0.40	0.82%	0.91	1.87%	47.38	97.31%	**48.69**
MC18		0.00%		0.00%	44.53	100.00%	**44.53**
MC19	0.32	0.73%		0.00%	44.20	99.27%	**44.53**
MC22		0.00%		0.00%	25.57	100.00%	**25.57**
ML01		0.00%	0.16	0.17%	91.43	99.83%	**91.58**
TC02		0.00%	0.78	0.35%	219.37	99.65%	**220.15**
TC07	0.39	0.44%	6.32	7.05%	82.88	92.51%	**89.59**
Grand Total	**1.94**	**0.20%**	**9.30**	**0.97%**	**951.88**	**98.83%**	**963.12**

Legend

- Existing Shed Areas
- Pervious Area
- 70% Impervious Area
- Impervious Area

Exhibit E

Mather South

Drainage Master Plan

Existing Impervious / Pervious Areas

Sacramento County, CA

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Job Number: 27082.00 Date: March 2017

N

0 300 600
SCALE: 1"=300'

Douglas Rd.

MATHER LAKE

Mather Lake Dam

B of R Flume

MC01
91.58 ac. ±

OSN1
L = 1659'
L = 3873'
L = 1303'
L = 2933'

OSN4
L = 1716'
L = 663'

OSN3
L = 2785'
L = 3682'
L = 2075'

OSN5
L = 2545'

OSN2
L = 1742'

L = 1044'

OSN6
L = 1405'
L = 549'

2-60" RCP

TC02
220.15 ac. ±
L = 3149'

L = 6721'

L = 2770'

Sunrise Blvd.

SUNRIDGE

TC07
89.59 ac. ±
L = 3799'
L = 3140'
L = 1393'

MC05
59.20 ac. ±
L = 1265'
L = 4131'

B of R Flume

2-60" RCP

MC06
89.76 ac. ±
L = 1357'

L = 1348'
L = 2610'

MC09
37.40 ac. ±

MC10
26.63 ac. ±

MC11
38.94 ac. ±
L = 2065'

36" CMP & 18" RCP
L = 635'

L = 1912'
MC14
12.96 ac. ±
L = 1970'

L = 2482'

MC16
31.57 ac. ±
L = 1833'
L = 2846'
L = 397'
L = 1604'

MC17
48.69 ac. ±

L=817'
MC13
16.08 ac. ±
L = 1677'

B of R Flume

L=730'
MC15
16.53 ac. ±

L = 1488'
L = 1415'
L = 3842'

2 - 6'x6' RCB

MC19
44.53 ac. ±
L = 1421'
L = 4012'

MC18
44.53 ac. ±

L = 3693'

FC21
69.41 ac. ±

L = 1352'
L=536'
MC22
25.57 ac. ±

L=2525'

Kiefer Blvd.

Eagles Nest Rd.

NEWBRIDGE

Legend

- Centroid
- Watercourse
- Shed Boundary
- Exisitng Flowline

Exhibit F

Mather South

Drainage Master Plan
Existing Drainage Sheds

Sacramento County, CA.

Scale: 1"= 300'

April, 2017

MacKay & Somps
ENGINEERS PLANNERS SURVEYORS
1552 Eureka Road, Suite 100, Roseville, CA 95661 (916) 773-1189

5-07-2017 13:36:05 jhames P:\27082\MstrPln\st\2017 Spring\Exhibit\Exhibit F_ Existing Sheds.dwg
[1] P:\27082\SPLY\tool\MS_MD-E-TOPO-.dwg [2] P:\27082\MstrPln\st\2017 Spring\bases\ExistingSheds.dwg [3] P:\27082\MstrPln\st\2017 Spring\bases\Existing_Sheds+MC1s.dwg

One or more shed areas from each of the above listed creeks impact the Project to one degree or another. Each of these existing shed areas are briefly described as follows:

- **On-Site Existing Sheds (To be developed not contributing to Morrison Creek):**
  - **Shed FC21**. Southerly off-site runoff from this shed (approximately - 69.4± acres) exits the Project near through an existing culvert under Kiefer Boulevard just west of the Sunrise Blvd. This shed then enters Frye Creek Tributary. Based on the Land Use Diagram (Exhibit B), the majority of this shed area will be developed.
- **On-Site Existing Sheds (Areas to be "Developed"):**
  - **Shed ML1.** This shed (approximately 91.6± acres) is in the northeast corner of the site. Runoff from Shed ML1 enters Mather Lake tributary. Based on the Land Use Diagram (Exhibit B), A portion of Shed ML1 is anticipated to be developed. This portion will shift from Mather Lake to the Todd Creek shed.
    - In discussions with the Sacramento County Economic Development and the Department of Water Recourses this shed shift exception was granted in 2015. See appendix D for exhibit.
  - **Shed TC2.** This shed (approximately 220.2± acres) is in the northern portion of the site. This shed exits the site through existing twin 60" culvert under Eagles Nest Road. This drainage shed is tributary to Todd Creek. Based on the Land Use Diagram (Exhibit B), most of Shed TC2 is anticipated to be developed, leaving the Todd Creek Corridor largely undeveloped.
  - **Shed MC5**. This shed, located immediately west of Folsom South Canal and immediately south of Shed TC2, contains approximately 59.2± acres. Tributary to this shed are Developed (offsite) flows from the East side of Folsom Canal crossing. Runoff from Shed MC5 and existing offsite enters Morrison Creek. This shed then exits the site at the southwestern boundary of the project and continues downstream. Based on the Land Use Diagram (Exhibit B), the majority of this shed area will be developed.
  - **Shed MC6**. This shed (approximately 89.8± acres) drains through center of the property. Shed MC6 drains into Shed MC16 and is inserted into the model to provide an in-stream compliance point for comparison with developed conditions flows. Based on the Land Use Diagram (Exhibit B), a portion of Shed MC6 is anticipated to be developed, leaving the upper reaches if Morrison Creek undeveloped.
  - **Shed TC7**. This shed (approximately 89.6± acres) drains through center of the property west to Eagles Nest Road and continues to

reaches of Todd Creek. Based on the Land Use Diagram (Exhibit B), approximately half of Shed TC7 is anticipated to be developed.

- **Shed MC9**. This shed, located immediately west of Folsom South Canal and immediately south of Shed MC5, contains approximately 37.4± acres. Runoff from Shed MC9 enters Morrison Creek. This shed then exits the site at the southwestern boundary of the project and continues downstream. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC09 is anticipated to be developed.
- **Shed MC10**. This shed, located immediately west of Folsom South Canal and immediately south of Shed MC5, contains approximately 26.6± acres. Runoff from Shed MC10 enters Morrison Creek. This shed then exits the site at the southwestern boundary of the project and continues downstream. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC10 is anticipated to be developed.
- **Shed MC13**. This shed, located immediately east of Shed MC9 and contains approximately 16.1± acres. Runoff from Shed MC13 enters Morrison Creek. This shed then exits the site at the southwestern boundary of the project and continues downstream. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC13 is anticipated to be developed.
- **Shed MC14**. This shed, located immediately west of Shed MC9 and contains approximately 13.0± acres. Runoff from Shed MC14 enters Morrison Creek. This shed then exits the site at the southwestern boundary of the project and continues downstream. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC14 is anticipated to be developed.
- **Shed MC15**. This shed (approximately 16.5± acres) drains south near at the north edge of Morrison Creek. Shed MC15 drains from Shed MC6 and enters the north side of Morrison Creek. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC15 is anticipated to be developed.
- **Shed MC16**. This shed (approximately 31.6± acres) drains south near at the north edge of Morrison Creek. Shed MC16 drains from Shed MC6 and enters the north side of Morrison Creek. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC16 is anticipated to be developed.
- **Shed MC18**. This south eastern shed (approximately 44.5± acres) drains north into the south side of Morrison Creek at the eastern Boundary of Folsom South Canal. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC18 is anticipated to be developed.
- **Shed MC19**. This south western shed (approximately 44.5± acres) drains north into the south side of Morrison Creek at the eastern Boundary of Folsom South Canal and is directly west of shed MC18.

Based on the Land Use Diagram (Exhibit B), the majority of Shed MC19 is anticipated to be developed.

- **Shed MC22**. Southerly off-site runoff from this shed (approximately 25.6± acres) exits the Project near the southwest corner of the site by breaching the existing surface of Kiefer Boulevard. This shed drains toward NewBridge Development and is conveyed directly though that project where it is discharged into its natural drainage course as is crosses Eagles Nest Road just south of Kiefer Blvd. Based on the Land Use Diagram (Exhibit B), the majority of Shed MC22 is anticipated to be developed.

- **On-Site Existing Sheds (Areas to be Remain as "Existing")[1]:**
  - **Shed MC11**. This shed (approximately 38.9± acres) drains near the center of the property west to Eagles Nest Road and continues to reaches of Morrison Creek. Based on the Land Use Diagram (Exhibit B), the majority of this shed area will remain largely undeveloped open space preserve, and a portion will be included in the right of way of Zinfandel Drive Extension.
  - **Shed MC17**. This south western shed (approximately 48.7± acres) drains south of the property. This shed enters the north side of Morrison Creek at the western Boundary of Eagles Nest Road. Based on the Land Use Diagram (Exhibit B), the majority of this shed area will remain largely undeveloped open space preserve, and a portion will be included in the right of way of Zinfandel Drive Extension.

- **Off-Site Sheds (Areas East of Folsom South Canal)[2]:**
  - **Shed SSP North**. This shed is located immediately east of Folsom South Canal and crosses the canal by use of an existing flume. The shed is approximately 1.63 square miles in size. The shed is currently partially developed and includes detention basins to mitigate runoff. The runoff crossing Folsom South Canal is limited by the capacity of the existing flume (341 cfs). This flow contributes to the northern branch of Morrison Creek.
  - **Shed SSP South**. This shed is located immediately east of Folsom South Canal and crosses the canal by use of an existing flume. The shed is approximately 3.25 square miles in size. The shed is currently partially developed and includes detention basins to mitigate runoff. The runoff crossing Folsom South Canal is limited by the capacity of

[1] These sheds are not proposed for development and they do not drain through the proposed drainage system that will be developed in conjunction with the project. These sheds are east of existing alignment of Eagles Nest Road and west of the new alignment of Zinfandel Drive Extension and will remain as existing conditions.
[2] These sheds are not proposed for development and hydrographs were provided by the County of Sacramento. See Appendix J for a memo regarding how these hydrographs were developed.

the existing flume (141 cfs). This flow contributes to the southern branch of Morrison Creek.

2.3 Existing Peak Flows

Existing flows and hydraulic conditions were analyzed to establish a base line for the proposed conditions and to determine necessary drainage improvements. As explained above, a hydrologic model of the project area watershed was created using the SacCalc computer program. The project is located within Sacramento precipitation Zone 2.

Several compliance points were developed to use for comparison purposes to determine the impact that the Project had on flows in the three creek systems that service the project site. These compliance points are briefly summarized in **Table 5** and shown in **Exhibit H**.

Table 3 – Existing Drainage Shed Peak Flows and Acreages

Shed Name	Acreages	10-Yr/24-Hr Flow (cfs)	100-Yr/24-Hr Flow (cfs)	100-Yr/10 Day Flow (cfs)
ML01	91.58	57	97	48
TC02	220.15	90	152	94
MC05	59.20	35	59	30
MC06	89.76	51	86	45
TC07	89.59	51	85	45
MC09	37.4	17	29	17
MC10	26.63	16	27	14
MC11	38.94	30	51	22
MC13	16.08	9.3	16	8.2
MC14	12.96	9.4	16	7.2
MC15	16.53	13	23	9.5
MC16	31.57	28	48	19
MC17	48.69	30	50	25
MC18	44.53	23	39	22
MC19	44.53	24	41	22
FC21	69.41	32	54	31
MC22	25.57	22	38	15

Table 3 provides the 10-year/24-hour, 100-year/24-hour and 100-year/10-day peak flow for each of the existing drainage sheds described above. The SacCalc computer program utilizes hydrologic criteria specified by the Sacramento County Hydrology Standards. The shed areas, detailed input parameters and output results (along with model files for existing conditions) are included in **Appendix A** of this report.

The existing conditions on-site watersheds were all delineated using the project topography. They are similar in size and shape to the watersheds found in the Zinfandel Drive Extension Drainage Study (Wood Rodgers 2011). Impervious surfaces were digitized using GIS software and an existing impervious percentage was obtained for each existing shed.

2.4 Existing Conditions Flood Plain

Existing flows and hydraulic conditions were then mapped to yield the existing 100-year/10-Day flood plain for Morrison Creek as shown in **Exhibit G**. The starting water surfaces for the 10-year 24-hour, 100-year 24 hour, and 100-year 10-day simulations through the project reach were developed assuming a base flow of 6.5 cfs for the northern branch of Morrison Creek and 4 cfs for the southern branch of Morrison Creek. The downstream water surface elevation was calculated based on the downstream channel slope of 0.4% and used as a normal depth calculation.

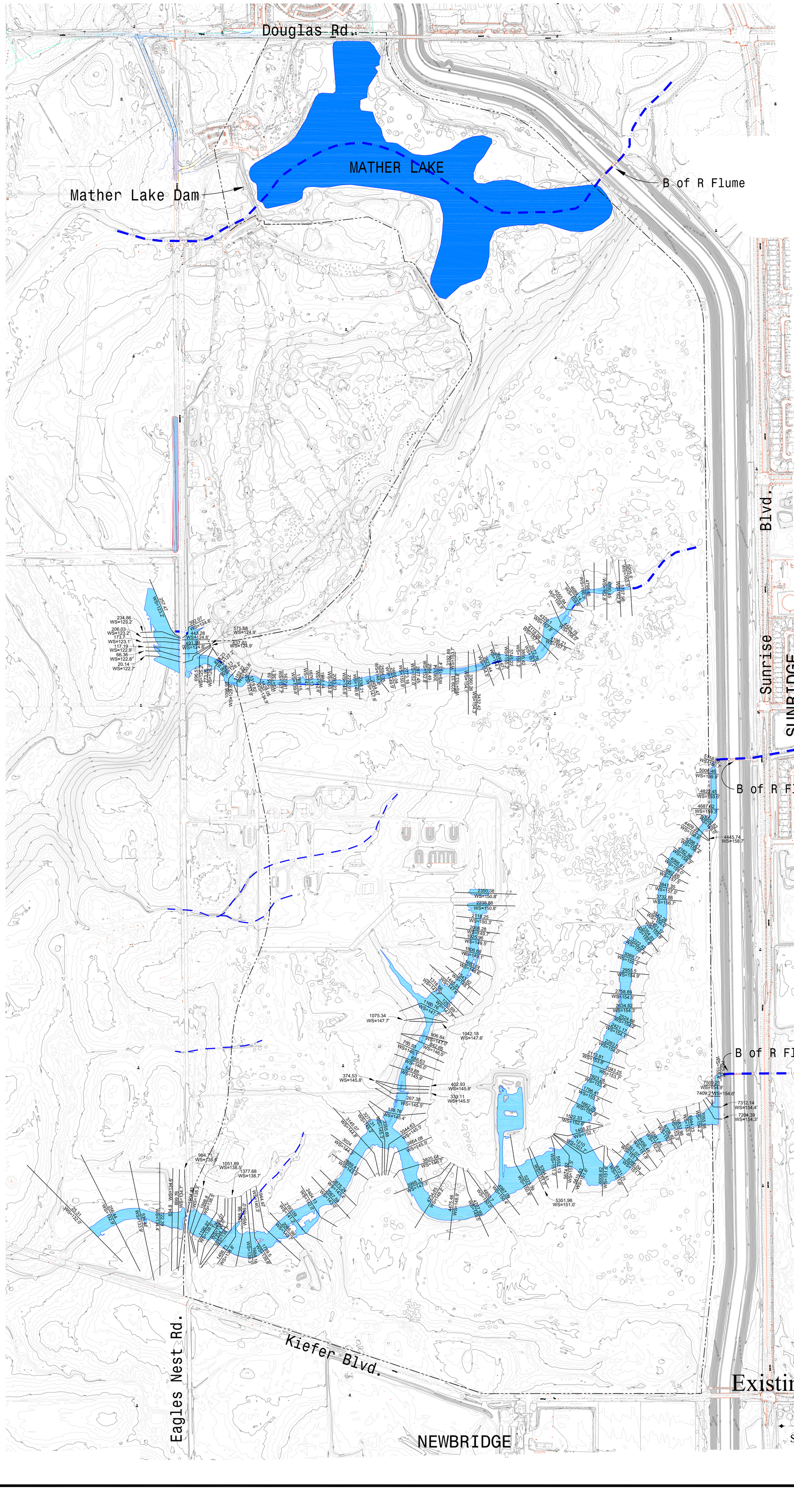

Exhibit G

Mather South

Drainage Master Plan

Existing 100 Year 10 Day Flood Plain

Sacramento County, CA.

Scale: 1"= 300'

October, 2017

MacKay & Somps
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[1] P:\27082\SRV\topo\MS_MB-E-TOPO--.dwg [2] P:\27082\Westfile\set1\2017_Summer\Bases\Existing_100_Year_Flood.dwg

3. Developed Conditions

3.1. Design Challenges

The proposed land use plan presents a unique opportunity to create a progressive, sustainable community. While some of these items are beyond our scope the community is set up to meet these challenges.

A significant challenge to create the unique character of the community will be the open channel flow and potential Low Impact Design (LID) strategies into the common areas in the community to provide both an aesthetically pleasing and a highly functional storm water treatment system.

Specifically, these challenges include developing areas to:

- Filter, infiltrate, evaporate and otherwise slow and/or reduce the amount and rate of surface runoff at the source.
- Maintain Todd Creek and Morrison Dry Creek beds while providing a variety of surrounding development.
- Incorporate vegetated swales and other water quality treatment features in the community's parks and recreation areas.
- Design permanent wet basins and landscape corridors that weave their way through the community and along Zinfandel Drive Extension.
- Integrate flood control detention and flow duration control basins into Morrison Creek.

3.2 Design Strategies

A unifying element of the land use plan is open space and habitat area that traverses the site from middle-east to southwest along the historic alignment of Morrison Creek. Today, this reach of Morrison Creek is nothing more than an ephemeral drainage course that is void riparian vegetation. As proposed, the development will weave its way around the heart of the surrounding dry creek beds.

Another element is Todd Creek. This central drainage course will take advantage of the natural fall and will remain undeveloped, however used for overland release during the 100 year storms.

Strategically located along Morrison Creek will be a series of off-line, multi-purpose detention basins. These basins will be deliberately located to accept all storm flows from the upstream development thereby creating a "clean" creek that meanders through the community. Other open space areas within the community offer similar opportunities to attenuate, mitigate and treat storm water runoff from the site prior to discharge into the neighboring creek systems.

A conceptual grading plan was developed for the proposed land use plan to determine the tributary drainage shed areas to each of the proposed detention

basins and potential LID features. See **Exhibit H**. Additionally, this conceptual grading plan was utilized to estimate the vertical fall that will be available in the developed condition to assure that elevation intensive LID features could, in fact, be utilized on this project.

In combination, the detention basins located along Morrison Creek and in the other open space areas of the community, and the extensive use of storm water control strategies and design features, will create a LID intensive drainage system will assure that the project mitigates its storm water impacts. At the same time, the proposed drainage system will create an aesthetically pleasing open space environment for the enjoyment of the residents of Mather South.

The Zinfandel Road has a unique 20' of Landscape corridor on each side to capture the water sheds shown on **Exhibit I**. Both sheds will be drained much like the existing condition today. The west side can drain to a drainage swale that would use LID features to capture runoff prior to entering the open space. The east side will mimic that and will ultimately drain in to Morrison creek after sufficient run off length is established in the future design of Zinfandel road.

Basin #1 has unique slope characteristics along Zinfandel Drive. Zinfandel Drive Extension (currently being designed by Wood Rodgers) has steep daylight slopes up to Basin #1 that vary as the proposed road rises from elevation 137' to about 152'. The top of the basin is a constant elevation of 147'. A landscape plan will be developed in the future to create a pleasing entrance; however**, Appendix G** shows example scenarios.

3.3 Developed Conditions Watershed Characteristics

Delineated on **Exhibit H** are the sheds for the developed conditions. All pertinent watershed characteristics are shown on these exhibits (watercourse lengths, centroids, areas, etc.). The developed conditions impervious areas are shown on **Exhibit I**.

3.4 Detention Basins

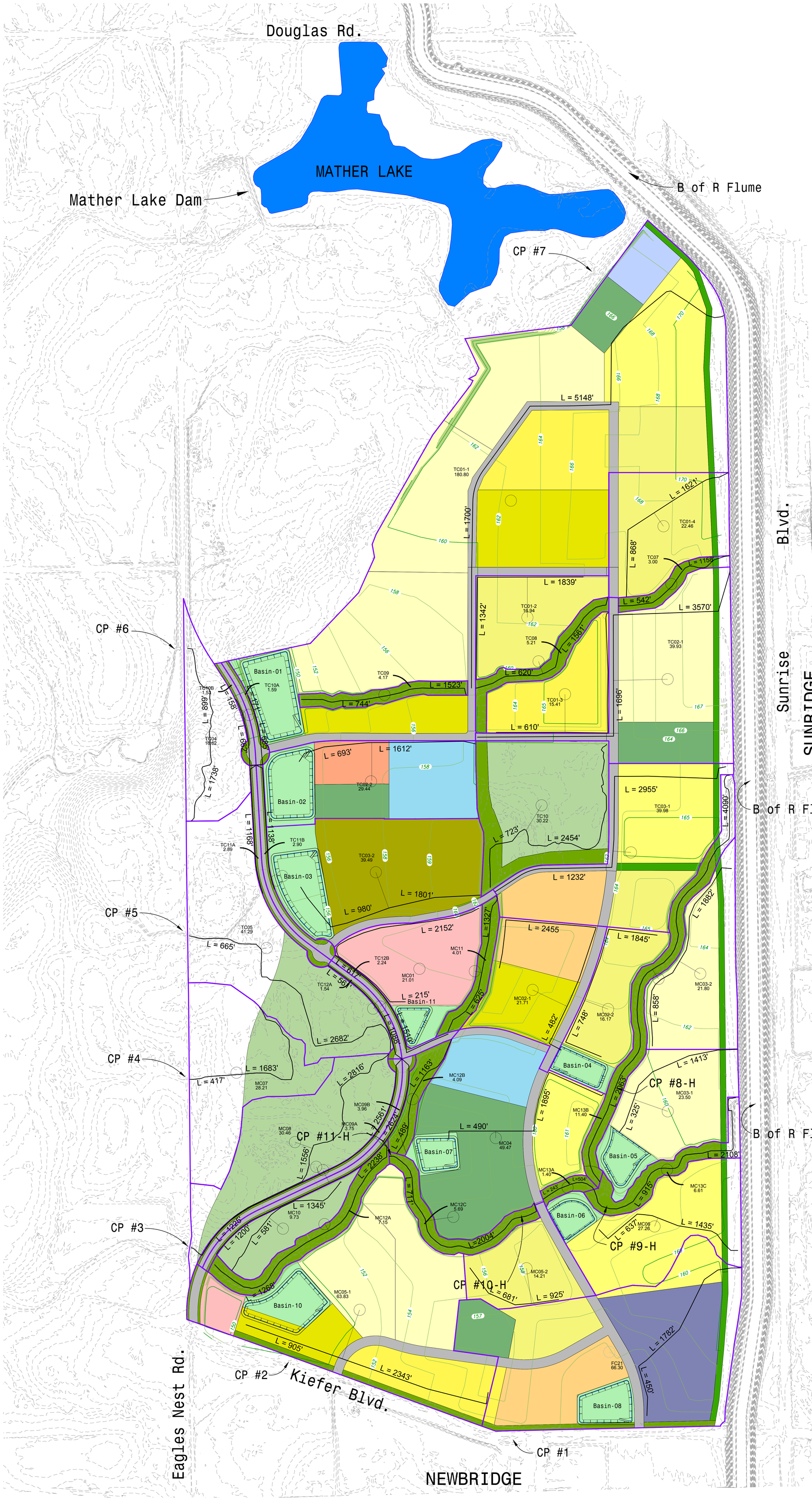
There are ten (10) detention, hydromodification and water quality basins proposed within the Project. Each of these basins will incorporate peak flow, hydromodification and water quality impact mitigation features. The location of each basin has generally been determined and preliminary sketches of how each basin will fit into its surroundings. Exhibits have been created to show how each preliminary each basin fits into the current land plan.

The location of these multi-purpose basins proposed for the Project as shown on **Exhibit J**. A summary of basin statistics (volumes, surface areas, etc.) are shown in **Table 4** with detailed statistics shown on **Exhibit J**. As explained above, these multi-purpose basins will be designed to provide peak flow attenuation and hydromodification flow duration control storage, in addition to wet

basin water quality treatment. These basins will be designed to accept piped and overland release flows from their respective watersheds.

Also, these multi-purpose basins will be designed to meet the requirements of the contributing watershed with a minimum of one foot of freeboard to basin top of bank elevations. In addition, to ensure safety of proposed houses from flood damage, the proposed pads will be designed to be at least 1.3 feet higher than the maximum water surface elevation of the downstream release point, including roads, at detention basins. The bottom of these multi-purpose basins will be set at an elevation above the 100-year WSE in the receiving water to ensure that the basins operate as designed and modeled. In some cases the basins may discharge further downstream then they would normally be to achieve this freeboard.

Exhibit H – Developed Conditions Drainage Shed Map



Legend

- Centroid
- Watercourse
- Major Shed Boundary
- Basin
- Commercial / Retail
- Community Center
- Environmental Campus
- Landscape Corridor
- Mather Preserve
- Open Space Drain
- Open Space Trail
- Park
- Public
- Research and Development
- Residential 5 du/ac
- Residential 6 du/ac
- Residential 7 du/ac
- Residential 8 du/ac
- Residential 10 du/ac
- Residential 20 du/ac
- Road
- School

WATERCOURSE LENGTHS ARE REDUCED FORM THE LENGTH SHOWN TO 90% OF THE LENGTH FOR THE SACCALC MODEL PER THE SACRAMENTO COUNTY DRAINAGE MANUAL VOL 2.

Exhibit H

Mather South

Drainage Master Plan
Developed Conditions
Drainage & Shed Map

Sacramento County, CA.

Scale: 1"= 300'

October, 2017

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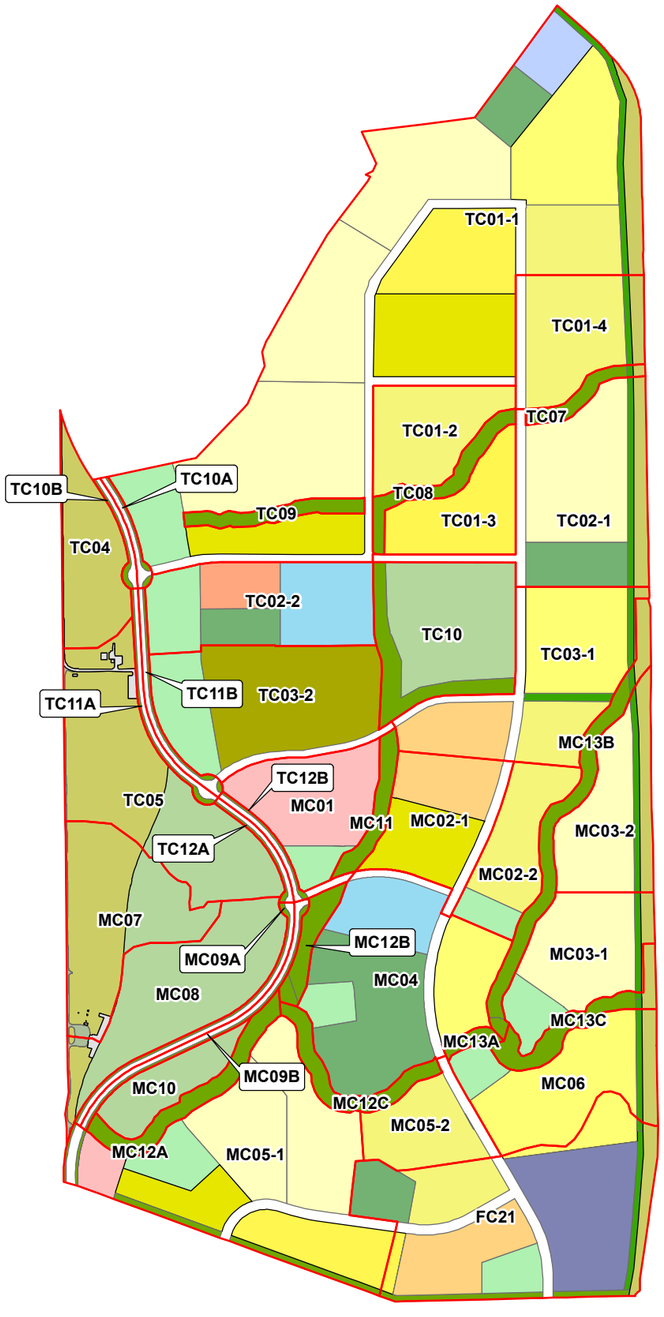
Shed Area Summary	Land Use																							
Shed ID	70% Impervious Surface	BASIN	COMMERCIAL / RETAIL	COMMUNITY CENTER	ENVIRONMENTAL CAMPUS	Impervious Surface	LANDSCAPE CORRIDOR	MATHER PRESERVE	OPEN SPACE DRAIN	OPEN SPACE TRAIL	PARK	Pervious Surface	PUBLIC	RESEARCH AND DEVELOPMENT	RESIDENTIAL 10 du/ac	RESIDENTIAL 20 du/ac	RESIDENTIAL 5 du/ac	RESIDENTIAL 6 du/ac	RESIDENTIAL 7 du/ac	RESIDENTIAL 8 du/ac	ROAD	SCHOOL	Grand Total
FC21		3.77					2.27			1.61	5.02	3.00		21.35		11.72		4.62	7.40	1.11	4.42		66.30
MC01		2.95	18.06																				21.01
MC02-1															10.37	8.68					2.66		21.71
MC02-2		3.03																0.01	13.13				16.17
MC03-1		4.29								0.95		1.21					17.05						23.50
MC03-2										1.91		4.37					15.52						21.80
MC04		3.29							0.02		22.48							10.14			3.57	9.97	49.47
MC05-1		5.45	3.28				3.02								6.87		30.56		0.02	10.73	3.91		63.83
MC05-2		0.00																0.00	12.39		1.82		14.21
MC06		3.07								1.05		2.64						20.50			0.00		27.26
MC07	0.83					0.35		8.73				18.30											28.21
MC08	0.52					0.23		27.97				1.74											30.46
MC09A							1.32														2.43		3.75
MC09B							1.32		0.00												2.63		3.96
MC10								9.73															9.73
MC11									4.01														4.01
MC12A								0.00	7.15														7.15
MC12B									4.09												0.00	0.00	4.09
MC12C									5.69												0.00		5.69
MC13A									1.40														1.40
MC13B									9.38	0.23		1.78											11.40
MC13C									5.13	0.16		1.32						0.00					6.61
TC01-1		8.03		0.00						2.78	4.95	5.04	5.27		27.70		69.68	19.37	10.50	15.08	12.41	0.01	180.80
TC01-2																			16.92		0.01		16.94
TC01-3																				15.37	0.02		15.40
TC01-4									0.01	0.85		1.91			0.00				17.56	0.00	2.13		22.46
TC02-1								0.00	0.00	1.97	7.03	4.46					21.84		0.00	0.00	4.62		39.93
TC02-2		6.88		5.80							4.55										0.00	12.20	29.44
TC03-1								0.00		1.87		0.50				8.68		16.74	6.96		4.22		38.98
TC03-2		9.34			27.90						0.00										2.25		39.49
TC04						0.47						16.15											16.62
TC05	0.39					0.97		16.33				23.60											41.29
TC07									2.65	0.12		0.23					0.00						3.00
TC08									5.21												0.00		5.21
TC09									4.16												0.00		4.17
TC10								23.33	6.87												0.01		30.22
TC10A		0.00					0.55														1.04		1.59
TC10B							0.59														0.94		1.53
TC11A							1.07														1.82		2.89
TC11B		0.00	0.00				0.97														1.93		2.90
TC12A							0.55														0.99		1.54
TC12B		0.00					0.58														1.66		2.24
Grand Total	1.74	50.10	21.33	5.80	27.90	2.02	12.25	86.10	55.77	13.49	44.03	86.25	5.27	21.35	44.95	29.07	154.66	71.39	84.89	42.30	55.50	22.18	938.35



Legend

- DevelopedSheds

Land Use

- 70% Impervious Surface
- ImperviousSurface
- Pervious Surface
- COMMERCIAL/RETAIL
- BASIN
- COMMUNITY CENTER
- ENVIRONMENTAL CAMPUS
- LANDSCAPE CORRIDOR
- MATHER PRESERVE
- OPEN SPACE DRAIN
- OPEN SPACE TRAIL
- PARK
- PUBLIC
- RESEARCH AND DEVELOPMENT
- RESIDENTIAL
- RESIDENTIAL 5 du/ac
- RESIDENTIAL 6 du/ac
- RESIDENTIAL 7 du/ac
- RESIDENTIAL 8 du/ac
- RESIDENTIAL 10 du/ac
- RESIDENTIAL 20 du/ac
- ROAD
- SCHOOL

N

W E

S

0 750 1,500 3,000

Feet

Exhibit I

Mather South

Drainage Master Plan

Developed Impervious / Pervious Areas

Sacramento County, CA

MACKAY & SOMPS

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1552 Eureka Road, Suite 100, Roseville CA. 95661

Job Number: 27082.00 Date: October, 2017

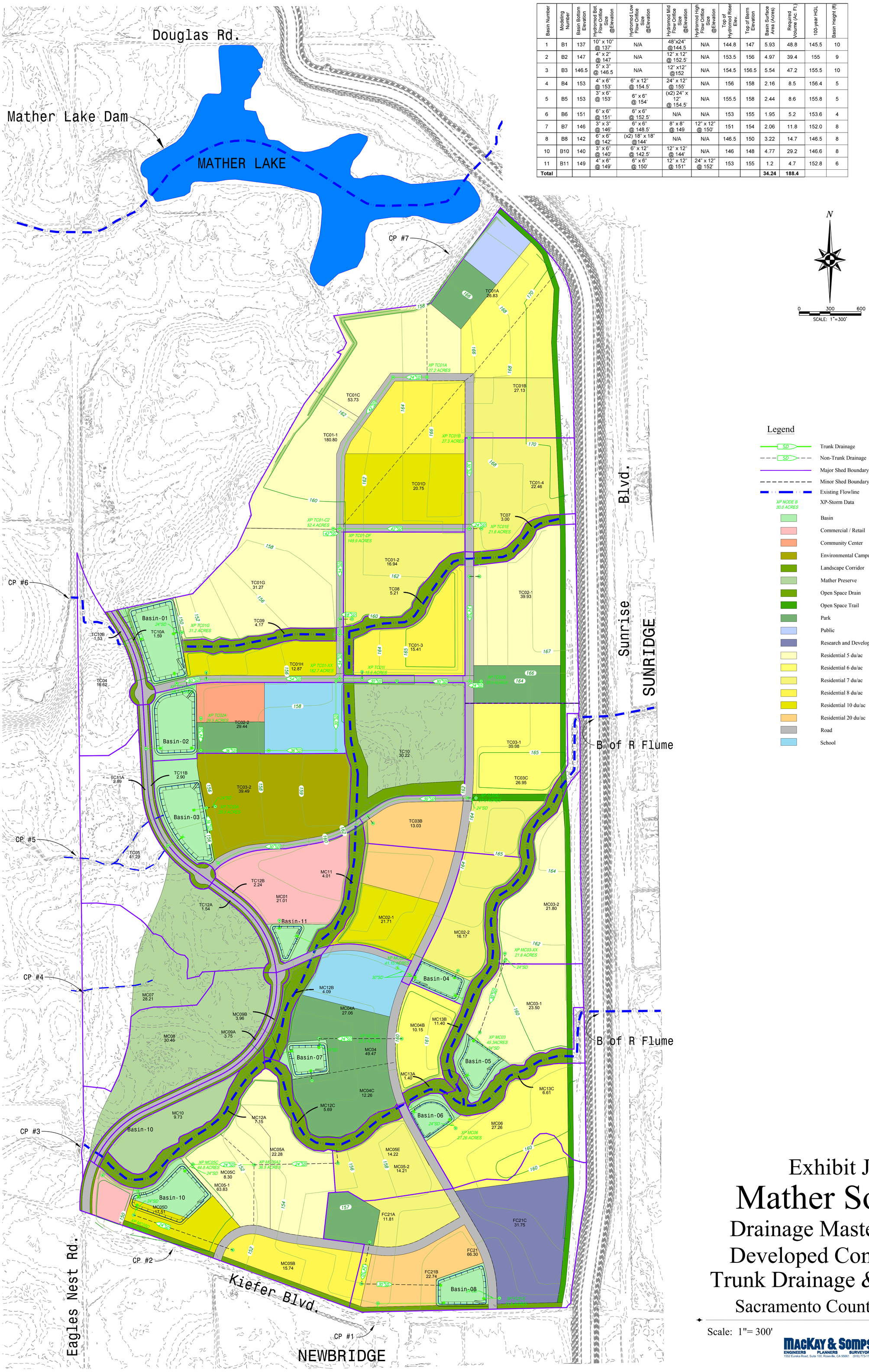
Table 4 – Detention Basin Statistics

Basin Number	Modeling Number	Basin Bottom Elevation	Hydromod Bot. Flow Orifice Size @Elevation	Hydromod Low Flow Orifice Size @Elevation	Hydromod Mid Flow Orifice Size @Elevation	Hydromod High Flow Orifice Size @Elevation	Top of Hydromod Riser Elev.	Top of Berm Elevation	Basin Surface Area (Acres)	Required Volume (Ac. Ft.)	100-year HGL	Basin Height (ft)
1	B1	137	10” x 10” @ 137’	N/A	48”x24” @144.5	N/A	144.8	147	5.93	48.8	145.5	10
2	B2	147	4” x 2” @ 147	N/A	12” x 12” @ 152.5’	N/A	153.5	156	4.97	39.4	155	9
3	B3	146.5	5” x 3” @ 146.5	N/A	12” x12” @152	N/A	154.5	156.5	5.54	47.2	155.5	10
4	B4	153	4” x 6” @ 153’	6” x 12” @ 154.5’	24” x 12” @ 155’	N/A	156	158	2.16	8.5	156.4	5
5	B5	153	3” x 6” @ 153’	6” x 6” @ 154’	(x2) 24” x 12” @ 154.5’	N/A	155.5	158	2.44	8.6	155.8	5
6	B6	151	6” x 6” @ 151’	6” x 6” @ 152.5’	N/A	N/A	153	155	1.95	5.2	153.6	4
7	B7	146	3” x 3” @ 146’	6” x 6” @ 148.5’	8” x 8” @ 149	12” x 12” @ 150’	151	154	2.06	11.8	152.0	8
8	B8	142	6” x 6” @ 142’	(x2) 18” x 18” @144’	N/A	N/A	146.5	150	3.22	14.7	146.5	8
10	B10	140	3” x 6” @ 140’	6” x 12” @ 142.5’	12” x 12” @ 144’	N/A	146	148	4.77	29.2	146.6	8
11	B11	149	4” x 6” @ 149’	6” x 6” @ 150’	12” x 12” @ 151”	24” x 12” @ 152’	153	155	1.2	4.7	152.8	6
Total									**34.24**	**188.4**		

These multi-purpose basins will operate independently of each other. Basins located along Morrison Creek will be off-line and discharge to the creek after mitigating peak flow and fully mitigating hydromodification and water quality impacts from their respective watersheds.

The basins that do not directly drain to Morrison Creek will, likewise, operate independently of each other. These basins will fully mitigate for the peak flow, hydromodification and water quality impacts from their respective watersheds prior to discharge to the local surface water drainage courses. To determine the conditions of the receiving watercourse a simple HEC-RAS model was made for each basin. This HEC-RAS model and inundation limits are not intended to be considered flood plains. Their purpose is to establish a probable water surface elevation in the downstream body of water during a 100-year event.
The basin bottom elevation was set above the 100-year discharge elevation to ensure that the basins operate independently of downstream conditions. Cross sections used in these models are found on **Exhibit K**.

Basin Number	Modeling Number	Basin Bottom Elevation	Hydromod Bot Flow Orifice Size @Elevation	Hydromod Low Flow Orifice Size @Elevation	Hydromod Mid Flow Orifice Size @Elevation	Hydromod High Flow Orifice Size @Elevation	Top of Hydromod Riser Elev.	Top of Berm Elevation	Basin Surface Area (Acres)	Required Volume (Ac. Ft.)	100-year HGL	Basin Height (ft)
1	B1	137	10" x 10" @ 137'	N/A	48"x24" @144.5	N/A	144.8	147	5.93	48.8	145.5	10
2	B2	147	4" x 2" @ 147	N/A	12" x 12" @ 152.5'	N/A	153.5	156	4.97	39.4	155	9
3	B3	146.5	5" x 3" @ 146.5	N/A	12" x12" @152	N/A	154.5	156.5	5.54	47.2	155.5	10
4	B4	153	4" x 6" @ 153'	6" x 12" @ 154.5'	24" x 12" @ 155'	N/A	156	158	2.16	8.5	156.4	5
5	B5	153	3" x 6" @ 153'	6" x 6" @ 154'	(x2) 24" x 12" @ 154.5'	N/A	155.5	158	2.44	8.6	155.8	5
6	B6	151	6" x 6" @ 151'	6" x 6" @ 152.5'	N/A	N/A	153	155	1.95	5.2	153.6	4
7	B7	146	3" x 3" @ 146'	6" x 6" @ 148.5'	8" x 8" @ 149	12" x 12" @ 150'	151	154	2.06	11.8	152.0	8
8	B8	142	6" x 6" @ 142'	(x2) 18" x 18" @144'	N/A	N/A	146.5	150	3.22	14.7	146.5	8
10	B10	140	3" x 6" @ 140'	6" x 12" @ 142.5'	12" x 12" @ 144'	N/A	146	148	4.77	29.2	146.6	8
11	B11	149	4" x 6" @ 149'	6" x 6" @ 150'	12" x 12" @ 151"	24" x 12" @ 152'	153	155	1.2	4.7	152.8	6
Total									**34.24**	**188.4**		



Legend

- Trunk Drainage
- Non-Trunk Drainage
- Major Shed Boundary
- Minor Shed Boundary
- Existing Flowline
- XP-Storm Data (XP NODE B 30.0 ACRES)
- Basin
- Commercial / Retail
- Community Center
- Environmental Campus
- Landscape Corridor
- Mather Preserve
- Open Space Drain
- Open Space Trail
- Park
- Public
- Research and Development
- Residential 5 du/ac
- Residential 6 du/ac
- Residential 7 du/ac
- Residential 8 du/ac
- Residential 10 du/ac
- Residential 20 du/ac
- Road
- School

Exhibit J

Mather South

Drainage Master Plan
Developed Condition
Trunk Drainage & Basins

Sacramento County, CA.

Scale: 1"= 300'

October, 2017

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ENGINEERS PLANNERS SURVEYORS
1552 Eureka Road, Suite 100, Roseville, CA 95661 (916) 773-1189

3.5 Drainage Study Requirements

The County Department of Water Resources has established specific criteria that are to be considered during the preparation of drainage studies. These requirements have been addressed in the preparation of this drainage study, with the major requirements having been discussed in other sections of this report.

There are, however, several lesser significant requirements that are appropriate to discuss in this section. The following discussion addresses these requirements:

a. Off-Site Drainage Improvements and Easements: Based on future phasing and the bordering NewBridge project there may be a need for off-site drainage improvements proposed for this project. Basin 8 is modeled to discharge flows to the southern property line at compliance point # 1 and eventually picked up by the NewBridge Storm Drainage Master Plan. All drainage impacts resulting from development of this project are mitigated on-site.

b. Drainage Improvement Impacts to Existing Habitat Features: No drainage improvements are proposed to occur within existing habitat features. As regard to Morrison and Todd Creek, the existing habitat features of the creek are being protected from disturbance. Except for roadway crossings, none of the proposed drainage improvements along the creek corridor (basins, outfalls, etc.) will occur outside of the existing habitat features. Roadway crossings of existing habitat features will be mitigated as a condition of the project's 404 permit.

c. Waters of the State and Waters of the US: The impacts of the proposed project on waters of the State and the US are being addressed separately from this drainage master plan as a part of the project's Section 404 permit application. The applicant will provide information on the Section 404 permit with the County Planning and Environmental Review Department and County DWR at the earliest possible date.

d. Preserve Operations & Maintenance Plan: A preserve operations and maintenance plan is being prepared as a part of the Section 404 permit process. Again, the applicant will provide information on the Section 404 permit with the County Planning and Environmental Review Department and County DWR at the earliest possible date.

e. US Army Corps of Engineers Section 404 Permit: As mentioned above, the applicant is processing a Section 404 permit with the Corps of Engineers. The details of this application will provide information on the Section 404 permit with the County Planning and

Environmental Review Department and County DWR at the earliest possible date.

f. Finance Plan and Supplemental Drainage Fees: A finance plan is being developed for the project. This finance plan will include the cost of drainage improvements and the various funding sources that will pay for these improvements. As the finance plan is developed the applicant will engage all County Departments in a discussion about how the required infrastructure will be financed over time. Capital and long-term maintenance costs will be considered in the financing plan.

g. Phasing Plan: A phasing plan for the project hasn't been developed at this point in time. The phasing plan will include a discussion on project phasing and the implications phasing will have on the financing program.

h. Detailed Detention Basin Configuration and Channel Rights-of-Way: This study was prepared to inform the environmental review of the proposed project to enable the County Board of Supervisors to approve a General Plan Amendment and a Specific Plan for the project area. Subsequent land use entitlement applications will be submitted over time to create zoning and approve small and large lot tentative subdivision maps.

   As such, this master plan has been prepared to a conceptual level of detail that is commensurate with the current planning entitlements being sought. Accordingly, while the conceptual detention basins and channels analyzed herein are shown in their approximate size, shape and location on the project exhibits, sufficient detail is provided herein to guide future detailed facility layout and design.

4. Developed Conditions Modeling

4.1 Compliance Points

Several compliance points were developed to use for comparison purposes to determine the impact that the Project had on flows in the three creek systems that service the project site. These compliance points are briefly summarized in **Table 5** and shown in **Exhibit H**.

Table 5 – Compliance Points

Compliance Point	SacCalc ID or HEC-RAS XS		Description
	Existing	Developed	
CP1	FC21	B8	Crossing at Kiefer Blvd. to Newbridge
CP2	MC22	None	Crossing at Kiefer Blvd. to Newbridge
CP3	7+22.39	7+22.39	Morrison Creek Crossing just d/s of Zinfandel Road
CP4	MC11	MC07	Crossing at Zinfandel Road to Morrison Creek
CP5	TC07	J-POC5	Crossing at Zinfandel Road to Todd Creek
CP6	4+43.28	4+43.28	Todd Creek just u/s of Zinfandel Road crossing
CP7	ML01	None[1]	ML01 to Mather Lake

Notes:

[1] Shed shift was approved in 2015. See appendix D.

4.2 Developed Conditions Flows

Developed condition flows to each detention basin were estimated using the County's Sac-Calc Hydrologic Calculator for the developed condition hydrology and HEC-RAS for unsteady state hydraulic analysis. The goal was to identify the required volume of storage required to eliminate any increase of peak flows in the project post development. Flows were estimated for the 10-year/24-hour storm, the 100-year/24-hour storm and the 100-year/10-day storm for the project site.

Modeling for the 10-year/24-hour storm, the 100-year/24-hour storm and the 100-year/10-day storm was performed. For the 100-year/24-hour storm event all detention basins were modeled as being full to the top of the hydromodification riser at the start of the model runs. This was done to account for storage from an earlier storm which may not be fully evacuated prior to the 100-year/24-hour event occurring. The detention basins are also sized to achieve at least one foot of freeboard for the 100-year water surface.

For the sheds upstream of the Mather South site, the same hydrographs that were provided by Sac County DWR for existing conditions were used in the developed conditions models (See Appendix J for hydrograph development memo). The results of this model are presented as the developed conditions in this storm drain master plan.

4.3 Modeling Results

A HEC-RAS model was created to route the upstream flows and project flows through Morrison Creek and Todd Creek. The HEC-RAS geometry was imported from AutoCAD Civil 3D with hydrology inserted from the SacCalc model. Two modeling scenarios were run to determine the impacts of development: Existing and Developed. For each of these two scenarios a 10-year, 100-year, and 100-year 10-day flow regime was run to show compliance of Morrison Creek discharge downstream of Zinfandel Drive and Todd Creek discharge downstream of Zinfandel Drive.

Manning's 'n' values, in existing and developed conditions, were modeled as 0.08 in both the channel and overbank areas. The channel itself is not proposed to be encroached on and therefore the geometry conditions should undergo no change in developed conditions. There is already upstream development which provides summertime flows through the project reach and therefore no additional vegetation is anticipated due to the proposed project.

Table 6 – Existing and Development Conditions Peak Flows (in cfs)

Compliance Point Number	Existing Conditions			Developed Conditions		
	10-yr/ 24-hr	100-yr/ 24-hr	100-yr/ 10-day	10-yr/ 24-hr	100-yr/ 24-hr	100-yr/ 10-day
CP1	32	54	31	13	37	29
CP2[1]	22	38	15	0	0	0
CP3	330	488	495	306	464	472
CP4	30	51	22	24	41	17
CP5	51	85	45	38	84	33
CP6	87	149	97	60	102	83
CP7[2]	57	97	48	0	0	0

Notes:

[1] Developed condition sheds shifts to CP3

[2] Developed condition sheds shifts to CP6

All required detention volumes required to attenuate developed conditions peak flows down to existing conditions levels will be provided in the on-site detention basins.

The required basin volumes are shown in **Table 7**. The bold numbers shown in **Table 7** represent the maximum detention volume for a particular detention basin. On a basin-by-basin basis, the proposed detention basins shown on **Exhibit J** and tabulated in **Table 4** meet and/or exceed the required volumes, as demonstrated in **Table 8**. SacCalc input and results for the developed conditions models are presented in **Appendix B**.

The outlet structure of each basin will include of a set of low flow culverts with an overflow pipe and an overflow weir. Hydromodification orifices will be included in each outlet structure to control the release of low intensity flows. All of the Basin bottom elevations shown are sufficient to prevent back water at the 100 year WSE of the connecting outfall.

4.4 Trunk Drainage System

The conceptual trunk drainage system for the project area is shown on **Exhibit J**. The trunk drainage system has been sized to meet County "Nolte" flow requirements for watersheds of 30-acres or more, as demonstrated by the XP-Storm Calculations contained in **Appendix C**. The project is located in Nolte Zone 3.

4.5 Developed Conditions Flood Plain

Developed flows and hydraulic conditions were then mapped to yield the developed 100-year/10-day flood plain for Morrison Creek and 100-year/24-hour flood plain for Todd Creek as shown in **Exhibit K**. Post development flood plain water surface elevations in Morrison Creek are at or below existing condition at the project limits (see **Exhibit G**).

Douglas Rd.

MATHER LAKE

Mather Lake Dam

B of R Flume

N

0 300 600

SCALE: 1"=300'

Legend

5006.5' WS=159.0'	HEC Cross Section Station and 100 Year Flood Elevation
	100 Year Flood Plain
	Existing Preserve Flowline
	Basin
	Commercial / Retail
	Community Center
	Environmental Campus
	Landscape Corridor
	Mather Preserve
	Open Space Drain
	Open Space Trail
	Park
	Public
	Research and Development
	Residential 5 du/ac
	Residential 6 du/ac
	Residential 7 du/ac
	Residential 8 du/ac
	Residential 10 du/ac
	Residential 20 du/ac
	Road
	School

Basin-01

Basin-02

Basin-03

Basin-04

Basin-05

Basin-06

Basin-07

Basin-08

Basin-10

Basin-11

Sunrise Blvd.

SUNRIDGE

B of R Flume

B of R Flume

B of R Flume

Eagles Nest Rd.

Kiefer Blvd.

NEWBRIDGE

Exhibit K

Mather South

Drainage Master Plan
Developed Condition
100 Year Flood Plain

Sacramento County, CA.

Scale: 1"= 300'

October, 2017

MacKay & Somps
ENGINEERS PLANNERS SURVEYORS
1552 Eureka Road, Suite 100, Roseville, CA 95661 (916) 773-1189

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Table 7 – Detention Basin Modeling Results

Basin No.	Modeling Number	Hydromod Volume (Ac-Ft)	100-Year 24-HR		100-Year 10-Day	
			Volume (Acre-Feet)	Water Surface Elevation	Volume (Acre-Feet)	Water Surface Elevation
1	B1	37.4	**43.1**	145.5	40.2	145.0
2	B2	27.4	**34.4**	155.0	27.4	153.5
3	B3	36.5	**41.7**	155.5	30.1	153.2
4	B4	5.5	**6.3**	156.4	5.9	156.2
5	B5	5.2	**6**	155.8	5.5	155.6
6	B6	3.4	**4.5**	153.6	4.0	153.3
7	B7	8.1	**9.8**	152.0	9.1	151.6
8	B8	11.8	**11.7**	146.5	10.2	145.9
10	B10	24.7	**27.7**	146.6	24.3	145.9
11	B11	3.7	**3.5**	152.8	3.1	152.4
	Total	163.7	188.7		159.8	

Notes:

[1] 100-Year/24-Hr Storage Volume is the maximum volume stored during the 100-Year/24-Hr event. This event starts with the Hydromod portion of the storage volume full.

Table 8 – Total Required Volumes

Basin No.	Required Storage Volume		
	Hydromod Volume (Ac-Ft)	100-Year /24-Hr Storage Volume[1] (Acre-Feet)	Total Required Volume[2] (Acre-Feet)
1	37.4	43.11	48.8
2	27.4	34.4	39.4
3	36.5	41.7	47.2
4	5.5	6.3	8.5
5	5.2	6	8.6
6	3.4	4.5	5.2
7	8.1	9.8	11.8
8	11.8	11.7	14.7
10	24.7	27.7	29.2
11	3.7	3.5	4.7
Total	**163.7**	**185.6**	**188.4**

Notes:

1 100-Year/24-Hr Storage Volume is the maximum volume stored during the 100-Year/24-Hr event.

2 Total Required Volume is the total storage volume with 1-ft of freeboard above the 100-Year/24-Hr water surface.

The location of the basins fit the land plan designated areas established on **Exhibit J**. Optimization of the proposed detention basins will be performed prior to the tentative map approval.

5. Hydromodification

In February 2013, Sacramento County, in cooperation with the Sacramento Stormwater Quality Partnership (SSQP), developed a Draft Hydromodification Management Plan (HMP) to comply with its current NPDES MS4 Permit from the Central Valley RWQCB. The HMP has not yet been approved, however at this time there are no formal hydromodification standards for the County of Sacramento. A model however is provided for review in this study.

While acceptance and the timing for final adoption of the HMP by the CVRWQB is not known, the project applicant has decided to introduce the project's strategy for compliance with hydromodification mitigation by providing a volume of water and outlet conditions similar to what would be provided under the previous draft HMP. It is understood by the project applicant that final acceptance by the CVRWQCB and/or similar standards adopted by Sacramento County could affect and require changes to the project site plan. The hydro-modification mitigation strategy should be evaluated prior to approval of tentative maps for the plan area depending on standards implemented.

It is understood that the final hydromodification management plan that the County may adopt will likely differ, perhaps significantly, from the County's Draft HMP as it existed in 2013. As such, the applicant for this project understands he is at risk should the future HMP standards differ from the assumptions built into this master plan.

The hydromodification strategy that will be employed for the Mather South community consists of the enlargement of the detention basins described above to provide the additional capacity required for hydromodification mitigation. In the absence of locally adopted standards, this project plans to utilize flow duration control structures in each of the detention basins to accomplish flow matching in the downstream creek systems.

The Sacramento Area Hydrology Model (SAHM) model was used to achieve an initial basin area and orifice sizing required to provide hydromodification mitigation. SAHM provides a watershed basin data input platform and produces compliance point output results. As the SAHM model is not adopted by the County of Sacramento the findings were taken as informational for the purpose of setting aside basin area for HMP requirements.

6. Stormwater Quality

To meet Sacramento County's stormwater quality requirements, as explained elsewhere in this master plan, the Project is proposing to incorporate all the basins to capture the required Storm Water Quality Volume (WQ_v). It is anticipated that a major portion of the landscape areas will consist of grass, trees, and native vegetation that could function as LID features. There is a great potential to add LID features within the project area during development of the project, however, these improvements are not needed as a part of the required water quality volume to meet the County's standards.

The proposed basins will function as wet basins under the County's design standards. **Table 9** provides the required stormwater quality volume summary, in addition to surface coverage acreage, stormwater quality depth, and treatment acreage for each of 10 wet basins. Detailed design of stormwater quality treatment in the basins and grassy swales, and calculations supporting the low impact development credits is beyond the scope of this report, but will be included in the future drainage studies prepared for small lot tentative map and rezoning approvals within the Project over time.

The proposed stormwater quality basins were conservatively sized assuming no LID features are included in the proposed development. The resulting stormwater quality calculations based on this conservative assumption are included in **Appendix E**.

As explained in Section 4.2, the project's ten (10) multi-purpose detention basins will be designed to attenuate peak flow and hydromodification flow duration control storage as well as provide stormwater quality treatment as permanent pool wet basins. Pursuant to the land plan, approximately 29.0± acre-feet of storage will be required for stormwater quality. This is in addition to the detention required for peak flow attenuation and hydromodification mitigation.

Table 9 – Stormwater Quality Basin Volumes
(Combination Wet Basins)

Basin Number	SWQ Treatment Area (Ac)	Required SWQ Volume	Proposed SWQ Basins		
		WQV, (Ac-Ft)	Depth (Ft)	Permanent Pool (Ac-Ft)[3]	Surface Area (Ac)
1	116.7	4.3	6	4.8	.80
2	278.0	10.4	7	10.5	1.50
4	41.9	2.1	5	2.5	0.50
5	45.3	1.4	4	2.4	0.60
6	27.3	1.0	4	2.0	0.50
7	45.9	1.4	4	1.6	0.40
8	69.1	3.5	4	3.5	0.80
10	78.2	3.3	4	4.0	1.0
11	21.3	1.6	4	2.0	0.50
Total	**723.7**	**29.0**		**33.3**	**6.60**

[3] Permeant pool volumes that are under Required SWQ are combination wet basins– See Appendix E for impervious factors.

7. Summer Nuisance Flow Control

Summer nuisance flows have recently become an area of concern for the regulatory agencies. Summer nuisance flows occur during the dry (summer) season and are mostly generated from the developments residents by over irrigation of landscaping, washing of vehicles and other domestic uses that results in water running off the development. Ephemeral tributaries that did not typically receive water runoff during the summer could become a perennial tributary due to summer nuisance flows. A component of the wetland permitting strategy for the project is to retain the ephemeral nature of the Creeks and to minimize the potential for the creek becoming a perennial steam after development occurs in the watershed.

Accordingly, the project proposes to address the impact of summer nuisance flows by retaining the summer nuisance flow runoff within the detention basins tributary to Frye Creek. These detention basins are designed as combination water quality / hydromodification / flood control basins. The storm drains pipes for each of these detention basins shed areas discharge into a permanent wet water quality basin which treats the development runoff through gravitational settling and biological processes.

Prior to Improvement Plan approval, a drainage study will need to be submitted prior to approval in accordance with the requirements outlined in the "Drainage Study Requirements" document dated June 12, 2008. The study shall describe permanent stormwater quality treatment facilities capable of treating stormwater to the satisfaction of the State Water Board for injection into the Mehrten formation in the infiltration trenches in the basins. Alternate solutions to percolations trenches shall be discussed in the study such as reuse of the collected summer nuisance flows for irrigation of public spaces, or rigorous LID measures, etc.

For reference the basin exhibits (**Appendix J**) show a percolation trench field through a pipeline network constructed within the floor of these detention basins. A typical percolation trench for the Todd and Morrison Creek detention basins will be designed as follows:

A typical percolation trench for the detention basins will be designed as follows:

Typical Percolation Trench Design

Total **Morrison Creek** and **Todd Creek** Watershed Area = 871.8± acres [7]

Less Creek Corridors = <56.2±> acres[4]

[4] Creek corridor watersheds will drain open space and will not contain urban nuisance flows.

Less Open Space/Preserve =	<170±> acres[5]
Less Open Space/Basin =	<52±> acres
Net Developable Nuisance Area =	583± acres
Total No. of Basins =	10
Average Development Area per Basin	= 583± acres / 10 basins
	= 58± acres / basin
Dry Season Flow per Average Basin	= 58± acres/basin at 0.001525 AF/Day[6]
	= 38000± gallons per day.

Assumed Percolation Rate below hardpan layer of 1-inch / hour (24 inches/day).[7]

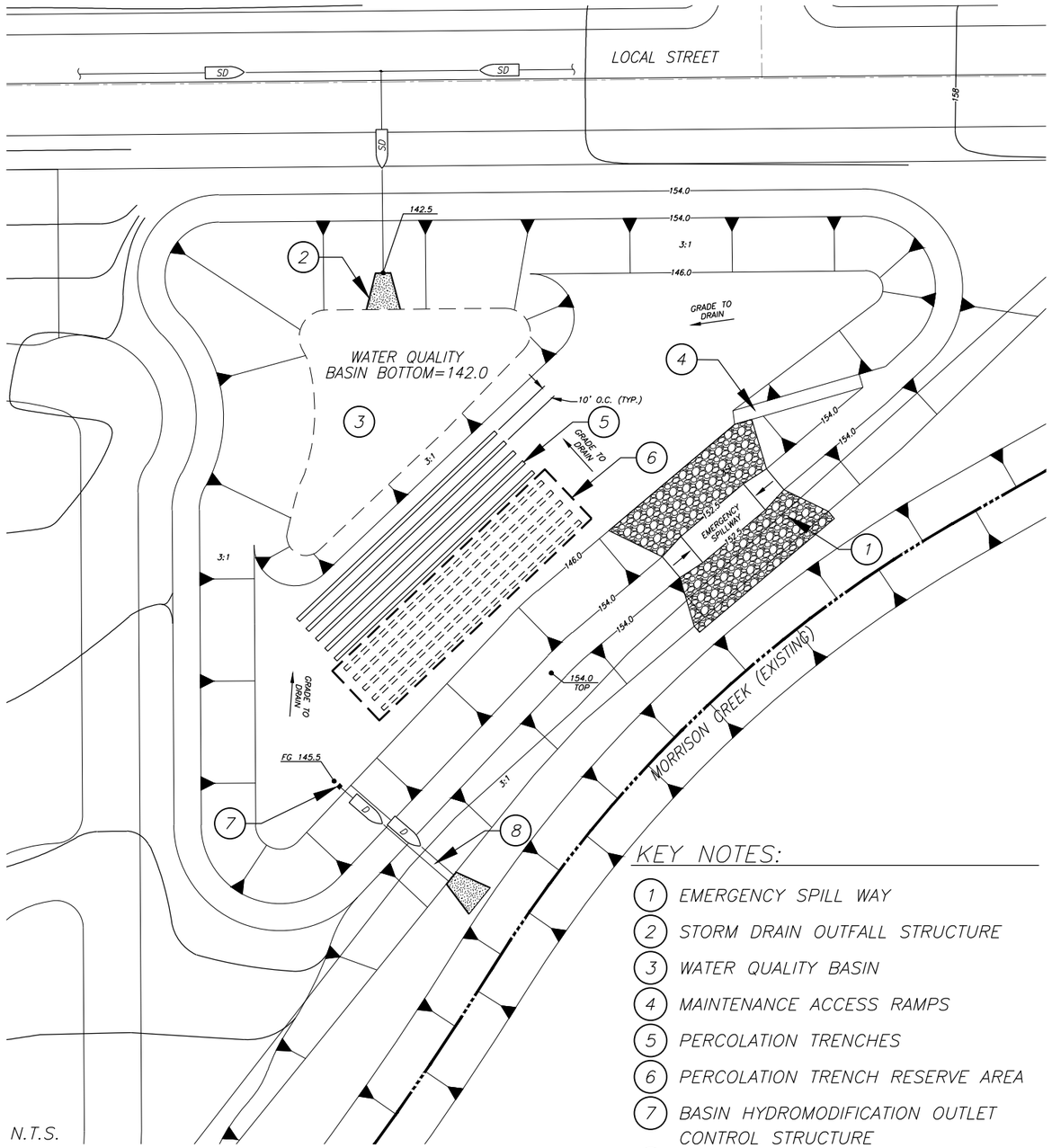
Assume 3-ft. wide x 200-ft. long Percolation Trench

Percolation Volume per trench per day	= (3-ft x 200-ft x 24-inches per day / 12-inches per ft) x 7.48 gallons per cubic foot
	= 8,976± gallons per day.
No. of Percolation Trenches required	= 38000± gpd / 8,976± gpd
	= 4.2± trenches/basin

Therefore, the average basin will include five (5) percolation trenches 3-ft. wide x 200-ft. long.

The above calculations for the percolation trenches show that the typical detention basin can mitigate the summer nuisance flow impacts. An allowance for the required percolation trench area (including 100% replacement area) has been provided in the layout of these basins. During the improvement plan phase, more detailed calculations will be required to address the summer nuisance flow volumes on a basin-by-basin basis. A prototypical detention basin layout, including a schematic cross-section, is shown in **Exhibit L.**

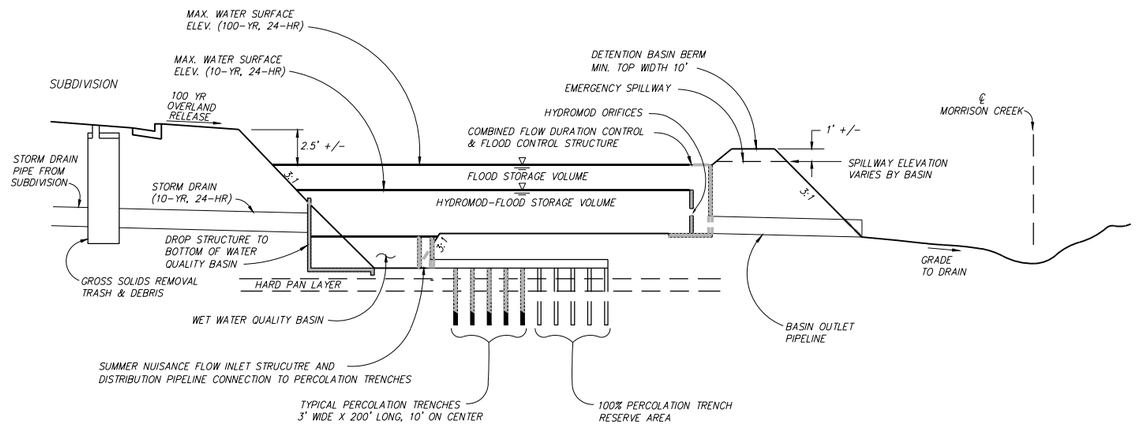
[5] Will not normally contain urban nuisance flows.
[6] Stormwater Quality Design Manual for the Sacramento Regions, dated May 2013, Table DB-2 Dry Weather Design Flows, Residential Basins 34, 63, 69, 132, average flow, page DB-9.
[7] Assumed percolation rate based on surrounding areas of underlying soils in the area. After soils analysis, actual design may vary.



N.T.S.

KEY NOTES:

1. EMERGENCY SPILL WAY
2. STORM DRAIN OUTFALL STRUCTURE
3. WATER QUALITY BASIN
4. MAINTENANCE ACCESS RAMPS
5. PERCOLATION TRENCHES
6. PERCOLATION TRENCH RESERVE AREA
7. BASIN HYDROMODIFICATION OUTLET CONTROL STRUCTURE
8. OUTLET PIPELINE



N.T.S.

Exhibit L

Mather South

Drainage Master Plan

Typical Hydro-Modification Detention Basin

Sacramento County, CA.

Scale: N.T.S. June, 2015

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8. LID Design Considerations

Using small, economical landscape features, LID techniques work as a system to slow, filter, evaporate, and infiltrate surface runoff at the source. While LID design calculations for a reduction in the required water quality and hydromodification volumes have not been incorporated in the calculations for this Project, various LID strategies can be incorporated into the design of each of the individual developments within the Plan Area, if desired.

The hydromodification and water quality facilities as proposed in this SDMP are adequate in accommodate site development without the need to utilize site-based LID strategies. As development of individual parcels occurs, each developer can incorporate LID design features into the on-site design of the project and reduce the size of the water quality and hydromodification basins accordingly, if desired.

9. Basin Design & Maintenance Considerations

There are numerous multipurpose basins proposed within the development. The Storm Drainage Master Plan shows the general location, shape and size of each basin. The Storm Drainage Master Plan also includes preliminary sketches of how each basin will fit into its surroundings.

9.1 Basin Design Considerations

The detention basins are a key component of a comprehensive storm water management and water quality system that extends throughout the developed portions of the Project Area. In addition to the basins, the system includes underground pipe conveyances and all of the surface components of that system (including inlets, maintenance access, and outfall structures). The overall drainage system will convey and treat storm runoff from the Project Area without reliance on on-site LID design features. As development of individual parcels occurs, each developer can incorporate LID design features into the on-site design of the project and reduce the size of the water quality and hydromodification basins accordingly.

The detention basins may hold water during and immediately after each storm.

The storm water and water quality features throughout the Project Area are an integrated management system. The detention facilities will be located at the edge of the drainage corridor where they will intercept run-off from the adjacent development areas before the water enters the main corridor. The basins will provide water quality treatment for urban run-off before such water enters the open space areas. Urban run-off water will first flow through the basin where water quality treatment will occur.

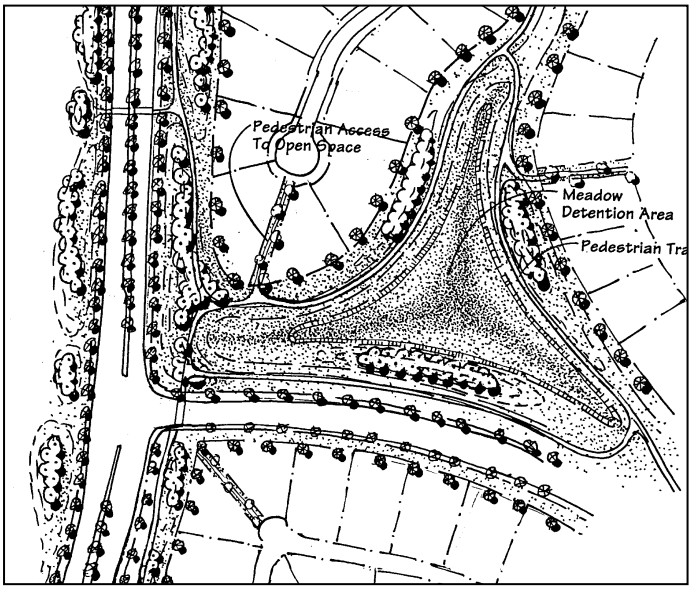
Although storm water management and water quality improvement are the primary functions, the detention facilities will also provide an aesthetic and informal recreation function. The basins will be an integral element of the amenities in open space buffer areas that also include naturalized landscaping and a bike and pedestrian trail system. Minor amenities such as benches, trashcans, and picnic tables may be located near the detention basins to enhance their recreational value. All improvements must be located outside of wetland preserve areas.

Typical basin feature located in the open space buffer areas will provide water quality treatment and storm water detention.

The detention basins will be visual amenities that include naturalized landscaping such as willow and native oaks, as well as native companion plant groundcovers and shrubs. With consideration to maintenance, requirements for the basin's primary functions of storm water management and water quality enhancement the design may allow for placement of boulders or other naturally occurring features that would enhance the aesthetics of the facility. The banks of the basins will be designed and graded such that public safety fencing shall not be required in most cases.

The basins will appear as a visual amenity and extension of the adjacent land use. Pedestrian paseos and other open space features could be designed into medium and high-density residential uses. Such facilities would include small basins and swales that are an integral part of the feature landscaping and interconnected with the overall storm water management system. The incorporation of these types of LID features into the on-site designs can reduce the size of the water quality and hydromodification features in the detention basins.

The parking areas in non-residential and multi-family residential uses may also function as part of the storm water management system. Parking areas and pedestrian areas may include landscaping features that function as storm water storage and water quality enhancements.



Individual subdivisions may include small basins as an entry feature.

Some basins may be located adjacent to and at the lower end of parks located throughout the Project Area. In these instances, the basins will include a portion that is typically quite shallow and will appear as an extension of the park. The basin will serve as a water quality enhancement feature that treats pollutants coming from the park turf and parking areas.

Multiple detention facilities allow for phased development of the Project Area. Basins can be designed and constructed on a phased basis to accommodate the storm flow from small sub-areas, and expanded over time as the need arises. Final design of each detention basin will occur as individual neighborhoods are developed and the need for mitigation of flows arises.

9.2 Detention Basin O & M Considerations

The proposed detention basins within the Project Area will require on-going operation and maintenance to assure they are functional over an extended period. Each basin will require an operation and maintenance plan that will need to be approved with the construction plans for the facility.

Parking lot landscaping can include water quality improvement features (LID features).

The purpose of this section is to identify and suggest the key considerations that should be included in a Basin Operation and Maintenance Plan (O&M Plan). In addition to O&M activities fall into several categories:

1. **Routine Maintenance Activities**. Primary maintenance activities include vegetation management and sediment removal. Mosquito abatement will be a concern if the detention basin is designed to include permanent pools of standing water.
2. **Prohibitions**. The use of pesticides and quick release fertilizers should be minimized, and the principles of integrated pest management (IPM) followed. The following is a list of suggested prohibitions:
    - Employ non-chemical controls (biological, physical and cultural controls) before using chemicals to treat a pest problem.
    - Prune plants properly and at the appropriate time of year.
    - Provide adequate irrigation for landscape plants. Do not over water.
    - Limit fertilizer use unless soil testing indicates a deficiency. Slow-release or organic fertilizer is preferable. Check with municipality for specific requirements.

- Pest control should avoid harming non-target organisms, or negatively affecting air and water quality and public health. Apply chemical controls only when monitoring indicates that preventative and non-chemical methods are not keeping pests below acceptable levels. When pesticides are required, apply the least toxic and the least persistent pesticide that will provide adequate pest control. Do not apply pesticides on a prescheduled basis.
- Sweep up spilled fertilizer and pesticides. Do not wash away or bury such spills.
- Do not over apply pesticide. Spray only where the infestation exists. Follow the manufacturer's instructions for mixing and applying materials.
- Only licensed, trained pesticide applicators shall apply pesticides.
- Apply pesticides at the appropriate time to maximize their effectiveness and minimize the likelihood of discharging pesticides into runoff. With the exception of pre-emergent pesticides, avoid application if rain is expected.
- Unwanted/unused pesticides shall be disposed as hazardous waste.
- Standing water shall not remain in the treatment and/or hydromodification management measures for more than five days, to prevent mosquito generation. Should any mosquito issues arise, contact the Sacramento-Yolo Mosquito & Vector Control District (SYMVCD), as needed for assistance. Mosquito larvicides shall be applied only when absolutely necessary, as indicated by the SYMVCD, and then only by a licensed professional or contractor.
- Contact information for SYMVCD is as follows:

  Sacramento-Yolo Mosquito & Vector Control District
  8631 Bond Road
  Elk Grove, CA 95624
  Phone 800-429-1022
  Fax (916) 685-5464

10. Summary / Conclusion:

The project is a mixed land use community located in eastern Sacramento County. The project's mix of land uses includes low to high-density and multi-family residential units, parks, open space areas, commercial/office land uses and school campuses.

This storm drainage master plan analyzed the existing and required drainage facilities that are necessary to serve the Project and mitigate peak flow, hydromodification and water quality impacts. The Project can develop as proposed by constructing the detention basins described herein while mitigating for the development's impacts. The multi-purpose detention basins include stormwater quality features, which will be kept in the wet condition during the summer months due to the anticipated summer nuisance flows, and hydromodification mitigation features.

In conclusion, this storm drainage master plan has demonstrated that the project can develop without impacting the predevelopment conditions in the downstream reaches of Morrison Creek, Todd Creek, Frye Creek, and Mather Lake.