WEST YOST
ASSOCIATES
Consulting Engineers

REGISTERED PROFESSIONAL ENGINEER
MARK O. KUBIK
No. 50963
Exp. 9-30-17
CIVIL
STATE OF CALIFORNIA

<u>TECHNICAL MEMORANDUM</u>

DATE:	October 6, 2016	Project No.: 276-10-16-29 SENT VIA: EMAIL
TO:	Mr. Michael Robertson, Baker-Williams Engineering Group	
FROM:	Mark Kubik, PE, RCE #C50963	
REVIEWED BY:	Millicent Cowley-Crawford, PE, RCE #C66597	
SUBJECT:	Lincoln Meadows Detention Basin Study	

INTRODUCTION

The Lincoln Meadows Project (Project) is a proposed 42-acre residential development located in a rural area northeast of the City of Lincoln in Placer County, California, northwest of the intersection of Hungry Hollow Road and Virginiatown Road (Figure 1). This area is currently not within the jurisdiction of the City of Lincoln, but is planned to be annexed prior to the completion of the Project, thus the development will be subject to the review and approval of the City.

Baker-Williams Engineering Group (Baker-Williams) retained West Yost Associates (West Yost) to perform a drainage study to assist with identifying potential flood-related Project impacts and to evaluate proposed mitigation measures. Baker-Williams has proposed two detention basins for construction with the Project. The detention basins will be designed to provide stormwater quality treatment and hydromodification management in compliance with the *West Placer Storm Water Quality Design Manual* (County of Placer, 2015) and flood control detention in compliance with the Placer County Flood Control and Water Conservation District's *Stormwater Management Manual* (PCFCWCD, 1994). Baker-Williams has performed the analysis to size the detention basins for stormwater quality and hydromodification management. West Yost performed a hydrologic and hydraulic analysis to determine the detention volume required to provide mitigation for potential flood impacts from the Project.

Hydrologic Setting

The site is located in California's Central Valley, not far from the foothills of the Sierra Nevada Mountain Range. The site consists of gently sloping grassland with elevations that range from approximately 219 feet (NGVD29) to 197 feet (NGVD29). Average annual precipitation is approximately 19.5 inches.

According to a geotechnical engineering investigation, performed by CTE CAL, Inc. (CTE CAL, 2015), soil in the area is generally dense or hard, being classified as Hydrologic Soil Group D, according to soil classifications by the Natural Resources Conservation Service. CTE borings identified medium dense to very dense gravelly clayey sand, dense to very dense silty sand, clayey sands, sandy clays and silty gravel. Existing wetlands and vernal pools were identified on the property, with groundwater generally 80-85 feet below grade, but as high as 9 feet below grade in some areas.

Existing Conditions

The property lies within two watersheds, with the northern portion of the property, approximately 30 acres, draining toward Markham Ravine the southern portion of the property, approximately 12 acres, draining toward Auburn Ravine. An irrigation canal owned by the Nevada Irrigation District (NID) passes through the site, entering at the northeast end of the Project and generally continuing south and west until it reaches the west boundary of the Project where the canal flows is replaced by two pipes that convey runoff to southwest corner of the Project (see Figure 1). One pipe is 10-inches in diameter and it accept normal irrigation flows. The other pipe is 18-inches in diameter and it acts to accept excess flow that exceeds the capacity of the smaller pipe. The NID canal intercepts some runoff that would otherwise drain north to Markham Ravine and redirects it south toward Auburn Ravine. The irrigation canal is trapezoidal in shape with a depth of 1.5 feet, a bottom width of 2 feet, and side slopes around 2H:1V. These dimensions are approximate and there are some variations along the canal. The capacity of the canal is relatively small, but some flood flows can be redirected by the ditch and this was factored into the analysis for Lincoln Meadows as discussed in more detail below. Runoff exits the Lincoln Meadows site at four locations. These locations are shown as the North Outfall, Southwest Outfall, South Outfall, and Southeast Outfall on Figure 1. Note that the Southwest Outfall includes the flow in both the 10-inch and 18-inch pipes that collect flow from the NID Canal at the west boundary of the Lincoln Meadows site.

Post-Project Conditions

After development of Lincoln Meadows, onsite runoff will continue to drain to both Markham Ravine and Auburn Ravine. The Project grading has been designed by Baker-Williams to keep the overall area draining to each of the major watersheds as close to the existing split as possible. Under post-project conditions 29 acres of the project site will drain north to Markham Ravine and 13 acres will drain south to Auburn Ravine. To mitigate for the potential increases in runoff due to development, two detention basins are proposed to be constructed with the Project, one for each of the major watersheds. The existing NID canal will be filled and replaced by an underground pipe that will continue to convey irrigation flows through the Project.

HYDROLOGIC MODELING

West Yost developed HEC-1 hydrologic models to calculate flood flows for existing pre-Project and post-Project conditions. The hydrologic models were developed based on the guidelines in the Placer County *Stormwater Management Manual* (PCFCWCD, 1990). The models were used to calculate flow hydrographs for the 10-year, 25-year and 100-year storm events with a 24-hour duration. These return periods are required to be analyzed when detention basins are being evaluated. Normally, the 2-year storm would be evaluated also. However, the hydromodification design is intended to control the smaller storm events through infiltration and storage within a layer of gravel and a layer of mulch. Therefore, the 2-year storm event was assumed to be controlled with these design features and it was not evaluated as a part of this flood control study.

Existing Conditions Hydrologic Modeling

Subshed boundaries for existing conditions are presented on Figure 1. Subsheds LMN1, LMN2, and LMN3 drain to the northwest corner of the Project (North Outfall) and ultimately to Markham Ravine. The combined area of these subsheds is 39.3 acres, which includes approximately 28 acres of the Project site and 10.3 acres of offsite area. Subsheds LMSW1, LMS1, and LMSE1 drain to the south end of the Project and ultimately to Auburn Ravine. The combined area of these subsheds is 12.9 acres, which includes approximately 12 acres of the Project site and 0.9 acres of offsite area.

Figure 1 also shows two additional subsheds located north of the Project site. These subsheds, NDAR3 and NDAR4, naturally drain to the north and west to Markham Ravine. Based on the natural flow path, runoff from these sheds would not enter the Lincoln Meadows Project. However, the NID canal passes through these subsheds and diverts some flow into Lincoln Meadows. Therefore, these subsheds were included in the HEC-1 model for Lincoln Meadows to help determine the flows that are diverted from these subsheds by the NID Canal. The NID Canal has limited capacity and not all flows that enter the canal can be contained in the canal. Excess flows will spill out of the canal and continue along the natural flow path. A hydraulic model of the NID canal was prepared using XP-SWMM to estimate the capacity of the canal north of Lincoln Meadows. From that model, it was determined that the bank-full capacity of the canal is approximately 13 cfs. Flows in excess of 13 cfs will overflow out of the canal and flow to the north and west to Markham Ravine along the natural path of the watershed. For the Lincoln Meadows hydrologic modeling, all flow in the NID Canal up to 13 cfs was assumed to flow through Lincoln Meadows to the southwest corner of the Project and on to Auburn Ravine.

Table 1 lists the key subshed parameters used in the hydrologic model. The subshed parameters for offsite Subshed NDAR4 were based on modeling prepared by Civil Solutions (Civil Solutions, 2002) for the environmental review phase of the adjacent Lincoln Highlands Project. The entire limits of the shed boundary for NDAR4 was not available from the Civil Solutions report and could not be verified due to a lack of topographic data. Therefore, only a small portion of this subshed is shown on Figure 1. Because the only way for runoff from this subshed to reach the Lincoln Meadows Project is via the NID Canal and that canal can only convey a small amount of the runoff generated from Subsheds NDAR3 and NDAR4 before flow will spill to the north away from Lincoln Meadows, the results of this study are not sensitive to potential discrepancies in the area of the Subshed NDAR4. Calculated peak flood flows from each subshed are summarized in Table 2. The calculated peak flows at each of the four outfalls from the Project site are presented in Table 3.

Table 1. Hydrologic Parameters															
		Kinematic Wave Overland Flow Parameters			Kinematic Wave Collector/Channel Parameters						Land-use, acres				
Subshed	Area, acres	Length, ft	Slope, ft/ft	Roughness Coefficient	Length, ft	Slope, ft/ft	Roughness Coefficient	Shape	Bottom Width or Diameter, ft	Side Slopes (H:V)	Ag/ Open Space 2%	Rural Res 5%	LDR 40%	Road/ Highway 95%	Watershed Impervious Percent
Markham Ravine Tributary Subsheds - Pre-Development Conditions															
NDAR4	45.7	200	0.02	0.4	3,000	0.0100	0.035	Trap	2	3:1	-	45.7	-	-	5.0
NDAR3	2.1	200	0.04	0.4	160	0.0140	0.035	Trap	10	30:1	-	2.1	-	-	5.0
LMN1	7.1	200	0.0300	0.4	120	0.0150	0.060	Trap	10	10:1	6.9	-	-	0.2	4.6
LMN2	23.1	300	0.0300	0.4	1,100	0.0100	0.045	Trap	10	30:1	23.0	-	-	0.1	2.4
LMN3	9.1	200	0.0150	0.4	1,000	0.0073	0.045	Trap	10	30:1	9.1	-	-	-	2.0
Markham Ravine Tributary Subsheds - Post-Development Conditions															
NDAR4	45.7	200	0.02	0.4	3,000	0.0100	0.035	Trap	2	3:1	-	45.7	-	-	5.0
NDAR3	2.1	200	0.04	0.4	160	0.0140	0.035	Trap	10	30:1	-	2.1	-	-	5.0
LMNP1	5.2	100	0.01	0.24	400	0.0150	0.015	Gutter	0.5	10:1	-	-	5.2		40.0
	Second Collector/Channel Element				400	0.0050	0.015	Circ	2.0	n/a	-	-	-	-	-
LMNP2	21.8	100	0.01	0.24	400	0.0250	0.015	Gutter	0.5	10:1	1.4	-	19.2	1.2	40.6
	Second Collector/Channel Element				1,530	0.0050	0.015	Circ	2.0	n/a	-	-	-	-	
LMNP3	6.3	100	0.01	0.24	370	0.0050	0.015	Gutter	0.5	10:1	1.0	-	5.3	-	34.0
	Second Collector/Channel Element				200	0.0050	0.015	Circ	1.5	n/a	-	-	-	-	-
LMNP4	6.2	200	0.0150	0.4	1,000	0.0073	0.045	Trap	10	30:1	6.2	-	-	-	2.0
LMNP5	0.9	300	0.027	0.4	290	0.0200	0.045	Trap	10	10:1	0.9	-	-	-	2.0
Auburn Ravine Tributary Subsheds - Pre-Development Conditions															
LMSW1	1.0	270	0.012	0.4	60	0.005	0.015	Circ	1	n/a	0.9	-	-	0.1	11.3
LMS1	10.8	300	0.03	0.4	500	0.0180	0.045	Trap	10	10:1	10.8	-	-	-	2.0
LMSE1	1.1	130	0.02	0.4	100	0.0100	0.045	Trap	10	20:1	1.0	-	-	0.1	10.5
Auburn Ravine Tributary Subsheds - Post-Development Conditions															
LMSWP1	1.0	270	0.012	0.4	60	0.0050	0.015	Circ	1	n/a	0.9	-	-	0.1	11.3
LMSP1	7.7	100	0.01	0.24	300	0.0100	0.015	Gutter	0.5	10:1	0.2	-	7.5	-	39.0
	Second Collector/Channel Element				650	0.0050	0.015	Circ	1.5	n/a	-	-	-	-	-
LMSP2	2.1	300	0.012	0.4	350	0.0080	0.045	Trap	10	40:1	2.1	-	-	-	2.0
LMSP3	0.6	40	0.02	0.11	360	0.0150	0.015	Gutter	0.5	10:1	-	-	-	0.6	95.0
LMSEP1	0.7	130	0.02	0.4	100	0.0100	0.045	Trap	10	20:1	0.6	-	-	0.1	15.3

Table 2. Calculated Subshed Peak Flows for Existing Conditions

Subshed	Area, ac	Storm Return Period		
		10-Year	25-Year	100-Year
Markham Ravine Tributary Sheds				
LMN1	7.1	7	10	15
LMN2	23.1	19	26	38
LMN3	9.1	9	12	18
NDAR3	2.1	2	3	5
NDAR4	45.7	43	59	86
Auburn Ravine Tributary Sheds				
LMSW1	1.0	Less than 1	Less than 1	1
LMS1	10.8	9	13	18
LMSE1	1.1	1	2	3

Table 3. Calculated Subshed Peak Flows for Post-Project Conditions

Subshed	Area, ac	Storm Return Period		
		10-Year	25-Year	100-Year
Markham Ravine Tributary Sheds				
LMNP1	5.2	7	10	15
LMNP2	21.8	31	42	61
LMNP3	6.3	9	12	18
LMNP4	6.2	5	7	10
LMNP5	0.9	Less than 1	1	1
NDAR3	2.1	2	3	5
NDAR4	45.7	43	59	86
Auburn Ravine Tributary Sheds				
LMSWP1	1.0	Less than 1	1	1
LMSP1	7.7	11	15	22
LMSP2	2.1	1	2	3
LMSP3	0.6	2	2	3
LMSEP1	0.7	Less than 1	1	2

Post-Project Hydrologic Modeling

For post-project conditions, subshed boundaries were redefined based on a preliminary grading plan prepared by Baker-Williams. Figure 2 shows the subsheds for post-project conditions. Subsheds LMNP1 through LMNP5 will drain to the northwest corner of the Project (North Outfall) and ultimately to Markham Ravine. These subsheds cover approximately 40.7 acres, 29 of which are located within Lincoln Meadows. Three of these northern subsheds, LMNP1, LMNP2, and LMNP3 will drain to a proposed detention basin to be constructed near the northeast corner of the Project site (see North Detention Basin on Figure 2). Subsheds LMNP2 and LMNP3 will be developed with single family residential homes as part of the Lincoln Meadows Project. Although Subshed LMNP1 is located offsite, it was assumed that this subshed will ultimately be developed with similar land uses and the North Detention Basin will be sized to provide stormwater quality, hydromodification, and flood control detention storage for the developed condition runoff from this subshed. Subsheds LMNP4 and LMNP5 were modeled as undeveloped and both of these subsheds will continue to drain to the northwest corner of the Project site without detention.

Subshed LMSWP1 will continue to drain to the Southwest Outfall. This subshed will remain as undeveloped open space and no detention is proposed for this subshed. Subsheds LMSP1, LMSP2, and LMSP3 will drain to the South Outfall. Subshed LMSP1 will drain to the South Detention Basin to be constructed at the south end of the Project. Subshed LMSP2 will remain undeveloped and runoff from this subshed will drain directly to a pipe system to be constructed in Virginiatown Road and will be discharged to the South Outfall on the south side of the road. Subshed LMSP3 represents a short reach of Virginiatown Road that will drain directly (without detention) into the pipe system to be constructed in Virginiatown Road. Most of subshed LMSEP1 will continue to drain to the Southeast Outfall and will not be developed or detained.

HEC-1 modeling was prepared to calculate the flood flow rates for post-project conditions. The post-project HEC-1 models were used to calculate flood flows from the Project site without including the effects of detention storage. The detention basins were evaluated with an XP-SWMM hydraulic model, as described in the next section. The post-project flood flows calculated with HEC-1 were used as input to the XP-SWMM models. Table 1 presents the key subshed parameters used in the hydrologic model for post-project conditions. Table 3 presents the calculated flood flows for each subshed. Table 4 presents the total flows calculated at each of the four outfalls for existing and post-project conditions without detention. This information was used to in conjunction with Figure 3 to determine the required target peak flood flows at the North and South Outfalls. Figure 3 is from the Placer County Flood Control and Water Conservation District's *Stormwater Management Manual*. Because the watersheds that are tributary to the Southwest and Southeast Outfalls are remaining as open space areas, the target flows at these outfalls are the same as the existing peak flow rates. The target flows are listed in Table 4.

Table 4. Calculated Peak Flows at Project Outfalls in cfs

Subshed	10-Year				25-Year				100-Year			
	Existing	Post-Project without Detention	Target Outflow	Post-Project w/ Detention	Existing	Post-Project without Detention	Target Outflow	Post-Project w/ Detention	Existing	Post-Project without Detention	Target Outflow	Post-Project w/ Detention
North Outfall	35	51	33	33	49	68	47	44	70	100	66	62
Southwest Outfall	14	14	14	No Detention Required	14	14	14	No Detention Required	14	14	14	No Detention Required
South Outfall	9	13	8	8	13	18	12	11	18	25	17	16
Southeast Outfall	1	1	1	No Detention Required	2	1	2	No Detention Required	3	2	3	No Detention Required

DETENTION BASIN ANALYSIS

As described above, two detention basins are proposed with the Project; one near the north end of the Project and one at the south end of the Project. The analysis for each of these detention basins is described below.

North Detention Basin

As shown in Table 4, the post-project peak flood flows at the North Outfall would increase by roughly 50 percent over the existing peak flows without construction of a detention basin. To mitigate for these potential increases, the flows from post-project Subsheds LMNP1, LMNP2 and LMNP3 will be directed into the North Detention Basin. A preliminary grading plan for the Project that includes the detention basin layout is provided in Appendix A. The detention basin will be designed to provide stormwater quality and hydromodification treatment and the worksheets prepared by Baker-Williams to size the basin for this purpose are provided in Appendix B. Based on these worksheets, there will be 0.4 feet of ponding in the detention basin for stormwater quality treatment/hydromodification mitigation. Therefore, in the XP-SWMM hydraulic model, the North Detention Basin was modeled with 0.4 feet of water in it at the start of the design storms simulation.

The elevation-volume data for the North Detention Basin is presented in Table 5. The outfall for the detention basin will consist of a concrete box with an open top. The box will include a 12-inch circular opening with an invert elevation of 198.15 feet (NGVD29), a 10-foot weir at elevation 199.3 feet (NGVD29), and a second 10-foot weir at elevation 200.4 feet (NGVD29). Two 36-inch pipes will convey flows out of the detention basin to a wide swale that will convey runoff to the North Outfall. A preliminary design of the outfall structure is provided in Appendix C.

As indicated in Table 4, construction of the North Detention Basin will achieve the flow attenuation required to meet the target outflows at the North Outfall. The maximum water surface elevations in the detention basin are provided in Table 6. The grading plan for the Project will be designed such that the proposed pads will have a minimum of two feet of freeboard to the maximum 100-year water surface elevation in the detention basin.

South Detention Basin

As shown in Table 4, without detention, the post-project peak flows at the South Outfall would increase by roughly 40 to 50 percent over the existing peak flows. To mitigate for these potential increases, the flows from post-project Subshed LMSP1 will be directed into the South Detention Basin. A preliminary grading plan for the Project that includes the detention basin layout is provided in Appendix A. The detention basin will be designed to provide stormwater quality treatment and hydromodification treatment and the worksheets prepared by Baker-Williams to size the basin for these purposes are provided in Appendix B. Based on these worksheets, there will be 0.4 feet of ponding in the detention basin for stormwater quality treatment/hydromodification mitigation. Therefore, in the XP-SWMM hydraulic model, the South Detention Basin was modeled with 0.4 feet of water in it at the start of the design storms simulation.

Table 5. North Detention Basin Elevation-Volume Data				
Elevation, feet, NGVD29	Depth, feet	Area, acre	Incremental Volume, acre-feet	Cumulative Volume, acre-feet
198.15	0	0	0	0
199.00	0.85	0.08	0.07	0.07
200.00	1.85	0.577	0.50	0.57
201.00	2.85	0.718	0.14	0.71
202.00	3.85	0.786	0.07	0.77
203.00	4.85	0.854	0.07	0.84

Table 6. Detention Basin Peak Water Surface Elevations in feet (NGVD29)					
Detention Basin	10-Year Storm	25-Year Storm	100-Year Storm	Detention Basin Embankment Elevation	Lowest Adjacent Pad Elevation
North Detention Basin	200.65	201.02	201.50	203.00	204.50
South Detention Basin	199.23	199.51	199.81	201.50	205.50

The elevation-volume data for the South Detention Basin is presented in Table 7. The outfall for the detention basin will consist of a concrete box with an open top. The box will include a 10-inch circular opening at invert elevation of 197.30 feet (NGVD29), a 1.5-foot weir at elevation 198.3 feet (NGVD29), and a 2.3-foot weir at elevation 199.3 feet (NGVD29). Three 15-inch pipes will convey flows out of the outlet box to the proposed pipe system in Virginiatown Road. The roadway pipe system will convey runoff to the South Outfall on the south side of Virginiatown Road. A preliminary design of the outfall structure is provided in Appendix D.

As indicated in Table 4, construction of the South Detention Basin will achieve the flow attenuation required to meet the target outflows at the South Outfall. The maximum water surface elevations in the detention basin are provided in Table 6. The grading plan for the Project will be designed such that the proposed pads will have a minimum of two feet of freeboard to the maximum 100-year water surface elevation in the detention basin.

Table 7. South Detention Basin Elevation-Volume Data

Elevation, feet, NGVD29	Depth, feet	Area, acre	Incremental Volume, acre-feet	Cumulative Volume, acre-feet
197.3	0.00	0.00	0.00	0.00
198.00	0.70	0.053	0.04	0.04
199.00	1.70	0.192	0.14	0.18
200.00	2.70	0.233	0.04	0.22
201.00	3.70	0.274	0.04	0.26
201.50	4.20	0.295	0.01	0.27

CONCLUSIONS

Without mitigation, the proposed Lincoln Meadows Project could increase peak storm flows downstream from the Project. The potential Project impacts can be mitigated with the construction of two detention basins as described herein. With construction of the basins, the post-project peak flood flows discharged to the Project outfalls will be reduced to 85 to 94 percent of the existing peak flood flows from the developed portions of the Project. The peak flows from the undeveloped watersheds within the Project area will match existing flow rates.

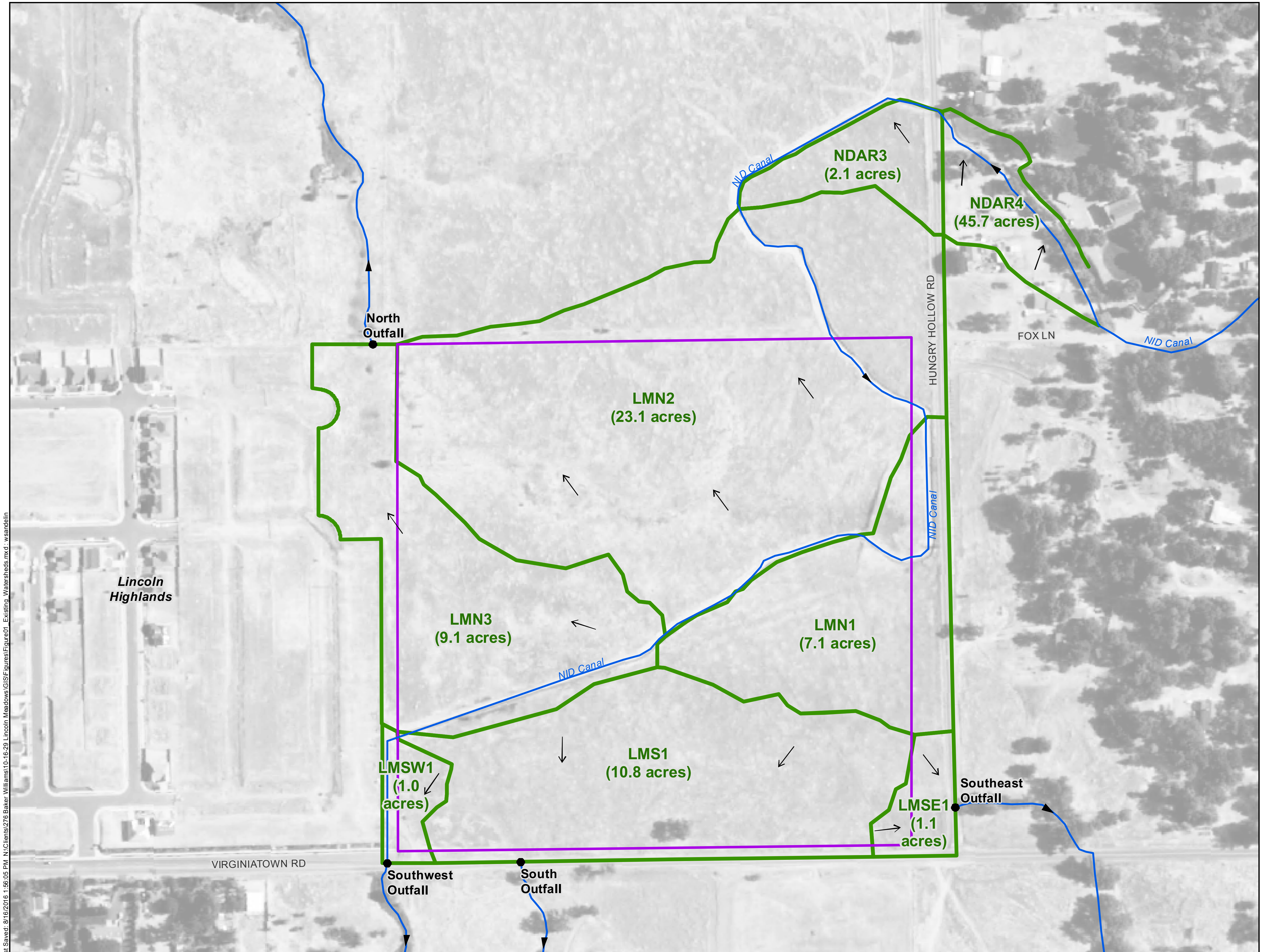
REFERENCES

County of Placer, 2015. West Placer Storm Water Quality Design Manual, Final Draft.

Placer County Flood Control and Water Conservation District, 1994. Stormwater Management Manual.

CTE CAL, 2015. Preliminary Geotechnical Investigation, Lincoln Meadows Subdivision, NWC Virginiatown and Hungry Hollow Roads, Lincoln, California.

Civil Engineering Solutions, 2002. Lincoln Highlands Subdivision, City of Lincoln, CA, Preliminary Hydrology Report.



0 120 240
Scale in Feet

Symbology

- Outfall
- Waterway
- Flow Direction
- Existing Watershed Boundary
- Project Boundary

WEST YOST ASSOCIATES

Figure 1

Existing Watershed Boundaries

Baker-Williams Engineering Group
Lincoln Meadows
Detention Basin Study

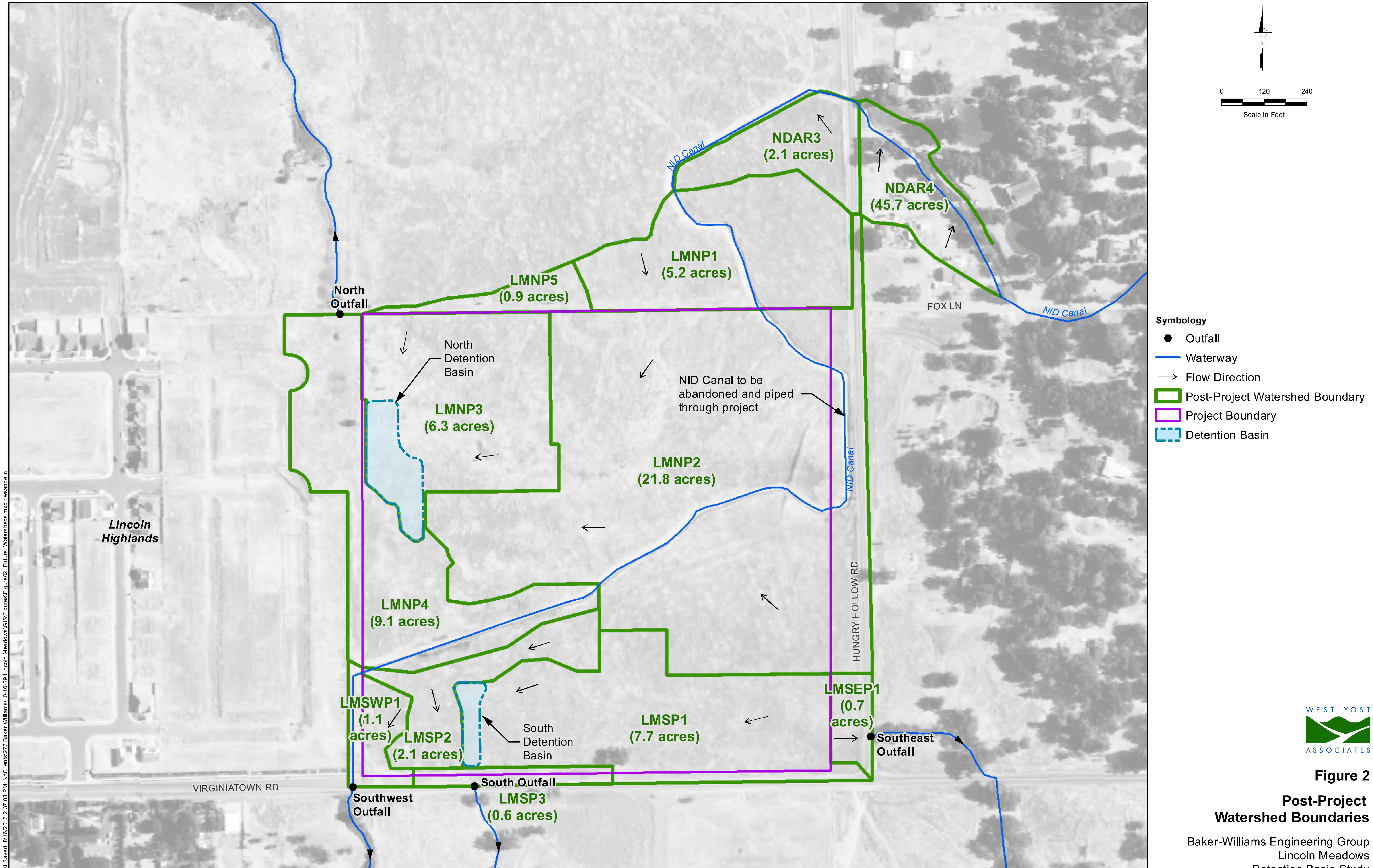


Figure 2

Post-Project Watershed Boundaries

Baker-Williams Engineering Group
Lincoln Meadows
Detention Basin Study

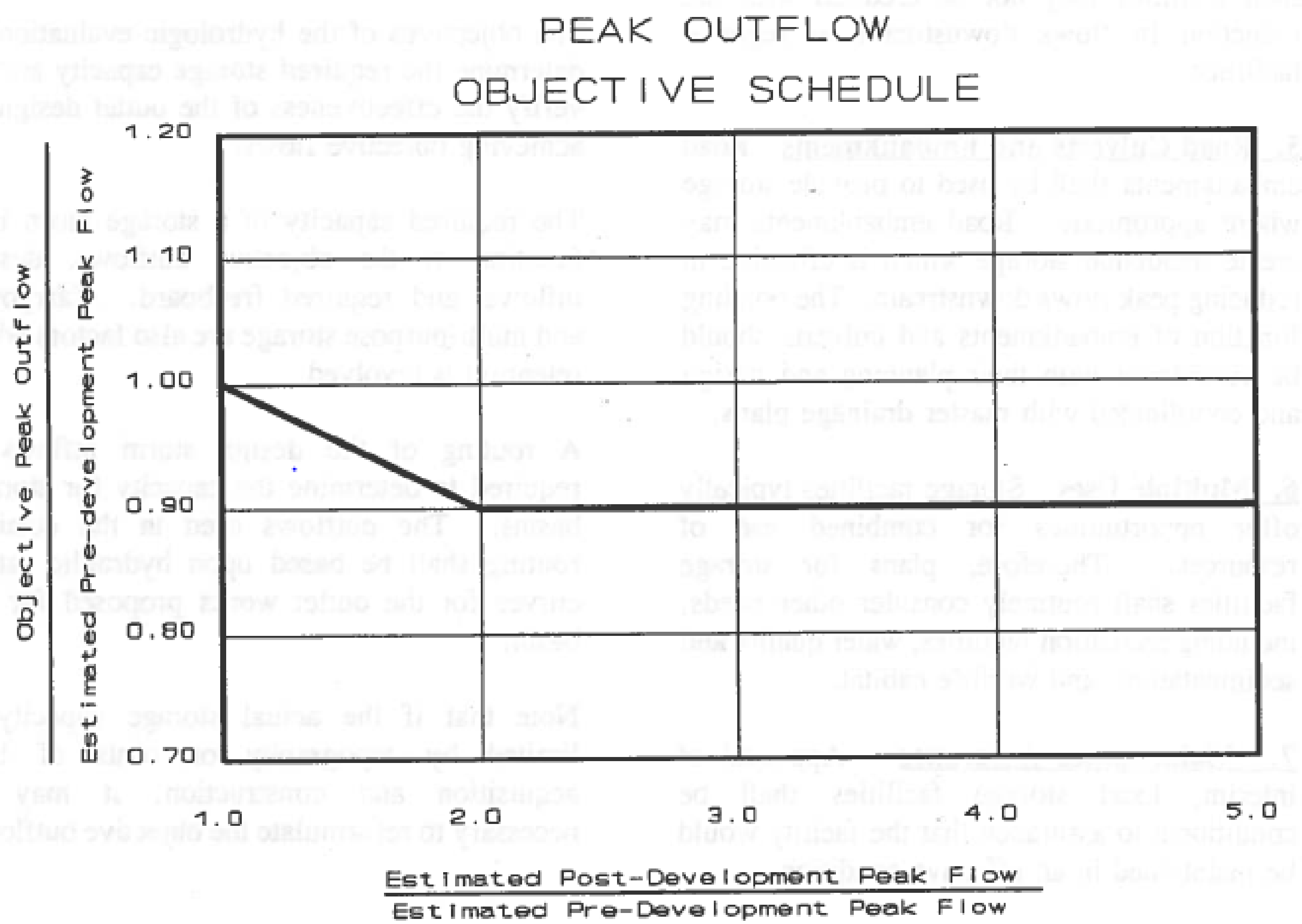


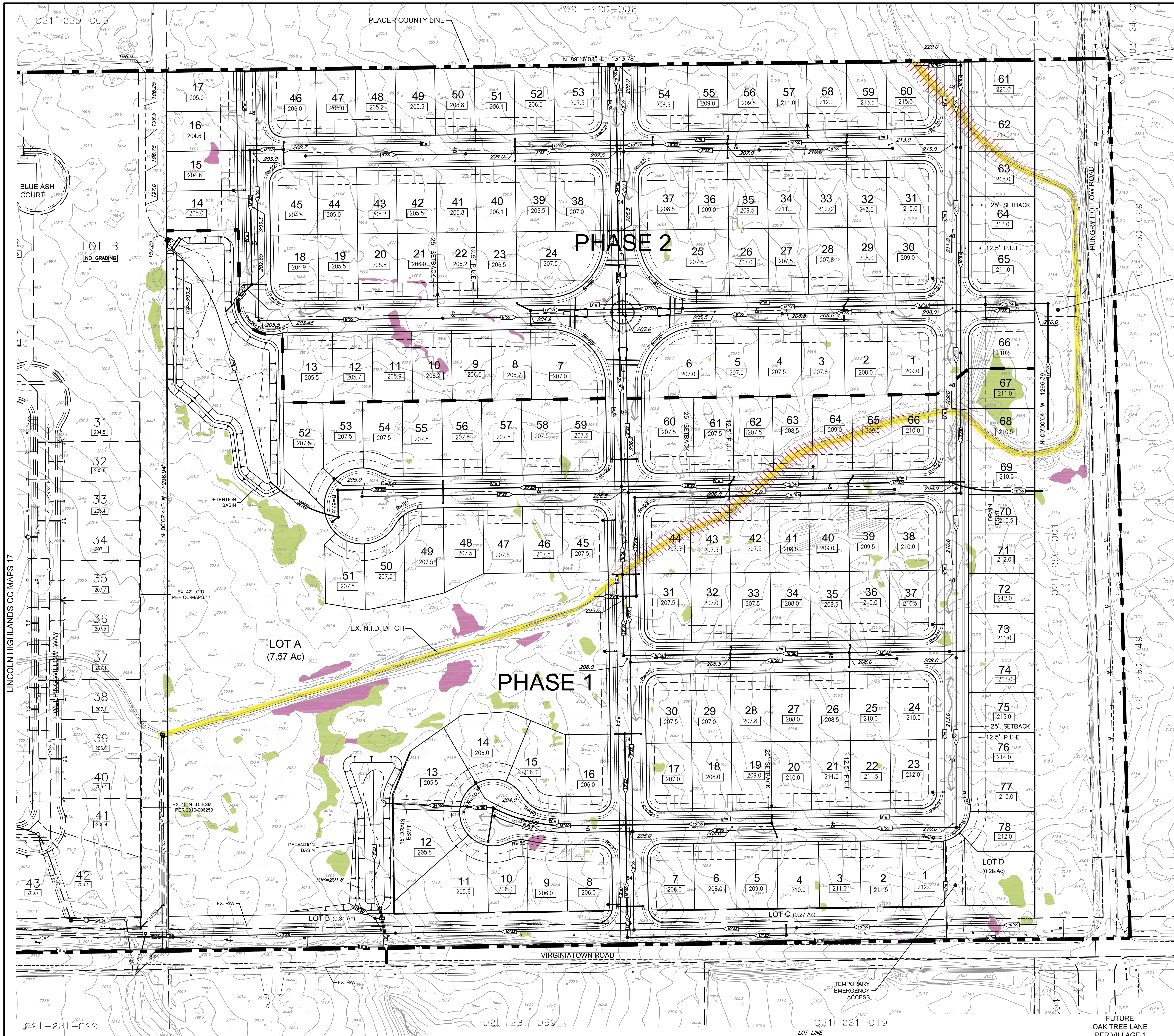
Figure 3

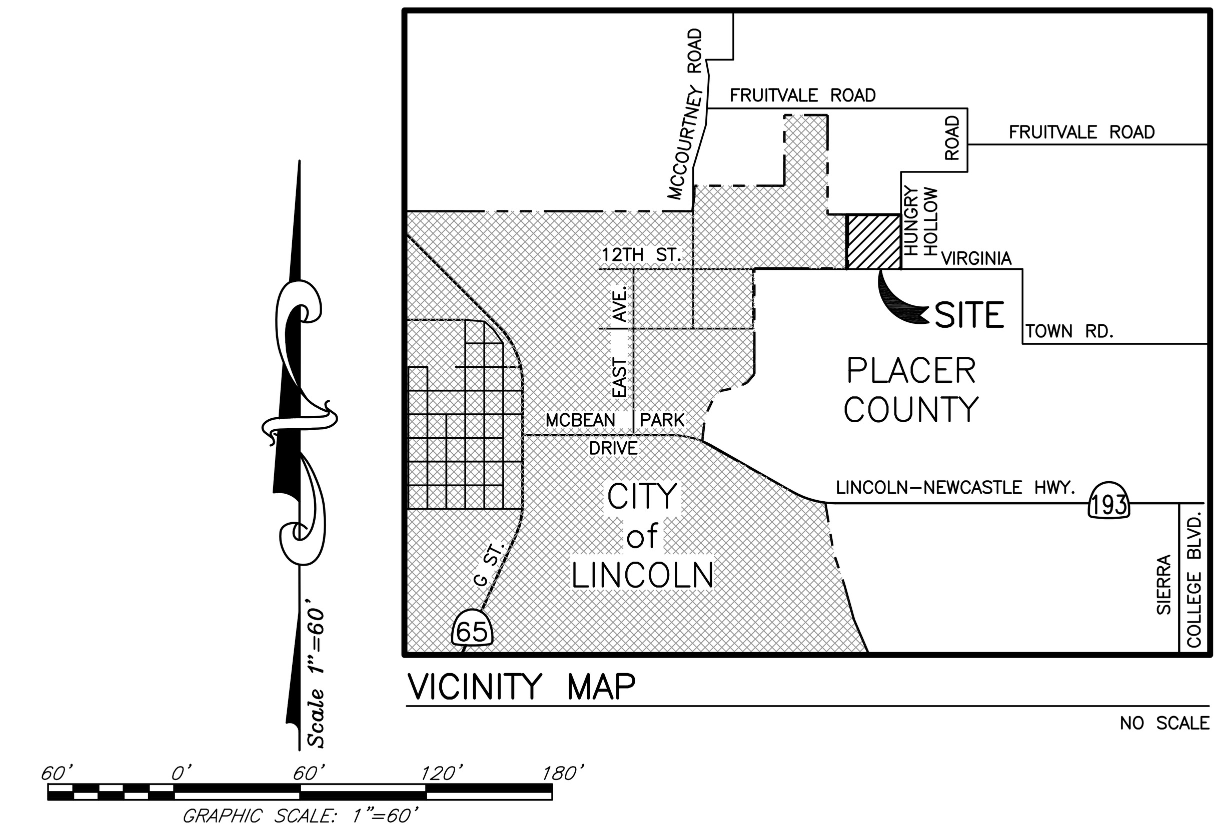
Peak Outflow Objective Schedule

Baker-Williams Engineering Group
Lincoln Meadows Detention Basin Study

APPENDIX A

Preliminary Grading and Utility Plan



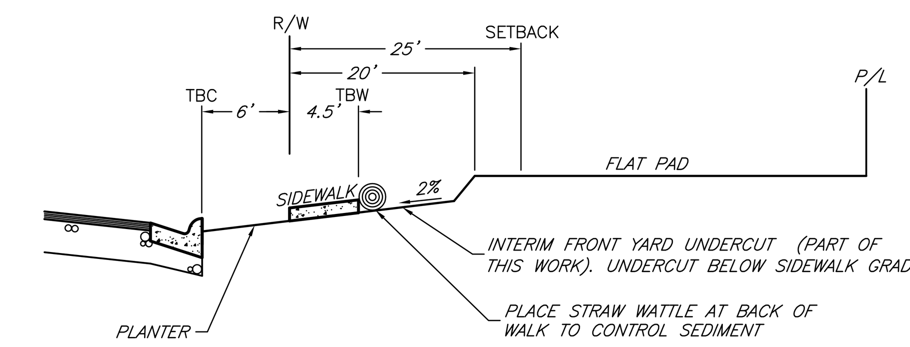


VICINITY MAP

NO SCALE

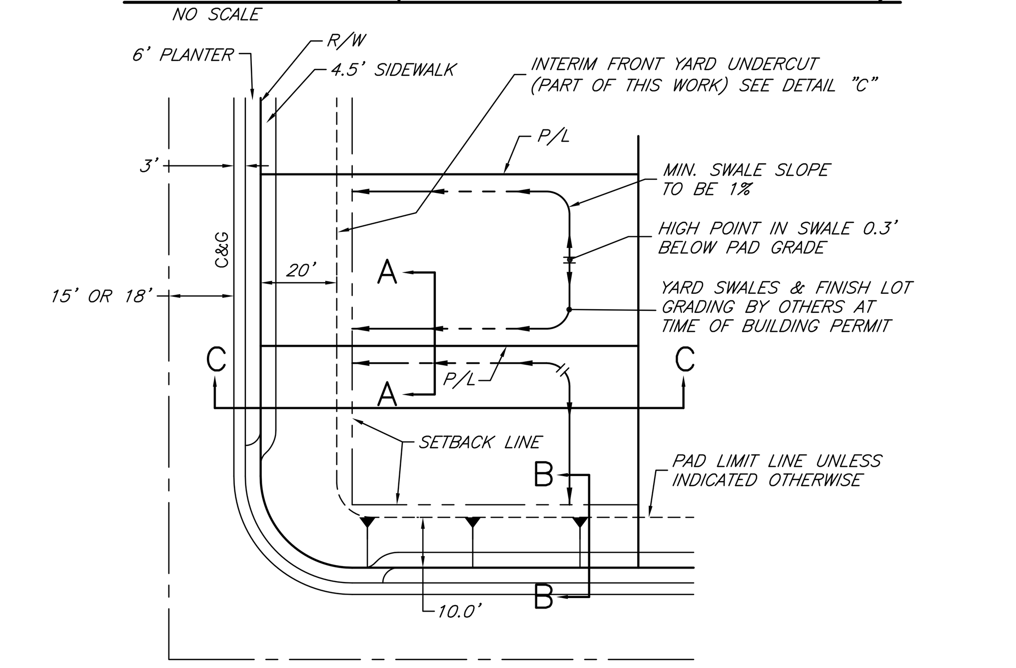
LEGEND:

PROP. SANITARY SEWER MAIN	PROP. WATER MAIN
EXIST. SANITARY SEWER MAIN	EXIST. WATER MAIN
PROP. FLUSHER BRANCH	PROP. WATER SERVICE
EXIST. FLUSHER BRANCH	EXIST. WATER SERVICE
PROP. SEWER SERVICE	PROP. WATER VALVE
EXIST. SEWER SERVICE	EXIST. WATER VALVE
PROP. MANHOLE	PROP. BLOW-OFF VALVE
EXIST. MANHOLE	EXIST. BLOW-OFF VALVE
PROP. STORM DRAIN	PROP. AIR RELEASE VALVE
PROP. RAW WATER IRRIGATION PIPE	EXIST. AIR RELEASE VALVE
EXIST. STORM DRAIN	PROP. FIRE HYDRANT ASSEMBLY
PROP. DROP INLET	EXIST. FIRE HYDRANT ASSEMBLY
EXIST. DROP INLET	DRAINAGE DIRECTION
	216.4 POSSIBLE PAD GRADE



SECTION C-C (TYPICAL FRONT YARD LOTS)

NO SCALE

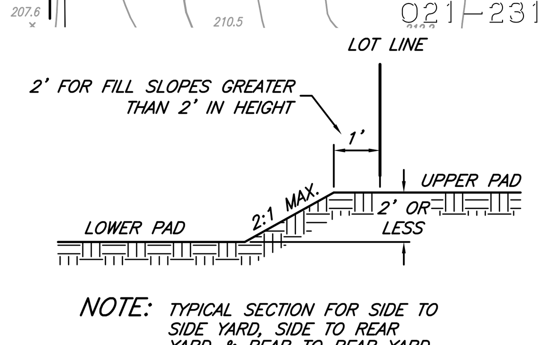


TYPICAL LOT GRADING

NO SCALE

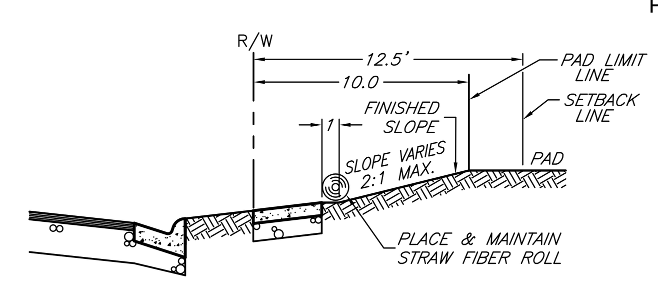
TYPICAL LOT GRADING DETAIL (DETACHED SIDEWALK)

NO SCALE



SECTION A-A

NO SCALE



SECTION B-B

(TYPICAL SIDE YARD)
(CORNER LOTS)

NO SCALE

PRELIMINARY GRADING and UTILITY PLAN

LINCOLN MEADOWS

CITY OF LINCOLN - PLACER COUNTY - CALIFORNIA

SEPTEMBER 24, 2014 SCALE: 1"=60'

REVISED JUNE 15, 2016

REVISED SEPTEMBER 30, 2016

BAKER-WILLIAMS ENGINEERING GROUP
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0301012-PREL-GRAD-UTILITY

APPENDIX B

Stormwater Quality Data

10-5-16

NORTH SHED TO MARKHAM RAVINE

Form 1-2 Project Category	
Development Category (Select all that apply)	
[1] **Small Project** – All projects, except LUPs, that create and/or replace between 2,500-5,000 ft² of impervious surface or detached single family homes that create and/or replace 2,500 ft² or more of impervious surface and are not part of a larger plan of development.	
[2] Enter total new and/or replaced impervious surface (ft²)	
[3] **Regulated Project** – All projects that create and/or replace 5,000 ft² or more of impervious surface.	
[4] **Regulated Redevelopment Project** with equal to, or greater than 50 percent increase in impervious area	
[5] **Regulated Redevelopment Project** with less than 50 percent increase in impervious area	
[6] Enter total pre-project impervious surface (ft²)	
[7] Enter total new and/or replaced impervious surface (ft²)	
[8] **Regulated Road or linear underground/overhead project (LUP)** creating 5,000 ft² or more of newly constructed contiguous impervious surface.	
[9] Enter total new and/or replaced impervious surface (ft²)	
[10] **Regulated Hydromodification Management Project** – Regulated projects that create and/or replace 1 acre or more of impervious surface. A project that does not increase impervious surface area over the pre-project condition is not a hydromodification management project.	X
[11] Enter total new and/or replaced impervious surface (ft²)	610128

Section 3 Regulated Projects

Section 3 forms are to be completed for all Regulated Projects.

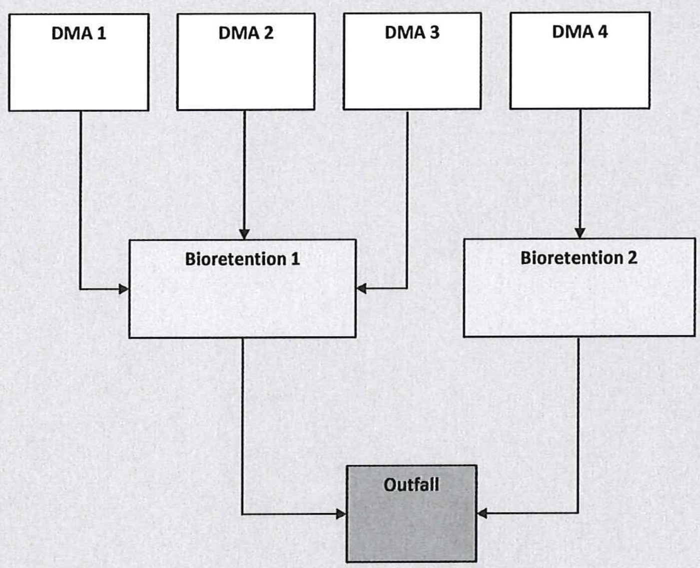
Form 3-1 Site Location and Hydrologic Features

Site coordinates: *Take GPS measurement at approximate center of site*	[1] Latitude	[2] Longitude	[3] Elevation (ft. above sea level)	[4] 85th Percentile, 24 Hour Design Storm Depth (in):
	38.90278 N	121.26778 W	209	0.9

[5] Receiving waters *Name of stream, lake or other downstream waterbody to which the site runoff eventually drains*	Markham Ravine
[6] 303(d) listed pollutants of concern *Refer to State Water Resources Control Board website* www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired	N/A
[7] Is Project going to be phased? *If yes, ensure that the SWQP evaluates each phase with distinct DMAs, requiring LID BMPs to address runoff at time of completion.*	no

[8] *Use this form to show a conceptual schematic depicting DMAs and conveyance features connecting DMAs to the site outlet(s). An example is provided below that can be modified for the proposed project or a drawing clearly showing DMAs and flow routing may be attached.*

Example only
Modify for project specific SWQP
Use separate sheet if necessary



NORTH

Form 3-2 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	Not Applicable (Include brief explanation)
Define the development envelope and protected areas, identifying areas that are most suitable for development areas to be left undisturbed.	x	
Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.		N/A soil is uniform throughout site
Limit overall impervious coverage of the site with paving and roofs.		Lot coverag will meet City of Lincoln requirements
Set back development from creeks, wetlands, and riparian habitats.	x	
Preserve significant trees.		N/a there are no existing trees
Conform site layout along natural landforms.	x	
Avoid excessive grading and disturbance of vegetation and soils.		N/A This is a typical low density residential subdivision with padded lots that drain to the street
Replicate the site's natural drainage patterns.	x	
Detain and retain runoff throughout the site.	x	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

Site Boundary
Soil types and areal extents, test pit and infiltration test locations
Topographic data with 1 ft. contours
Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
Environmentally sensitive areas and areas to be preserved.
Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
Potential pollutant sources and locations
Entire site divided into separate DMAs with unique identifiers
Existing and proposed site drainage network with flow directions and site run-on and discharge locations
Proposed design features and surface treatments used to minimize imperviousness and reduce runoff
Proposed locations and footprints of treatment and hydromodification management facilities
Design features for managing authorized non-stormwater discharges
Areas of soil and/or groundwater contamination
Existing utilities and easements
Maintenance areas

NORTH

Form 3-3 Source Control Measures			
Potential Pollutant Generating Activity or Source	Check One		Describe the source control measures to be implemented for each potential pollutant generating activity or source present on the project as listed in Appendix C and in the CASQA Fact Sheets. Include any special features, materials, or methods of construction that will be used.
	Present	Not Applicable	
Accidental spills or leaks	☐	☑	
Interior floor drains	☐	☑	
Parking/storage areas and maintenance	☐	☑	
Indoor and structural pest control	☐	☑	
Pools, spas, ponds, decorative fountains, and other water features	☑	☐	
Landscape/outdoor pesticide use	☑	☐	
Restaurants, grocery stores, and other food service operations	☐	☑	
Refuse areas	☑	☐	
Industrial Processes	☐	☑	
Outdoor storage of equipment or materials	☐	☑	
Vehicle and equipment cleaning	☐	☑	
Vehicle and equipment repair and maintenance	☐	☑	
Fuel dispensing areas	☐	☑	
Loading docks	☐	☑	
Fire sprinkler test water	☐	☑	
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources	☐	☑	
Unauthorized non-storm water discharges	☐	☑	
Building and grounds maintenance	☐	☑	

The source control measures identified in this table shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment[1], or from another equivalent manual.

[1] California Stormwater BMP Handbook New Development and Redevelopment. California Stormwater Quality Association (CASQA). January 2003.

NORTH

NORTH

Form 3-4 Runoff Reduction Calculator for Site Design Measures on Regulated Projects

Site Design Measure	Runoff Reduction Parameters		DMA ID No.[1]: 1		2		3		4	
				Runoff Reduction (ft^3)		Runoff Reduction (ft^3)		Runoff Reduction (ft^3)		Runoff Reduction (ft^3)
[2] Adjacent/On-Site Stream Setbacks and Buffers	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	P_{85} (in)	*85th percentile, 24-hour storm depth*	0.9		0.9		0.9		0.9	
[3] Soil Quality Improvement and Maintenance	A_{pond} (ft^2)	*ponding area*		0		0		0		
	D_{pond} (ft)	*ponding depth*								
	A_{sa} (ft^2)	*soil amendment area*								
	D_{sa} (ft)	*depth of amended soil*								
	n	*porosity of amended soil*								
[4] Tree Planting and Preservation	n_e	*number of evergreen trees*	150	27500		0		0		0
	n_d	*number of deciduous trees*	250							
	A_{tc} (ft^2)	*Total impervious area beneath tree canopies after four years growth*	20000							
[5] Rooftop and Impervious Area Disconnection	A_{imp} (ft^2)	*impervious drainage area*	295568	22168		0		0		0
	P_{85} (in)	*85th percentile, 24-hour storm depth*	0.9		0.9		0.9		0.9	
[6] Porous Pavement	A_{res} (ft^2)	*area of gravel storage layer*		0		0		0		0
	D_{res} (ft)	*thickness of gravel storage layer*								
	n_{agg}	*porosity of aggregate*								
	C	*efficiency factor*								
[7] Vegetated Swales	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	P_{85} (in)	*85th percentile, 24-hour storm depth*	0.9		0.9		0.9		0.9	
[8] Rain Barrels and Cisterns	N	*number of rain barrels and/or cisterns*	0	0		0		0		0
	V_a (ft^3)	*volume of each rain barrel and/or cistern*	0							
[9] Do all Site Design Measures meet the design requirements outlined in the Fact Sheets?					Yes		No			
[10] Total Volume Reduction (ft^3)			49668		0		0		0	
[11] Effective Treated Impervious Area (ft^2)			662235		0		0		0	

NORTH

Form 3-5 Computation of Water Quality Design Criteria for Stormwater Treatment and Baseline Hydromodification Measures

DMA ID No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
[1]Total impervious area requiring treatment	610128																				
[2] Impervious area untreated by Site Design Measures (ft^2) *Form 3-3 Item 3 – Form 3-6 Item 11*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3]Additional pervious area draining to BMP (ft^2)	650786																				
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*	0.50																				
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	17625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	1.506	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

DMA ID No.	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
[1]Total impervious area requiring treatment																					
[2] Impervious area untreated by Site Design Measures (ft^2) *Form 3-3 Item 3 – Form 3-6 Item 11*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3]Additional pervious area draining to BMP (ft^2)																					
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*																					
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Form 3-6 Volume-Based Infiltrating Bioretention Measures				
[1]**DMA ID No.** *If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.*	**1**			
[2]WQV (ft^3) *Item 6 in Form 3-5* *If combining multiple DMAs from Form 3-5, enter the sum of their respective WQVs.*	17625			
[3]Infiltration rate of underlying soils (in/hr)	0.10			
[4]Maximum ponding depth (ft) *BMP specific, see BMP design details*	1.0			
[5]Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 3 * 48 hrs) or Item 4*	0.4	-	-	-
[6]Infiltrating surface area, SA_{BMP} (ft^2) *Bottom of BMP*	26740			
[7]Planting media depth, d_{media} (ft)	1.0			
[8]Planting media porosity	0.30			
[9]Gravel depth, d_{media} (ft) *Only included in certain BMP types*	1.0			
[10]Gravel porosity	0.30			
[11]Retention Volume (ft^3) $V_{retention}$ *= Item 6 * [Item5 + (Item 7 * Item 8) + (Item 9 * Item 10) + (1.5* (Item 3 / 12))]*	26,740.0	-	-	-
[12]Untreated Volume (ft^3) $V_{untreated}$ *= Item 2 – Item 11* *If greater than zero, adjust BMP sizing variables and re-compute retention volume*	0	0	0	0
[13]**Is WQV for each DMA treated on-site?**	**Yes**		**No**	

NORTH

Section 4
Regulated Hydromodification Management Projects

Form 4-1 Peak Runoff Response Time

(Complete Section 4 forms for Regulated Hydromodification Projects only)

Determine total runoff response time for pre- and post-construction conditions at each project outlet.

Variables	Pre-construction DMAs to Project Outlet				Post-construction DMAs to Project Outlet			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
[1]Length of longest overland flow path *Not to exceed 100 ft*	100				100			
[2]Slope of overland flow path (ft/ft)	0.0280				0.0100			
[3]Manning's roughness coefficient for overland flow surface *See Table 5-5 of the Placer County SWMM*	0.4000				0.1500			
[4]Overland flow response time (min) Use *nomograph provided by Figure 5-1 of the Placer County SWMM using Items 1, 2, and 3 above*	6				7			
[5]Hydrologic Soil Group *Refer to Section 3.1.1. or NRCS Web Soil Survey*	D							
[6]Current Land Cover Type(s) *Select from categories shown in Table 5-3 of the SWMM*	fallow							
[7]Pervious Area Condition: *Based on the extent of vegetated cover* *Good >75%; Fair 50-75%; Poor <50%* *Attach photos of site to support rating*	fair							
[8]Infiltration Rate (in/hr) *Refer to Table 5-3 of the SWMM using Items 3, 4, and 5 above or obtain site specific field measurements (See Section 3.1.1)*	0.07							
[9]Length of collector flow (ft)	650				1,030			
[10]Cross-sectional area of collector flow facility (ft^2)	2				3.14			
[11]Wetted perimeter of collector flow facility (ft)	5				6.28			
[12]Manning's roughness of collector flow facility	0.0400				0.0150			
[13]Slope of collector flow facility (ft/ft)	0.0280				0.0025			
[14]Channel flow velocity (ft/sec) *V = (1.49 / Item 9) * (Item 7/Item 8) ^0.67 * (Item 10) ^0.5*	2.8	-	-	-	3.1	-	-	-
[15]Collector flow facility response time (min) T_c *= Item 9 /(Item 14 * 60)*	3.9	-	-	-	5.5	-	-	-
[16]Total runoff response time or T_t (min) T_t *= Item 4 + Item 15*	9.9	-	-	-	12.5	-	-	-

NORTH

Form 4-2 Hydromodification Target for Peak Runoff								
Variables	Pre-construction DMAs to Project Outlet				Post-construction DMAs to Project Outlet			
	1	2	3	4	1	2	3	4
[1] Drainage Area (ft^2) *Sum of all outlet level DMAs should equal total project area.*	1,260,914				1,260,914			
[2] Impervious Area (ft^2) *Sum of all outlet level DMAs should equal total project impervious area.*	0				610,128			
[3] Rainfall depth for 2yr storm with duration equal to response time (in) *See Placer County SWMM Table 5-A-1 for elevation of site and duration equal to response time*	0.19				0.21			
[4] Determine unit peak runoff (cfs/acre) *q = 60/Form 4-1 Item 16 * Item 3*	1.15	-	-	-	1.01	-	-	-
[5] Infiltration factor (cfs/acre) *F_i = Form 4-1 Item 8 * (1 + 1 /(1.3 + 0.0005 * Form 3-1 Item 3))*	0.12	-	-	-	-	-	-	-
[6] Peak runoff from DMAs (cfs) *Q_p = Item 1 * Item 4 – Item 5 * (Item 1 - Item 2)*	30.19	-	-	-	29.45	-	-	-

NORTH

Form 4-3 Detention Volumes for Hydromodification Management				
	Post-construction DMAs to Project Outlet			
	1	2	3	4
1 Land cover and hydrologic condition *See NRCD TR-55 Manual Table 2-2 for types*	residential			
2 Hydrologic Soil Group *Refer to Section 3.1.1. or NRCS Web Soil Survey*	-	-	-	-
3 Drainage Area (A) (ft^2)	1,260,914	-	-	-
4 Curve Number (CN) *Use Items 1 and 2 to select curve number from NRCS TR-55 Manual Table 2-2*	90			
5 Post-development soil storage capacity, S (in): *S = (1000 / Item 4) – 10*	1.1	#DIV/0!	#DIV/0!	#DIV/0!
6 Precipitation for 2-yr, 24-hr storm (in) *See Placer County SWMM Table 5-A-1 for elevation of site and 24-hr duration depths*	1.97			
7 Post-developed runoff volume for 2-yr – 24-hour storm, V_{runoff} (ft^3): V_{runoff} *= Item 3 * (1 / 12) * [(Item 6 – 0.2 * Item 5)^2 / (Item 6 + 0.8 * Item 5)]*	112,274.0	#DIV/0!	#DIV/0!	#DIV/0!
8 Attenuation Factor, $q_{out/in}$ (ratio of target outflow rate to peak inflow rate): $q_{out/in}$ *= Form 4-2 Item 6 Pre-Construction / Form 4-2 Item 6 Post-Construction*	1.02	#DIV/0!	#DIV/0!	#DIV/0!
9 Equalization Factor, Vs/Vr (ratio of storage capacity to runoff volume) *Vs/Vr obtained using Item 8 and nomograph in Figure 6-1 of NRCS TR-55 Manual for Rainfall Type IA*	0.14			
10 Runoff detention capacity to achieve hydromodification management criteria (ft^3) $D_{hydromod}$ *= Item 7 * Item 9*	15718	#DIV/0!	#DIV/0!	#DIV/0!
11 Site Design Measure (SDM) Volume (ft^3): *Sum of Item 10 in Form 3-6 for all SDMs in this DMA.*	49668			
12 Bioretention Volume (ft3): *Sum of Item 12 in Form 3-8 for all bioretention measures in this DMA.*	26740			
13 Flow-Through Detention Volume (ft3): *Sum of Item 11 in Form 3-9 for all flow-through facilities in this DMA.*	0			
14 Supplemental Detention Volume (ft^3):				
15 Combined Detention Volume in this DMA (ft^3): *Sum of Items 11 through 14*	76,408	-	-	-
16 Is detention capacity to achieve hydromodification management criteria achieved at all project outlets? *Yes, if Item 10 is less than or equal to Item 14. If not provide additional storage capacity*	**Yes**		**No**	

NORTH

10-5-16

SOUTH SHED TO AUBURN RAVINE

Form 1-2 Project Category	
Development Category (Select all that apply)	
[1]**Small Project** – All projects, except LUPs, that create and/or replace between 2,500-5,000 ft^2 of impervious surface or detached single family homes that create and/or replace 2,500 ft^2 or more of impervious surface and are not part of a larger plan of development.	
[2]Enter total new and/or replaced impervious surface (ft^2)	
[3]**Regulated Project** – All projects that create and/or replace 5,000 ft^2 or more of impervious surface.	
[4]**Regulated Redevelopment Project** with equal to, or greater than 50 percent increase in impervious area	
[5]**Regulated Redevelopment Project** with less than 50 percent increase in impervious area	
[6]Enter total pre-project impervious surface (ft^2)	
[7]Enter total new and/or replaced impervious surface (ft^2)	
[8]**Regulated Road or linear underground/overhead project (LUP)** creating 5,000 ft^2 or more of newly constructed contiguous impervious surface.	
[9]Enter total new and/or replaced impervious surface (ft^2)	
[10]**Regulated Hydromodification Management Project** – Regulated projects that create and/or replace 1 acre or more of impervious surface. A project that does not increase impervious surface area over the pre-project condition is not a hydromodification management project.	X
[11]Enter total new and/or replaced impervious surface (ft^2)	213,056

Section 3 Regulated Projects

Section 3 forms are to be completed for all Regulated Projects.

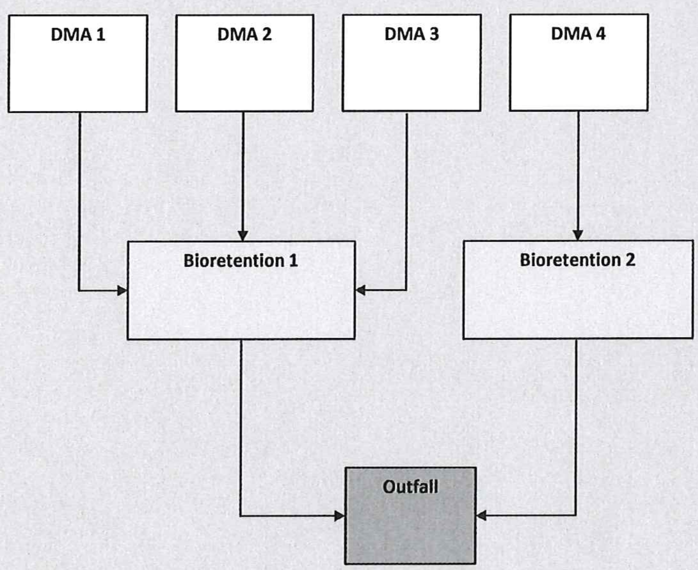
Form 3-1 Site Location and Hydrologic Features

Site coordinates: *Take GPS measurement at approximate center of site*	[1] Latitude	[2] Longitude	[3] Elevation (ft. above sea level)	[4] 85th Percentile, 24 Hour Design Storm Depth (in):
	38.90278 N	121.26778 W	209	0.9

[5] Receiving waters *Name of stream, lake or other downstream waterbody to which the site runoff eventually drains*	Auburn Ravine
[6] 303(d) listed pollutants of concern *Refer to State Water Resources Control Board website* www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired	N/A
[7] Is Project going to be phased? *If yes, ensure that the SWQP evaluates each phase with distinct DMAs, requiring LID BMPs to address runoff at time of completion.*	

[8] *Use this form to show a conceptual schematic depicting DMAs and conveyance features connecting DMAs to the site outlet(s). An example is provided below that can be modified for the proposed project or a drawing clearly showing DMAs and flow routing may be attached.*

Example only
Modify for project specific SWQP
Use separate sheet if necessary



SOUTH

Form 3-2 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	Not Applicable (Include brief explanation)
Define the development envelope and protected areas, identifying areas that are most suitable for development areas to be left undisturbed.	x	
Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.		N/A Soil is uniform throughout site
Limit overall impervious coverage of the site with paving and roofs.		Lot coverage will meet City of Lincoln requirements
Set back development from creeks, wetlands, and riparian habitats.	x	
Preserve significant trees.		N/A No existing trees on site
Conform site layout along natural landforms.	x	
Avoid excessive grading and disturbance of vegetation and soils.		N/A This is a typical low density residential subdivision with padded lots that drain to the street
Replicate the site's natural drainage patterns.	x	
Detain and retain runoff throughout the site.	x	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

Site Boundary
Soil types and areal extents, test pit and infiltration test locations
Topographic data with 1 ft. contours
Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
Environmentally sensitive areas and areas to be preserved.
Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
Potential pollutant sources and locations
Entire site divided into separate DMAs with unique identifiers
Existing and proposed site drainage network with flow directions and site run-on and discharge locations
Proposed design features and surface treatments used to minimize imperviousness and reduce runoff
Proposed locations and footprints of treatment and hydromodification management facilities
Design features for managing authorized non-stormwater discharges
Areas of soil and/or groundwater contamination
Existing utilities and easements
Maintenance areas

SOUTH

Form 3-3 Source Control Measures

Potential Pollutant Generating Activity or Source	Check One		Describe the source control measures to be implemented for each potential pollutant generating activity or source present on the project as listed in Appendix C and in the CASQA Fact Sheets. Include any special features, materials, or methods of construction that will be used.
	Present	Not Applicable	
Accidental spills or leaks	☐	☑	
Interior floor drains	☐	☑	
Parking/storage areas and maintenance	☐	☑	
Indoor and structural pest control	☐	☑	
Pools, spas, ponds, decorative fountains, and other water features	☑	☐	
Landscape/outdoor pesticide use	☑	☐	
Restaurants, grocery stores, and other food service operations	☐	☑	
Refuse areas	☑	☐	
Industrial Processes	☐	☑	
Outdoor storage of equipment or materials	☐	☑	
Vehicle and equipment cleaning	☐	☑	
Vehicle and equipment repair and maintenance	☐	☑	
Fuel dispensing areas	☐	☑	
Loading docks	☐	☑	
Fire sprinkler test water	☐	☑	
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources	☐	☑	
Unauthorized non-storm water discharges	☐	☑	
Building and grounds maintenance	☐	☑	

The source control measures identified in this table shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment[1], or from another equivalent manual.

[1] California Stormwater BMP Handbook New Development and Redevelopment. California Stormwater Quality Association (CASQA). January 2003.

SOUTH

SOUTH

Form 3-4 Runoff Reduction Calculator for Site Design Measures on Regulated Projects

		[1]DMA ID No.	1		2		3		4	
Site Design Measure	Runoff Reduction Parameters			Runoff Reduction (ft^3)		Runoff Reduction (ft^3)		Runoff Reduction (ft^3)		Runoff Reduction (ft^3)
[2] Adjacent/On-Site Stream Setbacks and Buffers	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	P_{85} (in)	*85th percentile, 24-hour storm depth*	0.9		0.9		0.9		0.9	
[3] Soil Quality Improvement and Maintenance	A_{pond} (ft^2)	*ponding area*		0		0		0		
	D_{pond} (ft)	*ponding depth*								
	A_{sa} (ft^2)	*soil amendment area*								
	D_{sa} (ft)	*depth of amended soil*								
	n	*porosity of amended soil*								
[4] Tree Planting and Preservation	n_e	*number of evergreen trees*	66	6592		0		0		0
	n_d	*number of deciduous trees*	133							
	A_{tc} (ft^2)	*Total impervious area beneath tree canopies after four years growth*	9950							
[5] Rooftop and Impervious Area Disconnection	A_{imp} (ft^2)	*impervious drainage area*	71344	5351		0		0		0
	P_{85} (in)	*85th percentile, 24-hour storm depth*	0.9		0.9		0.9		0.9	
[6] Porous Pavement	A_{res} (ft^2)	*area of gravel storage layer*		0		0		0		0
	D_{res} (ft)	*thickness of gravel storage layer*								
	n_{agg}	*porosity of aggregate*								
	C	*efficiency factor*								
[7] Vegetated Swales	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	P_{85} (in)	*85th percentile, 24-hour storm depth*	0.9		0.9		0.9		0.9	
[8] Rain Barrels and Cisterns	N	*number of rain barrels and/or cisterns*		0		0		0		0
	V_a (ft^3)	*volume of each rain barrel and/or cistern*								
[9] Do all Site Design Measures meet the design requirements outlined in the Fact Sheets?					Yes	X	No			
[10] Total Volume Reduction (ft^3)			11943		0		0		0	
[11] Effective Treated Impervious Area (ft^2)			159236		0		0		0	

SOUTH

Form 3-5 Computation of Water Quality Design Criteria for Stormwater Treatment and Baseline Hydromodification Measures

DMA ID No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
[1] Total impervious area requiring treatment	213056																				
[2] Impervious area untreated by Site Design Measures (ft^2) *Form 3-3 Item 3 – Form 3-6 Item 11*	53820	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3] Additional pervious area draining to BMP (ft^2)	148104																				
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*	0.50																				
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	5469	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	0.467	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

DMA ID No.	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
[1] Total impervious area requiring treatment																					
[2] Impervious area untreated by Site Design Measures (ft^2) *Form 3-3 Item 3 – Form 3-6 Item 11*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3] Additional pervious area draining to BMP (ft^2)																					
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*																					
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Form 3-6 Volume-Based Infiltrating Bioretention Measures				
[1]**DMA ID No.** *If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.*	**1**			
[2]WQV (ft^3) *Item 6 in Form 3-5* *If combining multiple DMAs from Form 3-5, enter the sum of their respective WQVs.*	5469			
[3]Infiltration rate of underlying soils (in/hr)	0.10			
[4]Maximum ponding depth (ft) *BMP specific, see BMP design details*	1.0			
[5]Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 3 * 48 hrs) or Item 4*	0.4	-	-	-
[6]Infiltrating surface area, *SA_{BMP}* (ft^2) *Bottom of BMP*	7430			
[7]Planting media depth, *d_{media}* (ft)	1.0			
[8]Planting media porosity	0.30			
[9]Gravel depth, *d_{media}* (ft) *Only included in certain BMP types*	1.0			
[10]Gravel porosity	0.30			
[11]Retention Volume (ft^3) *$V_{retention}$ = Item 6 * [Item5 + (Item 7 * Item 8) + (Item 9 * Item 10) + (1.5* (Item 3 / 12))]*	7,430.0	-	-	-
[12]Untreated Volume (ft^3) *$V_{untreated}$ = Item 2 – Item 11* *If greater than zero, adjust BMP sizing variables and re-compute retention volume*	0	0	0	0
[13]**Is WQV for each DMA treated on-site?**	**Yes**		**No**	

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Section 4
Regulated Hydromodification Management Projects

Form 4-1 Peak Runoff Response Time

(Complete Section 4 forms for Regulated Hydromodification Projects only)

Determine total runoff response time for pre- and post-construction conditions at each project outlet.

Variables	**Pre-construction DMAs to Project Outlet**				**Post-construction DMAs to Project Outlet**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
[1]Length of longest overland flow path *Not to exceed 100 ft*	100				100			
[2]Slope of overland flow path (ft/ft)	0.0210				0.0100			
[3]Manning's roughness coefficient for overland flow surface *See Table 5-5 of the Placer County SWMM*	0.4000				0.1500			
[4]Overland flow response time (min) Use n*omograph provided by Figure 5-1 of the Placer County SWMM using Items 1, 2, and 3 above*	7				7			
[5]Hydrologic Soil Group *Refer to Section 3.1.1. or NRCS Web Soil Survey*	D				D			
[6]Current Land Cover Type(s) *Select from categories shown in Table 5-3 of the SWMM*	fallow							
[7]Pervious Area Condition: *Based on the extent of vegetated cover* *Good >75%; Fair 50-75%; Poor <50%* *Attach photos of site to support rating*	fair							
[8]Infiltration Rate (in/hr) *Refer to Table 5-3 of the SWMM using Items 3, 4, and 5 above or obtain site specific field measurements (See Section 3.1.1)*	0.07							
[9]Length of collector flow (ft)	800				720			
[10]Cross-sectional area of collector flow facility (ft^2)	2.0				3.14			
[11]Wetted perimeter of collector flow facility (ft)	5				6.28			
[12]Manning's roughness of collector flow facility	0.0400				0.015			
[13]Slope of collector flow facility (ft/ft)	0.0200				0.0025			
[14]Channel flow velocity (ft/sec) *V = (1.49 / Item 9) * (Item 7/Item 8) ^0.67 * (Item 10) ^0.5*	2.9	-	-	-	3.1	-	-	-
[15]Collector flow facility response time (min) T_c *= Item 9 /(Item 14 * 60)*	4.7	-	-	-	3.8	-	-	-
[16]Total runoff response time or T_t (min) T_t *= Item 4 + Item 15*	11.7	-	-	-	10.8	-	-	-

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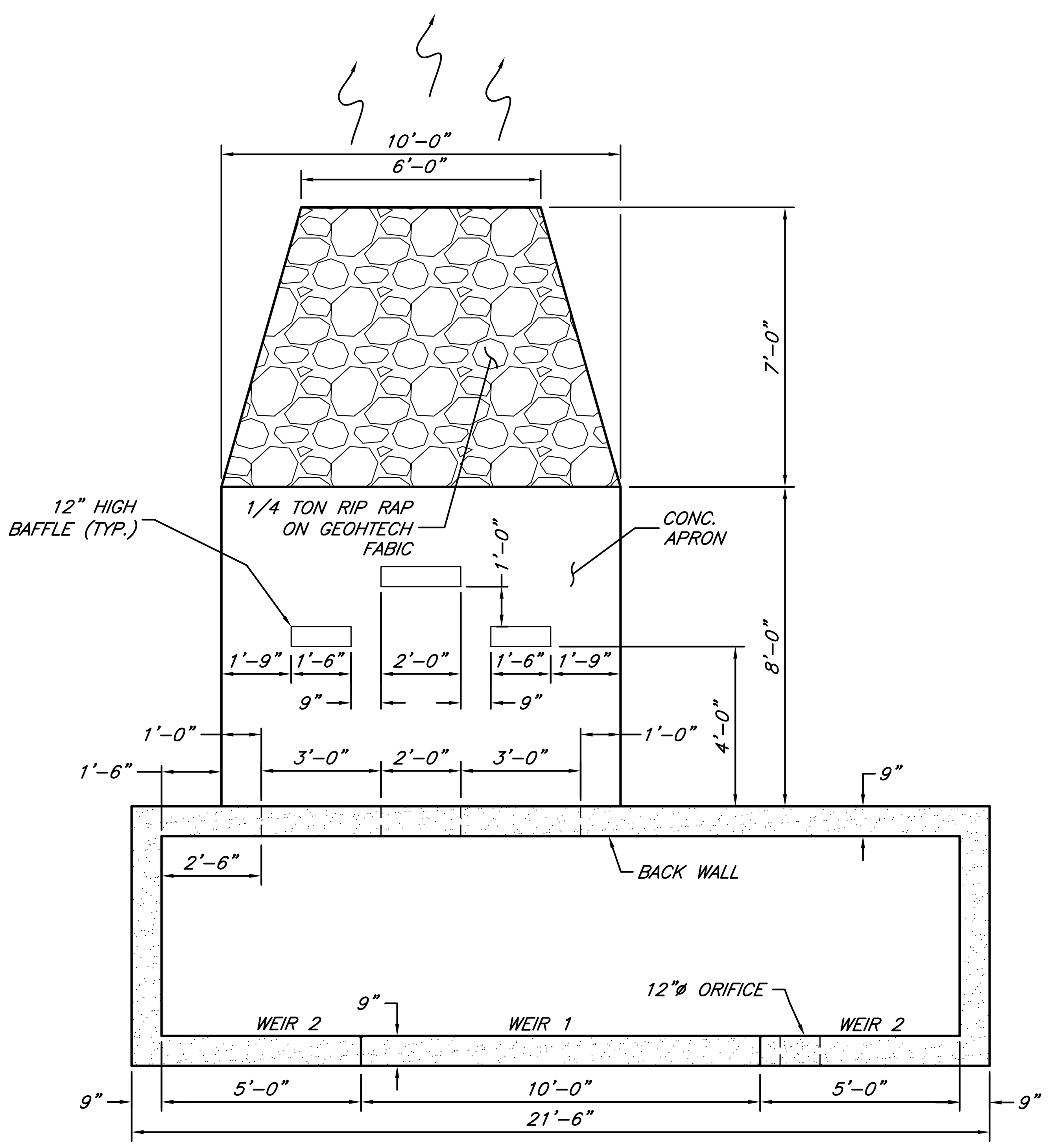
Form 4-2 Hydromodification Target for Peak Runoff								
Variables	**Pre-construction DMAs to Project Outlet**				**Post-construction DMAs to Project Outlet**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
[1] Drainage Area (ft^2) *Sum of all outlet level DMAs should equal total project area.*	361,112				361,112			
[2] Impervious Area (ft^2) *Sum of all outlet level DMAs should equal total project impervious area.*	0		0		213,056			
[3] Rainfall depth for 2yr storm with duration equal to response time (in) *See Placer County SWMM Table 5-A-1 for elevation of site and duration equal to response time*	0.21				0.19			
[4] Determine unit peak runoff (cfs/acre) *q = 60/Form 4-1 Item 16 * Item 3*	1.08	-	-	-	1.05	-	-	-
[5] Infiltration factor (cfs/acre) *F_i = Form 4-1 Item 8 * (1 + 1 /(1.3 + 0.0005 * Form 3-1 Item 3))*	0.12	-	-	-	-	-	-	-
[6] Peak runoff from DMAs (cfs) *Q_p = Item 1 * Item 4 – Item 5 * (Item 1 - Item 2)*	8.03	-	-	-	8.79	#REF!	-	-

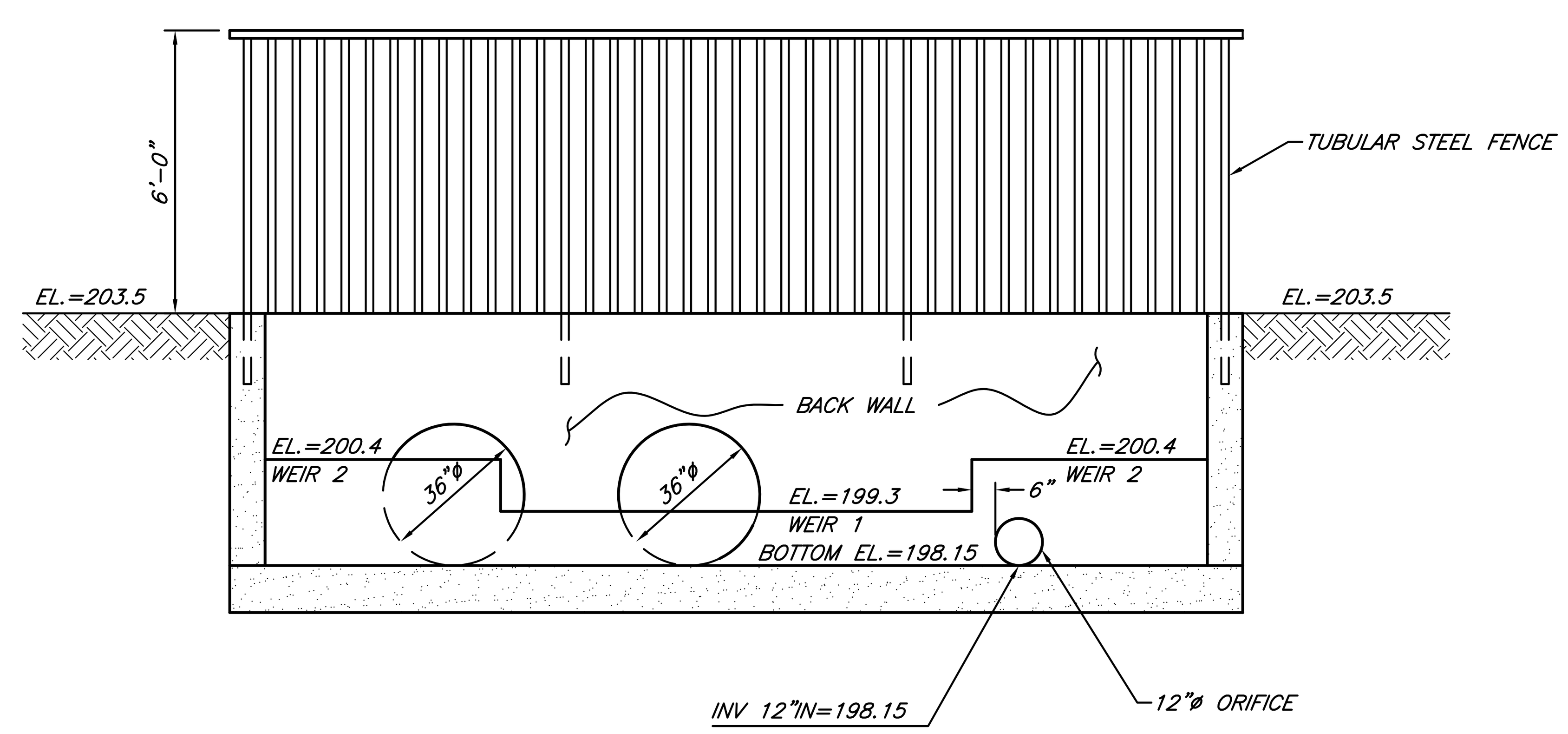
SOUTH

APPENDIX C

North Detention Basin Preliminary Outlet Design



TOP VIEW
SCALE: 1"=3'



FRONT VIEW
SCALE: 1"=3'

BASIN OUTLET STRUCTURE
SCALE: AS SHOWN

NORTH DETENTION BASIN
LINCOLN MEADOWS

0301012-DET-BASE

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APPENDIX D

South Detention Basin Preliminary Outlet Design

SOUTH DETENTION BASIN

LINCOLN MEADOWS

0301012-DET-BASE