Appendix H

Hydrology Study

DRAINAGE REPORT

Project Name:
PG&E Gas Operations Technical Training Center
Winters, CA

Date:
February 4, 2015

Prepared by:
BKF Engineers

Client:
Pacific Gas & Electric Company

This report has been prepared by or under the supervision
of the following Registered Civil Engineer(s):

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BACKGROUND/INTRODUCTION

1. Project Description

The following presents BKF Engineers' (BKF) analyses of storm drainage hydrology and water quality for the proposed PG&E Gas Operations Technical Training Center (GOTTC) in the city of Winters, California. The GOTTC project will be constructed on approximately 30 acres of land southwest of the East Grant Avenue (State Highway 128) and Interstate 505 interchange. See Figure 1 for the project vicinity.

Land Use

See Figure 2 for the existing land use and Figure 3 for the study area anticipated land use.

The on-site drainage area reviewed for purposes of this report totals 55.2 acres. A 2.7-acre portion of the site along the southern property line is within the top of bank of Putah Creek and approximately 15.6 acres zoned as Business Park Industrial is not owned by PG&E and will be developed in the future by others. Removing these two areas from the total, approximately 36.9 acres will be improved as a part of the GOTTC project.

The area within a 100-foot minimum setback from the top of bank of Putah Creek along the southern edge of the GOTTC project site and a minimum 100-foot wide corridor along the western edge of the GOTTC project site, totaling 6.3 acres, will be dedicated to the City as Open Space for public recreation and drainage purposes. As part of the project, the initial phases of the regional Putah Creek Diversion Channel (hereinafter referred to as the "Storm Water Channel") will be constructed within this area. This area will have no impervious surfaces other than compacted gravel maintenance roads along both sides of the Storm Water Channel.

Approximately 1.0 acres will be improved for public roadway purposes (Timbercrest Road).

Within the GOTTC project site, approximately 16.1 acres will be developed with 80 percent or 12.9 acres of impervious surface area. The remaining 13.5 acres will be maintained as open field and will be used for on-site storm water detention and excavation training purposes.

Existing Drainage

See Figure 4 for the existing drainage conditions. The topography of the site generally slopes from west to east with a slight crown dividing the site into north and south drainage subareas (McClish Sheds #1 & #2). These two subareas drain overland and discharge at the northeast and southeast corners of the site. A roadside ditch (hereinafter referred to as the "Grant Avenue Roadside Ditch") and a 36-inch reinforced concrete pipe (RCP) culvert (hereinafter referred to as the "Grant

Avenue 36-inch RCP") exist within the State of California right-of-way along the northern property boundary adjacent to East Grant Avenue and convey runoff east to an open channel in the State right-of-way along I-505 (hereinafter referred to as the "I-505 Channel"). A third on-site shed (Jordan Shed) drains east directly into the I-505 Channel. The I-505 Channel conveys runoff south along the project site's eastern boundary to an existing concrete spillway into Putah Creek.

Flows from the I-505 right-of-way and upstream properties north of the project site contribute to the runoff along Grant Avenue and I-505 via several culverts under Grant Avenue. During the 1-percent chance (100-year) storm event, the upstream flows exceed the combined capacity of the culverts under Grant Avenue and overtop the roadway near post mile 9.67. The combination of these upstream flows and the on-site discharges eventually exceeds the capacity of the Grant Avenue 36-inch RCP and Grant Avenue Roadside Ditch, resulting in flooding of portions of the project site.

Flooding

According to Federal Emergency Management Agency (FEMA) and the City of Winters Storm Drain Master Plan, the eastern and northern portions of the overall site are subject to inundation from the Grant Avenue 36-inch RCP and Grant Avenue Roadside Ditch during the 1-percent chance (100-year) storm event. These portions of the project site are within a FEMA Special Flood Hazard Area Zone AO (Depth 2 feet). The project area is shown on the Yolo County Flood Insurance Rate Map (FIRM), California Panel 564 of 785, Map Number 06113C0564G. With the proposed grading and fill on the project property, new structures will be elevated above the 1-percent change storm event water surface elevation. Public drainage improvements (described below) will be completed as part of the project to mitigate for the fill placed in the flood plain. A CLOMR/LOMR process will be completed through the City and FEMA to remove the site from Zone AO. The detailed survey of the site suggests a different overland flow path across the site than is shown on the FIRM. Because the project will complete a CLOMR/LOMR process, the mapping discrepancy is not important to the site design.

Proposed Drainage

See Figure 5 for the proposed drainage conditions. Pursuant to the City's Storm Drain Master Plan, the project applicant proposes to build the initial phase of the Storm Water Channel along the GOTTC project site's western boundary, within the 6.3-acre City Open Space area. The interim Storm Water Channel is sized for the existing 100-year flows from upstream properties with area available to support expansion of the Storm Water Channel to convey the increased 100-year peak flow rate anticipated with the ultimate build-out of the upstream drainage areas. Future improvements to the channel, coincident with upstream development, would

expand the channel to convey up to 1,000 cfs, construct a new outfall directly into Putah Creek, and abandon a portion of the interim channel.

The interim Storm Water Channel will intercept the upstream flows at the overall site's northwest corner and divert them south and east for discharge into the I-505 Channel. The Storm Water Channel will transition to a public 60-inch storm drainage culvert (hereinafter referred to as the "60-inch Culvert") just prior to the point of discharge into the I-505 Channel.

Drainage from the 1.0-acre public roadway (Timbercrest Road) will be directed to drainage inlets and conveyance pipes for direct discharge into the Storm Water Channel.

The project applicant proposes to build an on-site private detention and water quality pond (hereinafter referred to as the "Detention/Water Quality Pond") that will serve the 16.1-acre project site and the 13.5-acre excavation training area. The Detention/Water Quality Pond will be constructed within the fenced boundaries of the GOTTC project site at its southeast corner. The Detention/Water Quality Pond will be designed to City standards, providing both a water quality volume for treatment control and detention volume for flow rate control. A 24-inch outlet pipe will connect to the 60-inch Culvert.

The flows from the Storm Water Channel in the 60-inch Culvert will be combined with the flows from the Detention/Water Quality Pond's 24-inch outlet pipe and will discharge into the I-505 Channel at the southeast corner of the overall site area. An existing 15-inch corrugated metal pipe outfall will be replaced by the 60-inch culvert.

By intercepting the upstream flows with the Storm Water Channel and 60-inch Culvert, the flows through the Grant Avenue Roadside Ditch and Grant Avenue 36-inch RCP will be reduced, thereby eliminating the flooding of the project site that occurs when the capacities of these features are exceeded causing overland flow across the project site. The flows through the I-505 channel will also be reduced as a result.

Geotechnical

According to the Natural Resources Conservation Service Web Soil Survey, the northern and eastern portions of the site are underlain by "Brentwood silty clay loam, 0 to 2 percent slopes (BrA)," the southwestern portions of the site are underlain by "Yolo silt loam (Ya)," and the area within the banks of Putah Creek contain "Riverwash, (Rh)." Based on the Geotechnical Study for the project site, near-surface swales, ditches, and bio-retention areas will infiltrate into the underlying sandy soils. To mitigate against the potential destabilization of the creek bank, the south side of the Storm Water Channel will be located a minimum of 50 feet from the top of creek bank and may be lined to prevent lateral migration of water from the channel toward the creek. Outfalls will include erosion protection

measures such as flared-end sections, rock rip-rap, concrete sacks, etc. The flow rate through the Stormwater Channel will result in velocities of less than 2 feet per second and therefore erosion protection measures, other than hydro-seeding, within the channel are not anticipated. If the final channel design results in potentially erosive flow velocities, changes in direction in the channel will include erosion protection measures such as geo-fabric, rock rip-rap, concrete sacks, or some other engineered erosion control system.

Scope

This report addresses local storm drainage, stormwater detention to account for increased impervious surfaces associated with development, stormwater quality, and City and FEMA requirements for development within the existing floodplain. The overall site impervious area will increase significantly with the proposed development. With the project, the developed area of the site, including the excavation training area, will be about 50-percent impervious area. The Detention/Water Quality Pond will be sized to detain flows to 95-percent of the current 100-year peak flow rate.

Datum

All elevations presented are based on NAVD88 unless otherwise noted.

2. Design Criteria

   Drainage design criteria are per the City of Winters Improvement Standards and the City of Winters Storm Drain Master Plan with the exception of precipitation, rainfall intensities, and rainfall distributions which are taken from the Yolo County City/County Drainage Manual.

3. Brief Description of Analyses

   An existing conditions HEC-1L hydrology model associated with the City's Storm Drain Master Plan was provided to BKF by the City of Winters. The HEC-1L program was used to re-run the model using current precipitation and distribution patterns described in the Yolo County City/County Drainage Manual. Regional drainage improvements (Storm Water Channel and 60-inch Culvert) have been analyzed for the 10-day and 36-hour, 100-year frequency events using this methodology.

   HEC-RAS was utilized to analyze flows through the Grant Avenue Roadside Ditch, Grant Avenue 36-inch RCP, I-505 Channel, Storm Water Channel, 60-inch Culvert, Detention/Water Quality Pond, and the existing conditions overland flow across the subject property.

A copy of each of the following electronic files is provided concurrently with this report:

HEC-1L Files

- On and Off-site: 10-day, 100-year event – Existing and Proposed
- On and Off-site: 36-hour, 100-year event – Existing and Proposed
- On and Off-site: 24-hour, 100-year event – Existing and Proposed

HEC-RAS Files

- 10-day, 100-year event – Existing and Proposed
- 36-hour, 100-year event – Existing and Proposed
- 24-hour, 100-year event – Existing and Proposed

HYDROLOGIC ANALYSIS

1. Model Description

The project is located within the City of Winters Moody Slough Drainage Area. The Moody Slough Subbasin Drainage Report and the Dry Creek / Putah Creek Subbasins Drainage Report, both prepared by Wood Rodgers and dated August 2005, present flows and drainage criteria for the project area. Together these two reports comprise the City's Storm Drain Master Plan.

An existing conditions hydrology model associated with the Storm Drain Master Plan was provided by the City of Winters. Model input is a HEC-1L Computer Model entitled "SPRex10d.dat" last updated by Wood Rodgers. This computer model was developed from a previous model developed by Borcalli & Associates dated June 7, 2001 entitled "CEX10010.dat". The Borcalli model references an FIS Model of Willow Slough and Dry Slough dated 1/96 by E&B. The model "SPRex10d.dat" presents results for a 100-year, 10-day storm event and includes various diversion flows through existing storm drain systems.

Drainage areas for ultimate conditions north of East Grant Avenue are provided on Figure 6 of the Moody Slough Subbasin Drainage Report. Drainage areas south of East Grant Avenue are shown on Figure 2 from the Putah Creek / Dry Creek Subbasins Drainage Report. Figure 2 does not state whether it illustrates existing or proposed conditions.

The project vicinity is shown as Subareas 8BE1 and 8BZ2 on the Putah Creek / Dry Creek Subbasins Drainage Report Figure 2. These areas were combined as Subarea 8BE1 within the HEC-1L model of existing conditions.

The United States Department of Agriculture, National Resources Conservation Service (NRCS) Web Soil Survey website shows that approximately two-thirds of the project site is classified as Hydrologic Soil Group "C" and the remaining one-third is Hydrologic Soil Group "B". For a 100-year storm event, an antecedent

moisture condition (AMC) value of II is recommended. A range of runoff Curve Numbers (CN) is provided in Table 3 of the Putah Creek/Dry Creek Subbasins Drainage Report.

Subarea 8BE1 has a lag time 0.65 hours (39 minutes). This value is used for all project subareas for existing conditions to give results consistent with the City model.

Table 1 summarizes the existing conditions drainage characteristics.

Table 1: Drainage Area Characteristics, Existing

Location	HEC-1L Description	Area (acres)	Area (sq mi)	Land Use	B Soil (acres)	C Soil (acres)	B Soil CN	C Soil CN	Weighted 1-Day CN	Weighted 10-Day CN
Caltrans (I-505)										
Impervious	CT-IMP	2.5	0.0039	Roadway	0.9	1.6	98	98	98	96
Pervious	CT-PER	10.1	0.0158	Native Grasses	3.7	6.4	69	79	75	58
McClish										
Shed #1	EMC-G	14	0.0219	Fallow	3.5	10.5	78	83	82	68
Shed #2	EMC-I	26.8	0.0419	Fallow	18.4	8.4	78	83	80	65
Jordan	EJ-I	11.7	0.0183	Idle	0	11.7	-	74	74	57
McClish – Site	EXSITE-M	18.0	0.0281	Fallow	4.1	13.9	74	83	82	68
Jordan - Site	EXSITE-J	11.6	0.0181	Idle	0	11.6	-	74	74	57

For proposed conditions, the lag time was computed based on a time of concentration of 15 minutes for flow to the Detention/Water Quality Pond. This was multiplied by 0.6 to give a nine-minute lag time (0.15 hours).

For the revised HEC-1L model using the updated County rainfall distribution, a local rainfall intensity was computed using regional factors for Yolo County, with the exception of drainage areas CHS1, CHS2, CHS3, SUB11, SUB10 and SUB16 where a regional rainfall amount of 15.66 inches of rainfall was used for the 100-year, 10-day storm event. The rainfall depth represents average conditions for the upstream/off-site area. Since much of this runoff does not reach the study area, this approach is appropriate for this study. If used for other purposes, this model should be adjusted to account for the variation in rainfall throughout these basins. The revised HEC-1L model uses 15.45 inches for the 100-year, 10-day storm event within the on-site project area, based on the County criteria.

Table 2 summarizes the proposed conditions drainage characteristics.

Table 2: Drainage Area Characteristics, Proposed

Location	HEC-1L Description	Area (acres)	Area (sq mi)	Land Use	B Soil (acres)	C Soil (acres)	B Soil CN	C Soil CN	Weighted 1-Day CN	Weighted 10-Day CN
Caltrans (I-505)										
Impervious	CT-IMP	2.5	0.0039	Roadway	0.9	1.6	98	98	98	96
Pervious	CT-PER	10.1	0.0158	Native Grasses	3.7	6.4	69	79	75	58
Public Roadway	PR-G	1.0	0.0016	Roadway	0.4	0.6	98	98	98	96
McClish Lot 1	C-L1	3.8	0.0059	Undeveloped	0	3.8				68
McClish Lot 2	C-L2	11.8	0.0184	Undeveloped	0	11.8				68
Pond Shed										
GOTTC	GOTTC	16.1	0.0252	Commercial	1.0	15.1	92	94	94	86
GOTTC Training	TRAIN	13.5	0.0211	Idle	3.2	10.3	61	74	71	57
Storm Water Channel	DC	6.3	0.0098		4.6	1.7	61	74	65	46

2. Existing Conditions Drainage Model Results

The following discusses peak flow rates for the existing site conditions for the 100-year, 10-day storm event. These flow rates are shown on Figure 4. Flows are combined in the system using an unsteady-state model, meaning that flows are routed through a system that accounts for differences in timing of the hydrographs and the storage that occurs within the system. As a result of these timing differences and attenuation, the cumulative flows may not always be equal to the sum of the associated contributing flows.

From the revised HEC-1L computer model, a peak flow of 166 cubic feet per second (cfs) crosses East Grant Avenue from the north during the 100-year, 10-day storm event. The flow crosses upstream of the Grant Avenue 36-inch RCP through three existing culverts under East Grant Avenue. The flow also crosses East Grant Avenue downstream of the Grant Avenue 36-inch RCP through one existing culvert under East Grant Avenue and via overland flow. Water surface elevations are approximately 128.1 in the Grant Avenue Roadside Ditch upstream of the Grant Avenue 36-inch RCP and 126.9 in the I-505 Channel downstream of the Grant Avenue 36-inch RCP. The water surface elevation north of East Grant Avenue and the area overtopping East Grant Avenue is approximately 128.7.

Based on these parameters, from areas north of East Grant Avenue, a peak flow of 90 cfs (48 cfs west of Timbercrest Road and 42 cfs east of Timbercrest Road) will flow to the Grant Avenue Roadside Ditch west of the Grant Avenue 36-inch RCP. East of the Grant Avenue 36-inch RCP, 45 cfs will overtop Grant Avenue and 31 cfs will flow through a culvert under Grant Avenue for a combined peak flow of 76 cfs.

The revised HEC-1L model shows that no runoff from the upstream drainage area west of the project site and south of East Grant Avenue makes its way to the project area. The analysis summarized in this report includes no allowance for flow from upstream properties to the west flowing into the Grant Avenue Roadside Ditch.

Of the 90 cfs of upstream property flow west of the Grant Avenue 36-inch RCP, 40 cfs flows through the Grant Avenue 36-inch RCP to the I-505 Channel. The remaining 50 cfs exceeds the banks of the Grant Avenue Roadside Ditch and flows overland across the project site. To this 50 cfs flow, the 14.0-acre McClish Shed #1 contributes 12 cfs and the 11.7-acre Jordan Shed contributes 9 cfs for a peak flow of 68 cfs across the site, entering the I-505 Channel at various points.

The I-505 Channel will receive 76 cfs from north of East Grant Avenue, 40 cfs from the Grant Avenue 36-inch RCP, and 12 cfs from the I-505 right-of-way resulting in a peak flow 119 cfs of flow near the north end of the I-505 Channel. When combined with the 68 cfs of overland flow from the site, the peak flow increases to 187 cfs. Finally, a flow of 22 cfs from the 26.8-acre McClish Shed #2 will contribute to a total peak flow of 201 cfs in the I-505 Channel.

In its current state, the 100-year peak storm water discharge flow rate from the overall 52.5-acre site (McClish Shed #1, McClish Shed #2, and Jordan Shed) is 43 cfs. For 29.6-acre GOTTC site area, the existing condition peak discharge flow rate is 24 cfs.

Water levels in Putah Creek upstream of the project are presented in the Bridge Design Hydraulic Study Report for the Winters Road Bridge Replacement at Putah Creek by WRECO for Solano County, dated April 2008. The 100-year water level at the site of the former percolation dam about 1,500 feet west (upstream of the project) is approximately elevation 118 NGVD29 (elevation 120.7 NAVD88). The water surface slope is greater than 0.001 feet per foot for the modeled reach. Extrapolating a slope of 0.001 feet per foot downstream gives a water level of about 119.2 at the existing I-505 Channel spillway. The concrete spillway is at elevation 120.2. Therefore, existing condition flows are not affected by a tailwater condition at Putah Creek.

3. Proposed Conditions Drainage Model Results

The peak flow rates for the proposed site conditions are shown on Figure 5.

Off-Site

Following project construction, the off-site stormwater flows will include 80 cfs from north of East Grant Avenue and west of Timbercrest Road, 50 cfs from north of East Grant Avenue and east of Timbercrest Road, 35 cfs from north of East Grant Avenue and east of the Grant Avenue 36-inch RCP, and 12 cfs from the I-505 right-of-way.

Water surface elevations on the south side of East Grant Avenue were developed using a HEC-RAS computer model to determine flow through the I-505 Channel and surface flow across the McClish and Jordan parcels. Water surface elevations are approximately 126.4 at the upstream end of the Storm Water Channel and 127.5 in the Grant Avenue Roadside Ditch upstream of the Grant Avenue 36-inch RCP. Water surface elevations are approximately 125.4 in the I-505 Channel downstream of the Grant Avenue 36-inch RCP.

The computed water surface elevations south of East Grant Avenue were used for tailwater conditions for the culverts crossing East Grant Avenue. An unsteady-state model was used to allocate flows through the various culverts. The resulting water surface elevation north of East Grant Avenue is 128.4, which is 0.3 feet less than the existing water level of 128.7.

The construction of the Storm Water Channel will divert 80 cfs from the Grant Avenue Roadside Ditch. The Storm Water Channel will receive 15 cfs from the remaining McClish property[1]. The Storm Water Channel will also receive 1 cfs from the new public roadway (Timbercrest Road) and 4 cfs that falls directly on the Storm Water Channel area. The Storm Water Channel will convey a peak flow of 91 cfs to the southern end of the project site to the 60-inch Culvert where the Detention/Water Quality Pond will discharge an additional 16 cfs (see *On-Site* below) for a combined peak discharge flow rate of 106 cfs to the I-505 Channel.

The 60-inch Culvert will discharge at a new outfall at invert elevation 121.25 into the I-505 Channel just upstream of the existing spillway into Putah Creek. The tailwater elevation in the I-505 Channel at the junction with the 60-inch Culvert is 124.2. As currently designed, the slope of the Storm Water Channel is 0.0003 feet per foot. The Storm Water Channel is anticipated to be grass-lined with a conservative Manning's "n" Roughness Coefficient of 0.060 (from Table 5, Dry Creek / Putah Creek Subbasins Drainage Report). As currently designed, the maximum capacity of the interim Storm Water Channel section is approximately 185 cfs with a five-foot flow depth and 16 inches of freeboard. The 60-inch Culvert will be sloped at 0.0048 feet per foot with a maximum capacity of 150 cfs.

A peak flow of 53 cfs from north of East Grant Avenue will continue to flow through the Grant Avenue Roadside Ditch and the Grant Avenue 36-inch RCP. Approximately 35 cfs from north of East Grant Avenue will combine with this flow east of the Grant Avenue 36-inch RCP for a peak flow of 87 cfs entering the upstream end of the I-505 Channel. Combined with the 12 cfs from the Caltrans I-505 right-of-way, the peak flow through the I-505 Channel will be 91 cfs, including reductions for storage and differences in timing. The unsteady-state

[1] Since the future development of the remaining McClish property will be required to reduce post-project runoff to 95% of the pre-project level, conservatively, the existing drainage condition was used to calculate the 15 cfs discharge to the Storm Water Channel.

model accounts for tailwater conditions at the junction of the 60-inch Culvert and the I-505 Channel. The proposed condition flows will not be affected by a tailwater at Putah Creek.

Combining the 106 cfs 60-inch Culvert flow and the 91 cfs I-505 Channel flow, the total proposed peak discharge to Putah Creek at the existing I-505 Channel spillway is 197 cfs, 4 cfs less than the existing condition. Thus, the peak stormwater discharge flow rate from the project site following construction of the project will, in accordance with local, state, and federal laws, be less than the pre-project peak stormwater discharge flow rate.

On-Site

The Detention/Water Quality Pond will receive the following flows:

- 16.1 acres, CN = 86, 100-year Peak Flow Rate = 17 cfs
- 13.5 acres, CN = 57, 100-year Peak Flow Rate = 11 cfs

The peak flow from the 29.6-acre development to the Detention/Water Quality Pond will be 28 cfs. City standards require that the post-project peak flow rate be attenuated to less than or equal to 95 percent of the pre-project peak flow rate. As mentioned above, the existing condition peak discharge flow rate is 24 cfs from the 29.6-acre area to be improved. Therefore, the allowable post-project peak discharge flow rate is approximately 22 cfs. A 24-inch outlet pipe from the pond will limit the post-project discharge flow rate to 16 cfs accounting for tailwater conditions in the 60-inch Culvert. The invert of the Detention/Water Quality Pond outlet pipe will be at a minimum elevation 122.0. This will allow for a minimum of 0.75 feet of fall from the Detention/Water Quality Pond to the new I-505 Channel outfall.

The associated modeled detention volume is approximately 2.8 acre-feet and will occur between elevations 122 and 125.5 for the 100-year, 10-day storm event. The peak water level in the Detention/Water Quality Pond during the 100-year, 10-day storm event will be elevation 125.5 due to the tailwater condition in the 60-inch Culvert at elevation 125.0. The top of pond elevation will be constructed between 127.5 and 128.0 with up to 18 inches of fill over existing grade.

The following Tables 3, 4, and 5 summarize the unsteady-state water levels and peak flow rates at indicated locations for the 100-year, 10-day and 100-year, 24-hour events:

Table 3: Storage Areas

Storm Duration	Storage Area	Water Level (feet)		Peak Flow (cfs)		Storage Area (acres)		Storage Volume (acre-ft)	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
10-day	Grant Avenue	128.7	128.4	165.5	165.2	.0	.1	.4	.4
24-hour	Grant Avenue	128.7	128.3	163.0	163.0	.0	.1	.4	.4
10-day	Pond		125.5		15.6		2.1		4.1
24-hour	Pond		125.4		20.9		2.1		3.8

Table 4: Lateral Structures

Storm Duration	Reach	River Station	Peak Flow (cfs)		Water Level (feet)	
			Existing	Proposed	Existing	Proposed
10-day	Caltrans	2550	47.7	.0	128.4	127.6
	Caltrans	2499	52.4		128.3	
	Caltrans	2350	42.1	50.4	128.2	127.6
	Caltrans	1950	73.7	34.8	127.0	125.6
	Caltrans	1850	2.0		127.0	
	CHANNEL	2565		80.0		126.4
	CHANNEL	210		15.6		125.3
24-hour	Caltrans	2550	40.7	.0	128.6	127.5
	Caltrans	2499	67.5		128.4	
	Caltrans	2350	41.9	52.0	128.2	127.5
	Caltrans	1950	77.7	31.9	127.1	125.5
	Caltrans	1850	2.7		127.0	
	CHANNEL	2565		79.1		126.1
	CHANNEL	210		20.9		124.8

Table 5: Channel Cross Sections

Storm Duration	Reach	River Station	Peak Flow (cfs)		Water Level (feet)		Channel Velocity (ft/s)		Proposed as Percent of Existing Flow
			Existing	Proposed	Existing	Proposed	Existing	Proposed	(%)
10-day	Caltrans	2700	3.0	3.0	128.4	127.7	.0	.1	
	Caltrans	2287	40.4	53.4	128.1	127.5	4.5	5.9	32%
	Caltrans	1989	40.4	53.0	126.9	125.3	4.1	5.8	31%
	Caltrans	1000	186.7	91.0	126.2	125.0	1.8	1.4	-51%
	Caltrans	300	200.8		125.2		2.4		
	Caltrans	200		90.9		124.2		1.1	
	Caltrans	80-100	200.8	197.0	123.8	124.2	4.1	2.9	-2%
	OVERLAND	714	16.5		127.5		.1		
	OVERLAND	80	67.9		126.8		.7		
	CHANNEL	2605		13.3		126.4		.1	
	CHANNEL	201		106.5		125.0		4.8	
	CHANNEL	96		106.5		124.6		4.9	
	CHANNEL	56		106.1		124.2		5.3	
24-hour	Caltrans	2700	25.0	1.0	128.6	127.5	.3	.0	
	Caltrans	2287	39.8	52.8	128.2	127.4	4.4	5.9	33%
	Caltrans	1989	39.8	52.8	127.0	125.2	4.1	6.0	33%
	Caltrans	1000	195.6	87.1	126.2	124.9	1.8	1.4	-55%
	Caltrans	300	201.7		125.2		2.4		
	Caltrans	200		85.3		124.0		1.2	
	Caltrans	80-100	201.6	171.9	123.8	124.0	4.1	2.9	-15%
	OVERLAND	714	4.0		127.5		.0		
	OVERLAND	80	75.9		126.9		.7		
	CHANNEL	2605		4.5		126.1		.0	
	CHANNEL	201		86.8		124.6		4.3	
	CHANNEL	96		86.7		124.3		4.2	
	CHANNEL	56		86.5		124.0		4.6	

WATER QUALITY

Per the City Storm Drain Master Plan requirements, the Detention/Water Quality Pond will include a water quality volume based on the California Stormwater BMP Handbook approach with the following factors:

- Composite runoff coefficient, C = 0.50
- Sacramento capture curve, 48-hour Drawdown (Appendix D)
- Capture (% of Runoff) = 85%

Based on the above, the Unit Basin Storage Volume for C=0.50 is 0.4. Using a BMP Drainage Area of 30 acres, the required water quality volume is 1.0 acre-feet or 43,560 cubic feet. As currently designed, the water quality storage volume in the Detention/Water Quality Pond is approximately 48,600 cubic feet, occurring between elevations 119 and 122.

Runoff from the 16.1-acre developed area of the site will be collected and conveyed by a piped storm drain system to the pond. The developed area will include vegetated bio-retention areas to provide pre-treatment of some of the runoff from roof areas and pavements.

The 13.5-acre excavation training area will be graded such that it is relatively flat, similar to the existing condition. Due to the relatively high percolation rate of the surface soils (see discussion below), much of the rainfall on the excavation training area will infiltrate into the ground. Any surface runoff from the excavation training area will drain overland to the east to a swale. The swale will convey the runoff to the pond. The final design of the swale may include vegetation and/or a restricted outlet to allow the swale to function as a stilling basin or forebay for the pond.

Since the water quality storage volume in the pond is below the pond outlet elevation, the pond will rely on infiltration to discharge the water quality storage volume. Wallace Kuhl & Associates completed three percolation test excavations at the southern end of the project site. The details and findings are documented in their report dated September 22, 2014. Each of the percolation test locations was excavated to a depth of 10 feet, slightly greater than the depth of the Detention/Water Quality Pond. The steady state percolation rates were measured at 0.11, 0.13, and 0.13 inches per minute for the three test sites. The report notes a silty clay layer near the bottom of the percolation test excavations and that the measured percolation rates are likely a combination of lateral infiltration and vertical infiltration.

As currently designed, the bottom area of the Detention/Water Quality Pond is 13,996 square feet. Due to the presence of the silty clay layer below the bottom of the pond, a factor of safety of 5 is applied to the lowest measured percolation rate of 0.11 in/min for a design infiltration rate of 0.022 in/min (or 0.11 feet per hour). To determine the drawdown time of the water quality storage volume, the design infiltration rate is applied over the infiltration area. Ignoring the side slopes, water will discharge from the pond at a minimum rate of 1,540 cubic feet per hour. Therefore, 43,560 cubic feet of water quality storage volume will discharge in 28.3 hours, below the required maximum drawdown time of 48 hours.

IMPLEMENTATION PLAN

PG&E proposes to install the facilities described in this report as a part of the project development.

In the future, PG&E understands that the Storm Water Channel will be expanded and improved by others and a new outfall directly to Putah Creek will be installed to allow for increased flows associated with future upstream development, none of which has been proposed at this time. As part of this future channel improvement project, the interim channel in the 100-foot open space area south of the PG&E site may be abandoned.

As part of its future development, the owner(s) of the McClish parcel(s) to the west of the project will be responsible for the installation of on-site private storm drainage systems to collect, convey, treat, and detain runoff from its developed site, per City standards.

PROPOSED MAINTENANCE PROGRAM

PG&E will be responsible for maintenance of its on-site storm drain system and Detention/Water Quality Pond. Caltrans will continue to be responsible for maintenance of the I-505 Channel. The City of Winters, in an agreement with Caltrans, will continue to be responsible for maintenance of the Grant Avenue Roadside Ditch and Grant Avenue 36-inch RCP. The City of Winters will be responsible for maintaining the Storm Water Channel and 60-inch Culvert.

CONCLUSIONS

- The Storm Water Channel will convey a portion of the 100-year peak flows from upstream properties around the project site and alleviate site flooding issues associated with inadequate capacity of the Grant Avenue Roadside Ditch and Grant Avenue 36-inch RCP. The flow through the I-505 Channel upstream of the new 60-inch culvert will be reduced by 110 cfs from 201 cfs to 91 cfs (a reduction of nearly 55 percent). The peak flow at the spillway into Putah Creek will be reduced by 4 cfs from 201 cfs to 197 cfs.
- The proposed Detention/Water Quality Pond will mitigate for increased site impervious area, reducing the peak discharge by more than five percent from the pre-project condition for the GOTTC project site area. The total peak discharge to Putah Creek will be reduced by 4 cfs from the existing condition and therefore, will not result in any increased flows to downstream properties.
- The proposed Detention/Water Quality Pond will include a water quality treatment volume for the GOTTC project site area, compliant with local requirements.
- The proposed on-site and off-site drainage facilities will meet the City of Winters' drainage requirements for flood control, collection, conveyance, and water quality.

LIST OF FIGURES

Figure 1 Vicinity Map
Figure 2 Existing Land Use
Figure 3 Proposed Land Use
Figure 4 Existing Drainage Conditions
Figure 5 Proposed Drainage Conditions

REFERENCES

1. United States Department of Agriculture, National Resources Conservation Service, "National Engineering Handbook, Part 630, Hydrology," July 2004.
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3. Wallace Kuhl & Associates, "Geotechnical Engineering Report, PG&E Training Facility," prepared for Pacific Gas & Electric Company, September 22, 2014.
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5. Wood Rodgers, "Putah Creek / Dry Creek Subbasins Drainage Report," prepared for the City of Winters, August 2005.
6. Wood Rodgers, "Yolo County City/County Drainage Manual, Volume 1 of 2," prepared for Flood Safe Yolo Pilot Program, April 2009 (revised February 2010).
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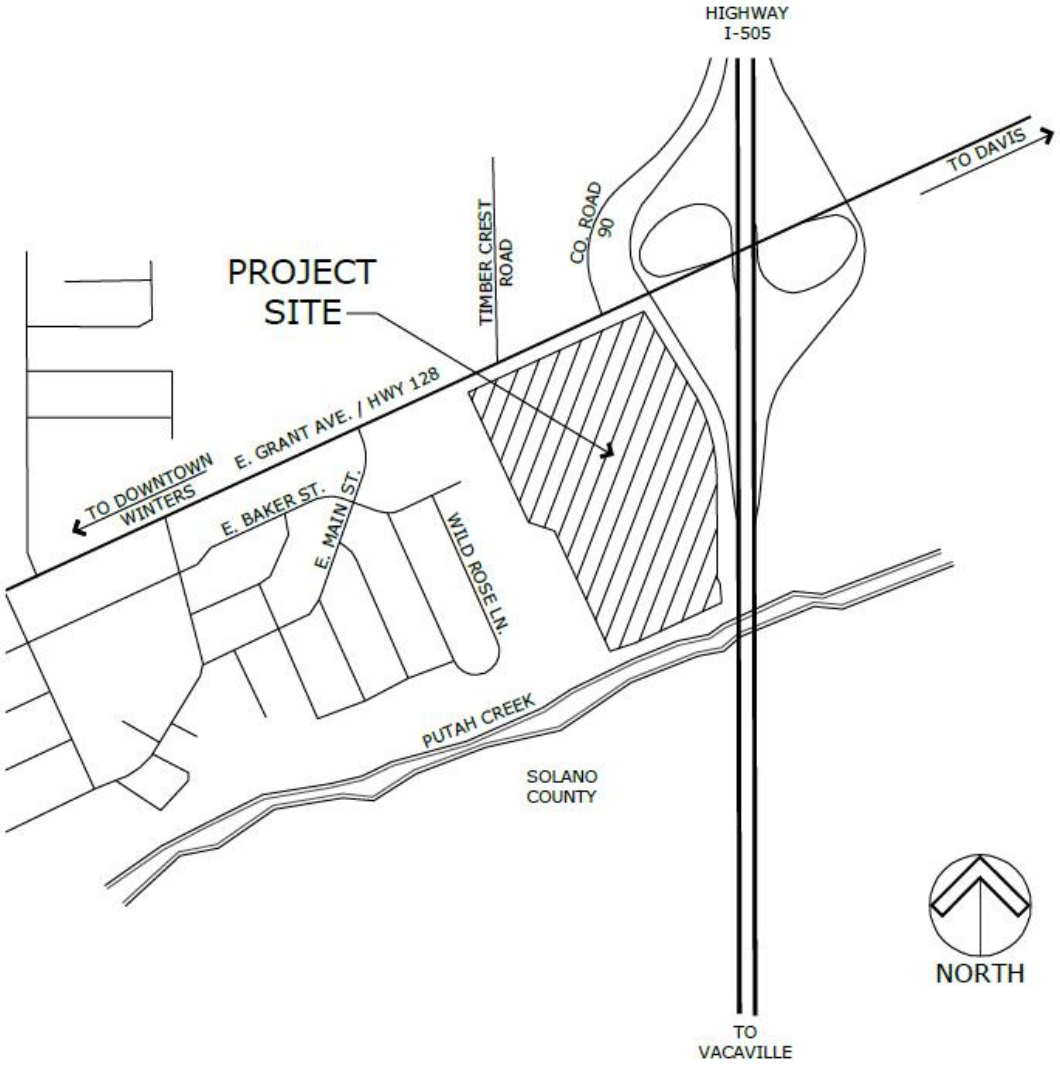

Figure 1: Vicinity Map

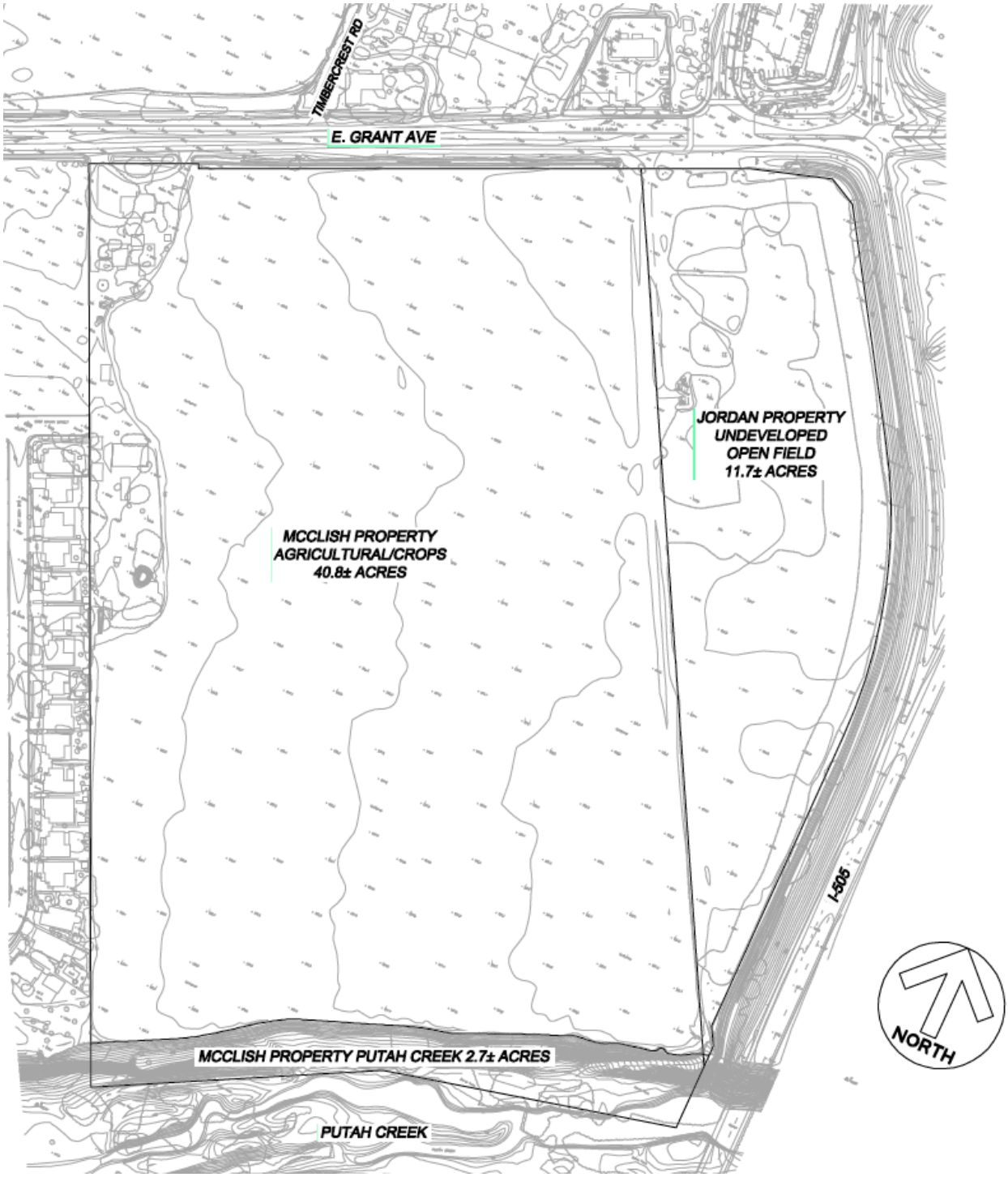

Figure 2: Existing Land Use

Figure 3: Study Area Land Use

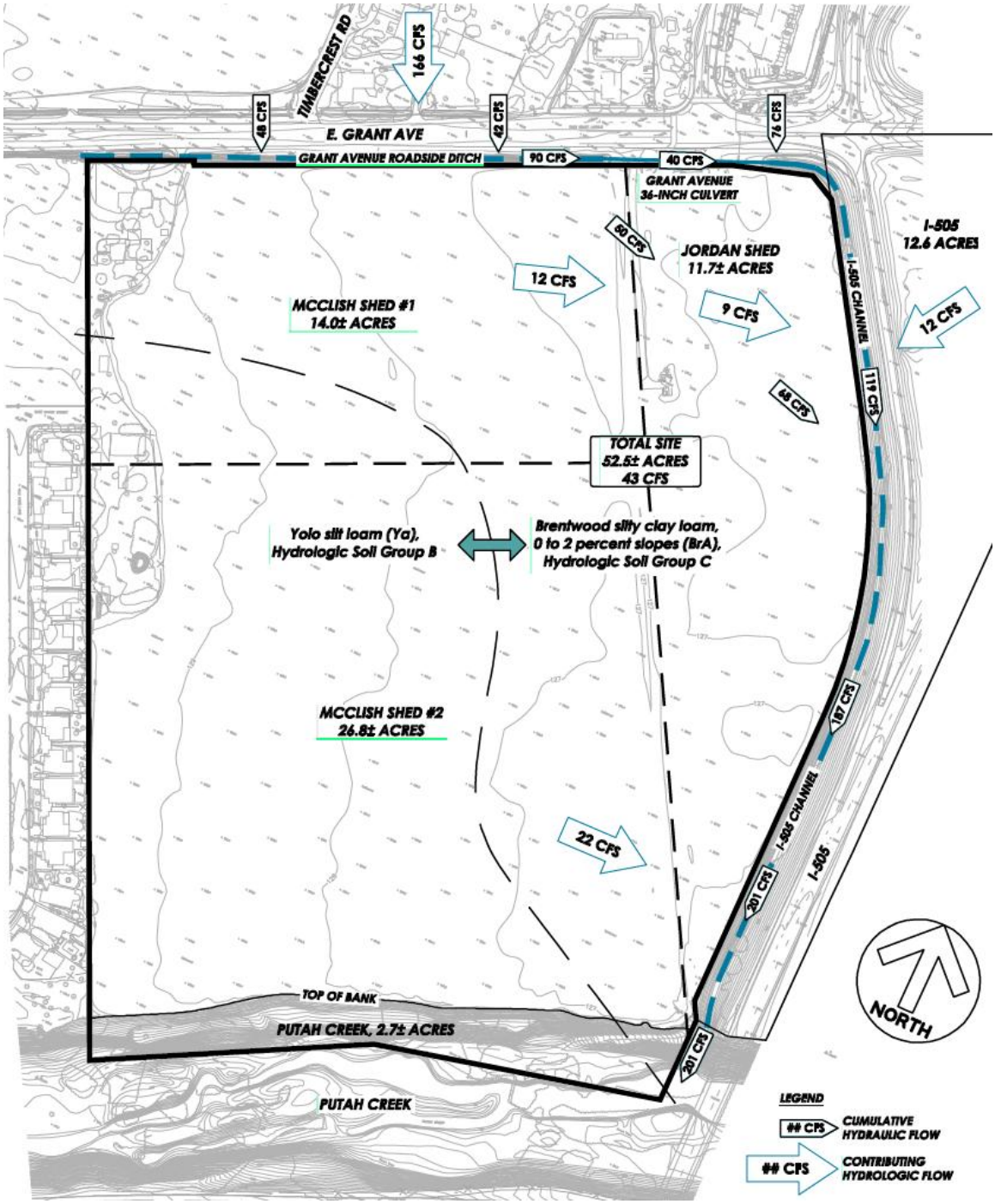

Figure 4: Existing Drainage Conditions

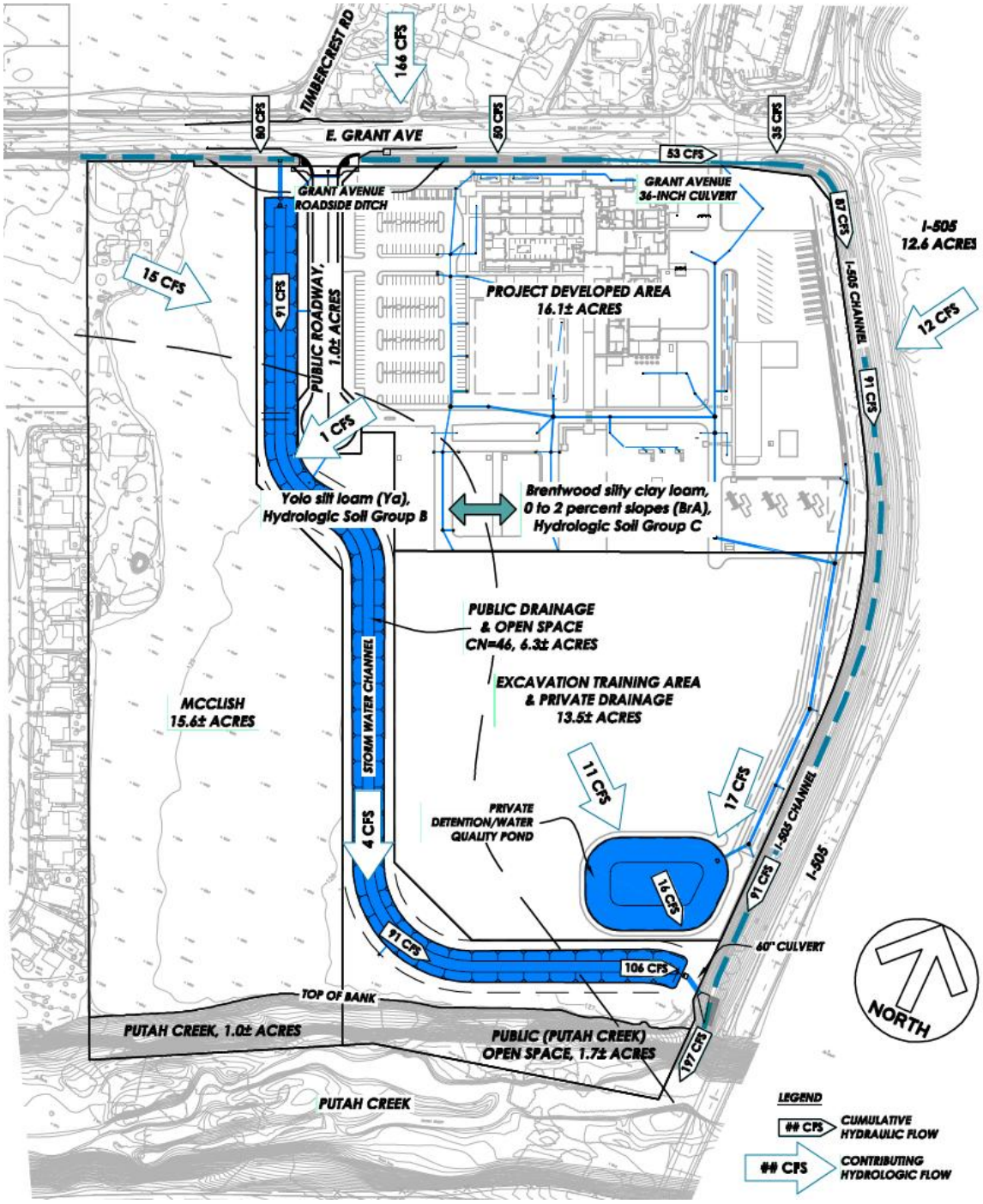

Figure 5: Proposed Drainage Conditions