REVISION OF THE

STORM DRAINAGE MASTER PLAN

FOR THE

ELVERTA SPECIFIC PLAN

SACRAMENTO COUNTY
CONTROL #99-SFB-0351

Prepared For:

Elverta Owners Group

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M&S Project #7501-30

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STORM DRAINAGE MASTER PLAN

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ELVERTA SPECIFIC PLAN

Sacramento County, California

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PREFACE

The 1,744+/- acre Elverta Specific Plan is a proposed master-planned community consisting of a diverse mix of land uses located in the northwestern part of Sacramento County. In 1998 the Sacramento County Board of Supervisors initiated the planning process for this community at the request of the Elverta Specific Plan Property Owners Group[1]. Through a collaborative effort of the County Planning Department and its consultants, the Elverta Specific Plan Property Owners Group, and a Board of Supervisors' appointed Citizen's Advisory Committee, a draft land use plan known then as the "Preferred Land Use Concept Plan" was developed, for which an Administrative Draft Specific Plan text document and various supporting technical studies were subsequently completed in 2000 and 2003, respectively[2].

In May of 2003, the County of Sacramento acting as the Lead Agency published and circulated a Draft Environmental Impact Report for public review and comment pursuant to CEQA requirements. After a lengthy public outreach and hearing process and in response to comments received during this process, the original draft land use plan was revised, resulting in the land use plan known as "Plan 4, as Revised" and "Refined Plan, Land Use Plan #4" as shown in Exhibit 1.

This revised and updated land use plan, supporting technical studies, and several other documents were incorporated into the Final EIR published by the County in May of 2007, which then served as the basis for multiple public hearings before the County Board of Supervisors, before eventually being certified on August 8, 2007[3].

Participating land use ownership has changed significantly subsequent to that date, driven mostly by economic conditions of the last few years. This new Elverta Owners Group (see Exhibit 3) has since initiated consultation with the natural resources agencies in pursuit of U.S. Clean Water Act, Section 404 permits needed for implementation of the project as approved by the Board of Supervisors. The 404 permitting involves the eventual issuance of one overall County-sponsored permit associated with the construction of the backbone infrastructure necessary to serve the Phase 1 development within the Plan Area, as well as 14 additional individual permits for the various landowner based development plans of the Elverta Owners Group constituting Phase 1 development. As part of this process, the federal resource agencies have required a NEPA Environmental Impact Statement (EIS) for the project.

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1 The Elverta Specific Plan Property Owners Group, also known as the "participating property owners", consists of those Specific Plan area land owners who participated financially in the Specific Plan Process and received rezoning for their properties subsequent to the Specific Plan approval and FEIR certification.

2 Source: Final Environmental Impact Report, Volume 1 (of 4), Elverta Specific Plan, Sacramento County Control #99-SFB-0351 and State Clearinghouse #SCH 2000092026.

3 For the complete time line and full description of the lengthy environmental review process and associated public hearings, please refer to the County of Sacramento records. To facilitate review of this study, some portions of the FEIR and original drainage master plan text and information have been incorporated into this study verbatim as indicated.

In an effort to create a more environmentally sound proposal, the Elverta Owners Group revised the original drainage corridor alignments approved in the Specific Plan. The revised alignments reflect more natural alignments that largely follow the existing drainages. The design of the revised corridors was also modified significantly to allow enhancement and restoration of natural resources within these corridors, while at the same time managing potential impacts due to hydromodification caused by the proposed urbanization of the project.[4] Additionally, the Elverta Owners Group decided to create the flexibility for potential future densification of the Project in accordance with a density bonus provision contained in the approved Specific Plan text that allows for an increase in residential densities of up to 25% based on a concurrent energy efficiency increases above a given threshold. As a result, a revised land use plan reflecting increased densities was created to be processed for approval by the County as a Specific Plan Amendment. This latest land use plan as reflected in Exhibit 2 is consistent with current trends in urban land use planning leaning toward denser urban development on smaller footprints.

The following study updates the hydrologic and hydraulic analysis for these revised drainage corridors and a potential residential density increase of up to 25%[5]. The completed analysis is being incorporated into the EIS being prepared for the Specific Plan.

4 Due to increases in the overall width of drainage corridors B and C on account of addressing the allowed for 25% density bonus, the developable residential acreage within the Specific Plan decreased, resulting in the total holding capacity of the Specific Plan as reflected in the proposed Specific Plan Amendment to decrease from an approved 4,950 DU to 4,807 DU, not counting the potential 25% density bonus allowed for. As the drainage modeling is based on the higher approved holding capacity of 4,950 DU (not counting the allowed for 25% density bonus), it furthermore increases the conservative nature of this Specific Plan drainage analysis.

5 As a result of this drainage master plan analysis accounting for the allowed for 25% density bonus (4950 DU + 25% = 6,188 DU), calculated runoff rates and volume are slightly higher than they would be, had the calculations been based on a total of 4,950 DU or the even lower proposed Specific Plan Amendment holding capacity of 4,807 DU. The results and associated facility requirements (mitigation measures) are thus considered to be conservative when compared to results based on the lower density.

1.0 EXECUTIVE SUMMARY

On August 8, 2007, nearly 14 years after initiation of the Rio Linda/Elverta Community Plan update, subsequent Specific Plan land use planning, technical study and EIR preparation, and public outreach/public hearing processes, the Sacramento County Board of Supervisors certified the Environmental Impact Report (EIR) for the Elverta Specific Plan (ESP). A few weeks later, various entitlements including a General Plan Amendment, Specific Plan, Financing Plan, and related documents were approved, the basis of which was a land use plan known as the "Plan 4, as revised" and "Refined Plan, Land Use Plan #4" (see Exhibit 1). The technical studies for the Specific Plan EIR were completed between 2002 and 2003, including a "Storm Drainage Master Plan for the Elverta Specific Plan, Sacramento County", completed on October 16, 2002.

Said Storm Drainage Master Plan for the Elverta Specific Plan analyzed the referenced land use plan (Exhibit 1) consisting of:

1. Residential land uses ranging from rural-type agricultural-residential densities of 1 to 5-acre minimum sized parcels (AR 1-5) through low, medium, and high density residential apartment-style zoning at up to 20 dwelling units per acre (RD 1-2, RD 3-5, RD 6-7, RD 10, and HDR-20, respectively). The holding capacity of the approved Specific Plan was limited to 4,950 residential dwelling units (DU). This consists of 450 rural density ag-res DU and 4,500 DU of more urban-style density;
2. Commercial uses;
3. A community center;
4. Two elementary schools, and
5. Supporting backbone infrastructure, including major roads, parks, drainage corridors, a power line corridor, and other ancillary land uses.

Since approval of the Specific Plan, the Elverta Owners Group, i.e. those property owners seeking development entitlements and funding ongoing natural resource permitting efforts, has undergone a change in participation, driven largely by the economic malaise of the last four to five years. The current Owners Group initiated consultations with the US Army Corps of Engineers (USACOE) in pursuit of U.S. Clean Water Act, Section 404 permits required for implementation of the approved project. Based on feedback the group received during the consultation meetings, a more biologically sound alternative to the approved land use plan was developed. In this new, preferred alternative, the proposed drainage corridors for drainage sheds B, C, and D (the three southernmost drainage sheds in the Specific Plan area containing a majority of the urban land uses proposed for the Project) were realigned to largely coincide with the underlying existing drainages. These new proposed drainage corridors were widened significantly to manage the potential impacts of hydromodification due to urbanization of the Project area. The resulting wide drainage corridors allow for habitat creation and enhancement within these corridors much superior to that found in the Plan Area today.

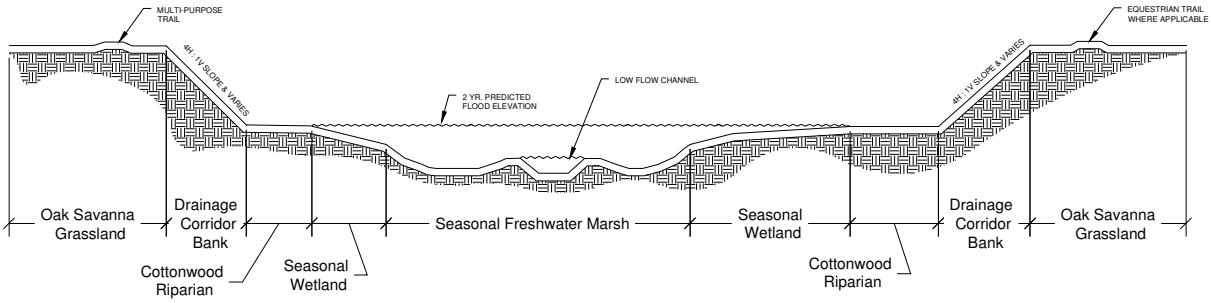
This current 2013 Drainage Master Plan for the Elverta Specific Plan analyzes drainage impacts resulting from updates to the Elverta Specific land use plan and associated

drainage corridor realignments depicted in Exhibit 2. The analysis defines how the proposed revised development can occur in a responsible and safe manner and how potential impacts on existing downstream drainages can be fully mitigated to existing or better than existing conditions. It further defines how a portion of the Plan Area made up of parcels owned or controlled by the Elverta Owners Group (Phase 1 development area as reflected in Exhibit 3) may develop in a safe and responsible manner consistent with all applicable standards and regulations. The analysis is being incorporated into a NEPA Environmental Impact Statement (EIS) for the Specific Plan, required by the resource agencies to support the U.S. Clean Water Act, Section 401 and 404 permitting processes.

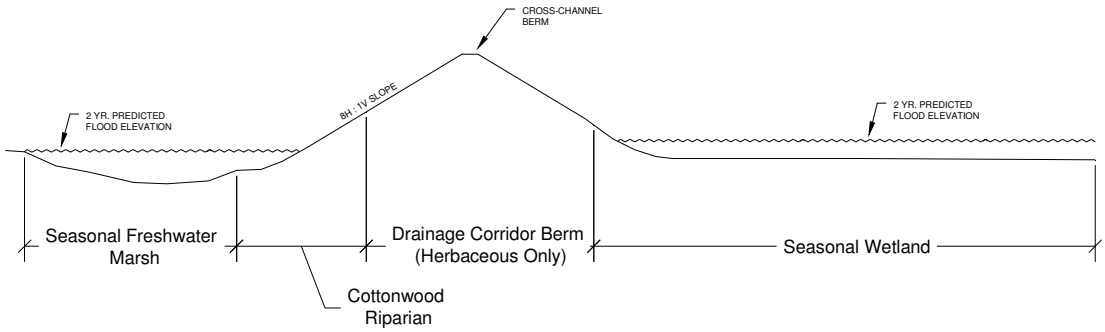
The revised project as proposed can be implemented in a safe and responsible manner that appropriately mitigates all development impacts on stormwater runoff to existing or better than existing conditions at the downstream end of the project and upstream of non-participating properties for both buildout conditions and Phase 1 interim conditions. This is clearly demonstrated in the following Table 1, which compares peak runoff rates resulting from the 100-year design storm for both existing conditions and developed conditions (with full implementation of identified drainage improvements).

Development impacts to water quality will be fully mitigated by the implementation of a combination of Low Impact Development (LID) measures, Best Management Practices, and point-of-discharge water quality treatment basins as discussed in Chapter 5.0 of this study. Hydromodification management will occur in-stream through the attenuation of frequently occurring storm events via a number of cross channel berms that discharge runoff into the downstream drainages through calibrated vertical openings in these berms (see Chapter 3.5 and Appendix 9.2 of this study). The width and slope of the proposed drainage channels cause runoff to flow very slowly through the channels, further helping to reduce the erosion potential within the defined on-site channel limits.

The drainage corridor sections shown below depict the conceptual layout of the proposed drainage channels within the Project limits. Wetland and riparian habitat will be restored, created, or enhanced within these expanded drainage corridors to exceed the functional value of the habitat that currently exists within the degraded drainages on-site. This is further discussed in Chapter 7.0 of this report, with conceptual habitat development plans appended (Appendix 9.5).



Proposed Channel Cross Section



Proposed Longitudinal Channel Section

TABLE 1:
PRE- AND POST-DEVELOPMENT 100-YR PEAK RUNOF COMPARISON

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		
			Existing	Phase 1	Developed
600- and 700-Series Sheds:					
Node B-2 (downstream compliance)	n/a		296	n/a	311
Node 600UP (downstream compliance)	n/a		27	n/a	39
Node 702UP (downstream compliance)	n/a		29	23	26
Note: 600- Series shed analysis results based on 2002 Storm Drainage Master Plan					
Shed AA:					
Node A (downstream compliance)	n/a		95	94	88
Note: Shed A analysis results based on 2002 Storm Drainage Master Plan					
Corridor B:					
Downstream of Phase 1 compliance	38+46	38+46	184	183*	n/a
Downstream Compliance	11+50	11+50	173	n/a	138
(*based on temp. interim on-site mitigation by Phase 1 participants as modeled)					
Corridor C:					
Non-participant	180+20	181+41	283	216	262
Downstream Compliance	162+22	162+21	316	265	286
Corridor D:					
Downstream of U-Street	0+98	15+00	146	n/a	68.00

[insert Exhibit 1: Land Use Plan "Plan 4, As Revised]

[insert Exhibit 2: Current/Preferred Land Use Plan]

[insert Exhibit 3: Elverta Owners Group (Participants, Phase 1 Development)]

2.0 INTRODUCTION

2.1 STUDY PURPOSE

A Storm Drainage Master Plan (dated October 16, 2002) was prepared for the Elverta Specific Plan (the Plan Area) and approved by the Sacramento County Department of Water Resources early in 2003 for inclusion in the project's Environmental Impact Report, certified in 2007. The drainage analysis studied existing conditions and determined what facilities would be required to allow buildout of the proposed "Plan 4, as Revised" land uses (Exhibit 1) to occur in a responsible and safe manner and to fully mitigate the Plan Area's development impacts on downstream properties. The hydraulic analysis of the major drainages completed for the 2002 plan relied on the US Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC RAS), Version 3.0 Steady State computer modeling software.

The current (2013) Drainage Master Plan for the Elverta Specific Plan analyzes drainage impacts resulting from updates to the Elverta Specific land use plan and associated drainage corridor realignments made since Project approval in 2007 - changes made in response to feedback received from federal regulatory resource agencies (see Exhibit 2). The analysis defines how the proposed revised development can occur in a responsible and safe manner and how potential impacts on existing downstream drainages can be fully mitigated to existing or better than existing conditions. The outcome of this analysis will be incorporated into a required NEPA Environmental Impact Statement (EIS) for the Specific Plan and to support of the U.S. Clean Water Act, Sections 401 and 404 permitting processes.

This study adheres to specific requirements for the planning and analysis of drainage facilities as set forth in:

1. the Storm Drain Design Standards of the Municipal Services Agency of Sacramento County Department of Water Resources,
2. the Sacramento County Water Agency Drainage Ordinance,
3. the Sacramento City/County Drainage Manual Volume 2: Hydrology Standards,
4. the Sacramento County Water Agency Code Titles 1 and 2,
5. the Sacramento County Floodplain Management Ordinance,
6. the Stormwater Quality Design Manual for the Sacramento and South Placer Regions,
7. the Sacramento County Department of Water Resources Plan Submittal Take-In Check List, and
8. the draft Sacramento Stormwater Quality Partnership Hydromodification Management Plan, dated January 28, 2011.

The study was prepared under the responsible supervision of Ken Giberson, a State of California registered Civil Engineer.

2.2 PROJECT DESCRIPTION

The Elverta Specific Plan underwent rigorous technical and environmental analysis through the early part of this past decade, culminating in the preparation of a Draft Environmental Impact Report (EIR)[6] by the County in May of 2003. The EIR was then the subject of a lengthy public review and hearing process, concluding with its certification by the Sacramento County Board of Supervisors on August 8, 2007. Shortly thereafter, the Specific Plan, land use plan (known as "Plan 4, as Revised" and "Refined Plan, Land Use Plan #4", see Exhibit 1), associated Public Facilities Financing Plan, and other related documents were approved.

The land use plan subject of the EIR contains a broad range of land uses, including:

1. Residential land uses ranging from rural-type agricultural-residential densities of 1 to 5-acre minimum sized parcels (AR 1-5) through low, medium, and high density residential apartment-style zoning at up to 20 dwelling units per acre (RD 1-2, RD 3-5, RD 6-7, RD 10, and HDR-20, respectively);
2. Commercial uses;
3. A community center;
4. Two elementary schools; and
5. Project backbone infrastructure, including major roads, parks, drainage corridors, a power line corridor, and other ancillary land uses.

Though the holding capacity of the approved plan was limited to 4,950 residential dwelling units (450 rural density ag-res units and 4,500 units of more urban-style density), the Final (2007) EIR notes that "*…the holding capacity for each property may increase […] in cases where additional units are allowed in conformance with the density bonus provisions of the Elverta Specific Plan Affordable Housing Plan or other applicable state laws or local ordinances*."[7] Under the County's density bonus provisions regarding energy efficiency, overall density may also be increased by up to 25% consistent with a commensurate energy efficiency increase. The Elverta Owners Group thus calculated the overall land use capacity to potential increase to 6,188 DU, which would result in a net weighted average percent impervious cover increase of 4.4 percent (from 26.9% to 31.3%).

The current Elverta Owners Group initiated consultations with the US Army Corps of Engineers (USACOE) in pursuit of U.S. Clean Water Act, Section 401 and 404 permits required for implementation of the approved project. Based on feedback the group received during the consultation meetings, a more biologically sound alternative to the approved land use plan was developed. In this new, preferred alternative, the proposed drainage corridors for drainage sheds B, C, and D (the three southernmost drainage sheds in the Specific Plan area, containing a majority of the urban land uses proposed for the Project) were realigned to largely coincide with the underlying existing drainages. Additionally, these proposed drainage corridors were widened significantly to manage

6 County of Sacramento Control Number 99-SFB-0351; State Clearinghouse Number SCH 2000092026

7 Elverta Specific Plan FEIR, Land Use Chapter 4, Page13.

the potential impacts of hydromodification due to urbanization of the Project area. The resulting wide drainage corridors allow for habitat creation and enhancement within these corridors much superior to that found in the Plan Area today[8].

Modifying the alignment and width of the drainage corridors required some minor land use changes to the Approved Project, most notably a rearrangement of the Town Center, as the drainage corridor now bisects the site rather than following an alignment along its edge. In addition, portions of the Loop Road to the south of Elverta Road were re-aligned to provide for more efficient land use configurations to accommodate the widened corridor to the south. RD-20 sites were also moved and reconfigured in order to get close to the necessary acreage requirements associated with the Project's Affordable Housing Plan - reference Exhibit 2 for the revised land use plan and drainage corridor alignments. This 2013 Drainage Master Plan revision contains updated analyses reflecting these revised drainage corridor alignments in addition to the potential 25% land use density increases and minor land use changes associated with the revised corridor alignments.

On-site shed areas 702UP and AA located just north of shed area B were also analyzed as part of this drainage master plan update, as runoff from these sheds combines downstream of the project area with runoff from the B and C sheds. Based on this downstream confluence of these sheds, it is necessary to ensure that cumulatively on-site development does not cause an exceedance of existing downstream conditions past their confluence.

The northernmost shed areas designated in the original drainage study as 600B, C, and 600UP, did not experience any land use or drainage corridor changes, nor does their runoff combine with that from the southern sheds until they reach the Natomas East Main Drainage Canal. As such, they were not re-analyzed in this drainage master plan update. Additionally, none of the properties located within those drainage sheds have expressed any development interest at this time, nor are they participating financially in the ongoing entitlement and environmental permitting processes. The flood control analysis of these northern sheds is contained in the original drainage study dated October 16, 2002 as included in the FEIR for the Elverta Specific Plan dated May 2007 referenced under the County Control Number 99-SFB-0351 and the State Clearinghouse Number SCH 2000092026. Should any properties within these northernmost sheds wish to develop, additional drainage analysis of these new development proposals will be required by the County to address not only updated flood control drainage analysis standards, but also potential impacts to hydromodification, which were not analyzed in the original 2002 study.

8 Wetland Functions And Values Assessment, Elverta Specific Plan, dated December 2010

2.3 EXISTING SITE CONDITIONS

The 1,744± acre Elverta Specific Plan (ESP) is located within the watershed of the Natomas East Stream Group (NESG)[9] as shown on Exhibit 4: *Regional Drainage Sheds.* The NESG consists of 13 tributaries that drain approximately 27 square miles and outfall to Steelhead Creek (formerly known as the Natomas East Main Drainage Canal, aka the NEMDC). ESP area runoff drains to Tributaries F, G, and I of the NESG.

Historically, the drainage within the ESP area have flown from northeast to southwest through a series of both natural and improved, but mostly ill-defined small intermittent drainages with minimal, primarily grassy vegetation. These existing drainages intersect Steelhead Creek about 2.3± miles downstream (west) of the project. Steelhead Creek then drains to the south and then westerly, eventually outfalling to the Sacramento River at the confluence with the American River (see Exhibit 5: Existing Regional Topography)[10].

9 Natomas East Stream Group (NESG), Hydraulic & Hydraulic Study prepared by Borcalli & Associates for the Sacramento Area Flood Control Agency (SAFCA) dated September, 1994.

10 Elverta Specific Plan FEIR, Volume 1, Chapter 7, Page 1.

[insert Exhibit 4: REGIONAL DRAINAGE SHEDS]

[insert Exhibit 5: EXISTING REGIONAL TOPOGRAPHY]

The Plan Area's topography varies from an elevation of 89 feet at the northeast corner to approximately 50 feet on the west side near Elverta Road. Current land uses within the project consist of small agricultural operations and grazing fields, with roughly a dozen residences scattered across the Plan Area. Roadside ditches and cross-culverts intersect the more-or-less natural drainages at various locations and as such, form part of the existing drainage network at the site.

Based on existing topography, the ESP area is divided into five existing major drainage basins, which are further divided into smaller sub-basins (see Exhibit 8: *Existing Conditions Watershed Map*). The northern on-site basin (600 series) includes 237± acres of existing open fields and agricultural land. It is designated by the Specific Plan for rural-type development of Ag-Res zoning with minimum parcel sizes of 1 to 5 acres. This basin drains to the northwest and is tributary to the NESG Tributary "F". Its drainage is isolated from the more urban development, which drains to the southwest.

The other four existing basins are designated as A, B, C and D, in a north to south progression, with on-site basins A, B, and C making up the upstream end of the NESG Tributary "G" and on-site basin D being the headwater of the NESG Tributary "I". Under existing conditions, drainage is collected and conveyed through these basins in often ill-defined, meandering, and branching shallow drainages formed through decades of agricultural operations. Some segments of these drainages have been confined to small man-made, linear ditches to better align with property lines and other physical features.

Significant urban development is proposed to occur within these basins as depicted in the revised land use plan (see Exhibit 2). Only basins B, C, and D are proposed to contain major open space drainage corridors that will convey drainage from their tributary sheds totaling several hundred acres each. Basin A is isolated to approximately 88 acres (developed conditions) located along the western Plan Area boundary. Under existing conditions, runoff from this shed is conveyed in a southwesterly direction across Palladay Road and then off-site in very shallow, ill-defined drainages.

[insert Exhibit 5-b: Major Proposed Watersheds]

"B" Shed:

The "B" drainage basin originates upstream of the Plan Area in Placer County. Approximately 45 acres of the basin are located in Placer County in the proposed Placer Vineyards project. Based on said project's drainage master plan, it was determined that runoff leaving Placer County under developed conditions had to be reduced to no more than 90% of its existing runoff rate. To be conservative, this drainage analysis thus assumed 'existing conditions' runoff rates for both existing and developed conditions.

Downstream of the County line, the "B" drainage runs across a couple of rural properties, crosses Kasser Road through a small culvert and then flows across the western portion of the proposed Countryside Equestrian Estates project into an existing agriculture pond just upstream of 16th Street. Runoff then crosses 16th Street through a small culvert and continues in a southwesterly direction in an ill-defined meandering channel to Palladay Road. The low-lying nature of the tributary shed upstream of 16th Street coupled with a culvert of inadequate capacity to convey peak runoff rates is causing ponding to occur upstream of 16th Street, with 16th Street likely being flooded at this location during major storm events. Though a detailed analysis of this existing condition is beyond the scope of this drainage master plan, the analysis contained herein is based on the assumption that 'existing conditions' flows are being conveyed from the shed area upstream of 16th Street under both existing and developed conditions. In an effort to make assumptions that would yield conservative results and thus a safe design, "in situ" attenuation under existing conditions has been accounted for in the hydrology through a long time of concentration. The applicant for the Northborough project (called the "Countryside Equestrian Estates project" in the 2007 FEIR) will have to submit to the County a project-specific drainage analysis prior to submittal of improvement plans, which details existing conditions runoff and proposed development mitigation which mitigates development impacts on storm drainage to match existing conditions.

Toward the western Plan Area boundary, the existing "B" shed drainage conveyance consists of a small, man-made, linear drainage ditch flowing in a westerly direction. It crosses beneath Palladay Road through a small culvert and continues to the Plan Area boundary confined to a small, man-made, low-capacity drainage swale. At the Plan Area boundary it then drains through a small agriculture pond before discharging unimpeded into a more natural downstream drainage across an undeveloped parcel. About 1,120 feet downstream of the project area and just west of El Verano Ave., runoff from the B-shed combines with that from the C-shed.

"C" Shed":

The original headwaters of the "C" basin originates upstream of the Specific Plan Area in Placer County and then drains into Gibson Ranch Park immediately to the east of the Plan Area and the proposed Countryside Equestrian Estates project. As detailed in the FEIR for the Elverta Specific Plan[11], the drainage runoff from this 135-acre sub-shed is then diverted by an existing berm and directed to flow into Dry Creek. Based on comments received from Sacramento County Department of Water Resources (DWR), this drainage study includes a number of analysis alternatives with and without the

11 Elverta Specific Plan FEIR, Volume 1, Section 7, Page 43

diversion berm in place. It is our understanding that mitigation pertaining to the berm specific to the Northborough project is being addressed by the applicant for said project.

The next sub-shed immediately downstream of the aforementioned Gibson Ranch Park diversion berm comprises the eastern portion of the Northborough project. It drains into an existing agricultural irrigation pond, before discharges into a small existing open concrete channel located on developed properties in the Rifle Ridge Estates subdivision. This channel then discharges into the "C" corridor within the boundary of the Specific Plan area. Based on discussions with Wood Rodgers, the consultant for the Northborough project, the developed conditions models included herein assume full post-development mitigation to 'existing conditions' runoff rates entering the upper end of the C-corridor drainage channel within the project boundary.

Given the limited conveyance capacity of the existing concrete channel leaving the Northborough project under existing conditions, the applicant for said project is proposing to construct a bypass channel through their project past the existing Rifle Ridge Estates subdivision to the upper end of the C-corridor channel. The hydrology of the tributary Northborough shed, as modeled, accounts for flat terrain and a long time of concentration sufficient for regional modeling at the Specific Plan level. Consistent with County DWR standards, it is our understanding that the applicants for the Northborough project has submitted project-specific drainage modeling, which entail a higher degree of detail specific to said subdivision than this master plan study contains.

After re-entering the Plan Area, the "C" drainage continues in ill-defined, meandering, and multi-branched drainages in a southwesterly direction to 16th Street. It crosses beneath 16th Street through a small 36"x22" arch culvert, continues in an ill-defined drainage in a southwesterly direction toward Elverta Road, and then crosses beneath Elverta Road through another culvert, before turning in a westerly direction.

An existing branch of the "C" drainage headwaters originates within the Existing Rifle Ridge Estates subdivision. Its runoff is discharged at the ESP boundary to a drainage ditch paralleling the north side of Elverta Road. It crosses beneath Elverta Road through a small culvert located just east of 16th Street, then crosses 16th Street, flows through a large depressional wetland feature, before combining with the main branch of the existing "C" drainage. The flow entering the wetland at the southwest corner of Elverta Rd. and 16th was calculated based on the hydrology of the sub-shed upstream of its discharge location described above. The hydraulics of the roadside ditch conveyance were accounted for in the SacCalc routing of the runoff hydrograph from the tributary sub-shed.

Near the downstream Plan Area boundary, the existing "C" basin drainage flows in a shallow, winding alignment along the south side of Elverta Road, before being confined to a narrow man-made ditch just east of the Specific Plan boundary. It continues on to 9th Street, crosses beneath said street through four 48" culverts, parallels the south side of Elverta Road for approximately 215+/- feet and then crosses to the north side of Elverta Road though another set of four 48" culverts. Both of these sets of culverts have insufficient capacity to freely convey the existing 100-year peak runoff, thus causing backwater conditions.

The confluence of the "B" and "C" drainage swales is located approximately ¼ mile downstream of the Plan Area boundary, just to the west of El Verano Avenue. The confluence was deemed to not affect the hydraulic grade line within the study area. The combined drainages continue on as single meandering swale known as NESG Trib "G". 5,427 feet downstream of the confluence of the B- and C-drainages, Trib "G" flows through a breach in a former railroad track embankment. The size of the breach acts as a flow construction under high-flow events, causing backwater conditions upstream of the embankment, with approximately a 3-foot drop of the hydraulic grade line (HGL) across the embankment under the 100-yr design storm event. Downstream of the embankment, Trib "G' flows into Steelhead Creek roughly 2.1 miles west of the Plan Area.

"D" Shed:

The "D" basin is located entirely south of Elverta Road. It originates upstream of the Plan Area, where 4.2 acres of the existing rural Quail Ranch development convey runoff in roadside ditches adjacent to Class "C" streets to the existing "D" basin swale. This swale then flows through a man-made agriculture pond, through a small culvert beneath 16th Street, and onward in a southeasterly direction toward the intersection of Dry Creek Road with U-Street.

Just north of this intersection, runoff from the "D" basin flows through a 24-inch CMP culvert beneath Dry Creek Road, parallels U-Street in a man-made ditch for about 270', before turning southward beneath U-Street through an elliptical 24-inch by 30-inch CMP culvert. These existing culverts are of insufficient capacity to convey peak runoff rates, causing the intersection to flood during major storm events.

Downstream of Dry Creek Road, the drainage continues on as NESG Trib "I" toward Steelhead Creek about 2.8 miles (along a meandering path) downstream of the Plan Area.

2.4 SOILS INFORMATION

According to USDA NRCS soils mapping and the Sacramento County soil type maps included in the City/County Drainage Manual (see Exhibit 6), Type D soils are predominant within the study area limits. As these soils exhibit less infiltration than the Type B soils that occur infrequently within the project area, storm drainage runoff calculated using SACPRE intermediate files based on Type D soils will be slightly greater than would otherwise have been the case had the few occurrences of Type B soils been incorporated. This theoretically results in more conservative calculations, though the difference would likely be very minor, given the predominance of Type D soils within the study limits.

The results of the published data review have been corroborated by actual field work and subsequent laboratory analysis as described in a report titled *Soil Landscape of the […] Elverta Project, […], Sacramento County, California* prepared in November 2010 by Kelley & Associates Environmental Sciences, Inc. (see Appendix 9.3). Due to limited access rights, said field exploration had to be limited to those properties owned by

participants in the Elverta Owners Group. Additional analysis may have to be undertaken on other properties wishing to develop in the future.

The purpose of the field work was to analyze the soil characteristics within the limits of the proposed drainage corridors B, C, and D so as to inform the proposed detailed design of the corridors and drainages. Beyond the basic water quality treatment and flood control/mitigation that are the main focus of this drainage master plan, considerations for the creation of natural resources habitat within these corridors and drainages such as the depth of the existing duripan below ground (see Appendix 9.4) have been incorporated into the overall analysis. The viability and long-term sustainability of the proposed naturalized corridors are extremely important considerations in the overall drainage facilities design and have thus been studied much more extensively than might otherwise traditionally have been the case. Further discussion on corridor design details and natural resources restoration can be found in Chapter 7.0 of this master plan.

[insert Exhibit 6: Soils Map]

2.5 FEMA SETTING

Exhibit 7 excerpted from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) No. 0602620055F and No. 0602620060D depicts the extent of the mapped 100-yr floodplain in the vicinity of the Plan Area. As depicted, the entire 1,744+/- acre ESP area is located outside the 500-year floodplain; however, a small portion of about 5 +/- acres near the intersection of Elverta Road and 9th Street is within the mapped 100-year floodplain of NESG Tributary G.

The detailed FEMA study limits for Tributary G extend into the ESP area just south of Elverta Road east of 9th Street. For NESG Tributary I, the FEMA-mapped floodplain does not extend into the ESP area. The limits of the existing detailed FEMA study stop at U-Street.

The analysis and preparation of the floodplain mapping noted above was prepared by Borcalli & Associates in 1997 under contract with the County of Sacramento. The resulting body of work is entitled the *FLOOD INSURANCE STUDY FOR NATOMAS EAST STREAM GROUP TRIBUTARIES AND THE NATOMAS EAST MAIN DRAIN CANAL, SACRAMENTO COUNTY, CALIFORNIA*. A portion of the "effective model" and associated cross section data used to map the floodplain up to and downstream of the Elverta Specific Plan was imported into the model prepared by MacKay & Somps as part of this study to allow a) the Elverta Specific Plan models to be calibrated to the existing floodplain mapping and b) the extension of the Elverta Specific Plan analysis downstream to the former railroad embankment to ensure no negative impacts on the existing railroad embankment backwater conditions due to development within the Elverta Specific Plan area.

It should be noted that the 1997 model by Borcalli & Associates did not include or consider the 135 acre sub-shed upstream of the Northborough project currently being diverted to Dry Creek ("existing conditions"). The analysis contained within this study shows that the addition of the currently-diverted 135-acre sub-shed under "existing conditions" (i.e. elimination of the exist. berm) has only an insignificant impact on the 100-yr HGL upstream of the railroad tracks, raising the HGL_{100} from 45.29' to 45.31', i.e. by 2/100th of a foot. Under fully developed mitigated conditions within the Elverta Specific Plan however, the HGL_{100} upstream of the railroad embankment drops to 45.12'.

The Elverta Owners Group will have to file a CLOMR (Letter of Map Revision) for existing conditions with FEMA in accordance with the County's flood plain ordinance, extending the limits of the detailed 100-yr floodplain analysis and resulting existing conditions floodplain mapping across the ESP area. As individual rezone entitlements for participating properties have already been approved for the ESP, DWR has indicated that the existing conditions CLOMR for the entire ESP area will have to be filed prior to submittal of the first of any large-lot or small-lot tentative parcel maps (whichever occurs first).

Subsequent to approval of the existing conditions LOMR, yet prior to any fill being placed within the mapped existing conditions 100-yr floodplain and ahead of construction of the Phase 1 drainage corridor improvements identified in Chapter 4 of this drainage

study, the Elverta Owners Group will need to file a Conditional Letter of Map Revision (CLOMR) with FEMA for approval. Consistent with Rio Linda/Elverta Community Plan policies PF-10/DR-1 and PF17, any associated loss in floodplain storage resulting from such fill will need to be mitigated to the satisfaction of the County Department of Water Resources to prevent downstream flooding impacts. The hydrologic and hydraulic analyses contained within this report will eventually form the basis of the required floodplain mapping for FEMA submittals.

[insert Exhibit 7: FEMA FIRM]

3.0 HYDROLOGY & HYDRAULICS FOR EXISTING & PROPOSED CONDITIONS

3.1 PREVIOUS STUDIES

The nature of the existing drainages and topography of the NESG, consisting of basically uncontrolled drainages that at numerous locations have been modified or realigned by agricultural operations, draining through a gently undulating, but mostly flat terrain, has contributed historically to the frequent flooding in the Rio Linda/Elverta community. This regional problem is exacerbated not only by backwater conditions in the NESG tributaries caused by high flood stages in the Sacramento and American Rivers, but also by local conditions caused by roadside ditches and driveway culverts of inadequate capacity to convey local runoff away from structures and streets, as well as constrained conveyances through and across other man-made structures such as the afore-mentioned former railroad embankment on Trib G. Additionally, local drainage swales through private properties are also subject to flooding due to obstructions placed or constructed in the swales, causing diversion or ponding of stormwater runoff.

As referenced in the FEIR for the Project, in an effort to master plan flood control facilities, in the early 1990 the Sacramento County Department of Water Resources undertook comprehensive analyses of the three largest NESG tributaries for existing conditions as well as to formulate a plan to mitigate future development impacts. A plan based on the results of the County's analysis that focused on NESG Tributary "I" which flows through the most developed area of the Rio Linda/Elverta community was met by strong opposition from the community and thus dropped by the County.

In 1994 the Sacramento Area Flood Control Agency (SAFCA) through their consultant Borcalli & Associates conducted the *Natomas East Stream Group Hydrology and Hydraulics Study* to determine alternatives to the channelization project previously pursued by the County. That study concluded that detention in reaches of the NESG tributaries upstream of Rio Linda Boulevard would be the most effective solution to mitigating future development impacts in the NESG[12].

In the late 1990's SAFCA then undertook various NESG watershed flood control improvement projects as part of their North Area Local Project. These included construction of a new pump station (known as the D15 pump station) and construction of a new levee on the north side of Dry creek between the D15 pump station and Rio Linda Boulevard. Implementation of all of these improvements has resulted in lowering of the 100-year water surface elevation in Steelhead Creek north of the pump station by approximately 3-4 feet[13].

The afore-mentioned 1997 Flood Insurance Study undertaken by Borcalli & Associates for the County of Sacramento took into consideration the various NESG watershed flood control improvement projects undertaken by SAFCA in the preceding years.

12 ESP Final EIR, Volume 1, Chapter 7, Page 5

13 P. Ghelfi, SAFCA, December 2002

The Final EIR for the Rio Linda / Elverta Community Plan Update contained further drainage analyses assessing the impacts associated with buildout of four different community plan land use alternatives being considered. As stated in the ESP Final EIR *Because the currently proposed Elverta Specific Plan land uses fall within the range of land use densities/intensities analyzed in the drainage studies for the RLECP Final EIR, the conclusions of those drainage studies as set forth in the Final EIR would apply to the currently proposed [Elverta] Specific Plan as well.*[14]

Subsequent to the completion of the original drainage master plan for the Elverta Specific Plan on October 16, 2002, SAFCA responded to questions raised by the County regarding impacts to the Steelhead Creek (formerly known as NEMDC) D15 pump station. With the help of MBK engineers, SAFCA utilized the Elverta drainage master plan modeling results to analyze the project's potential impacts. SAFCA's consultant concluded that rather than causing an environmental impact, buildout of the Elverta Specific Plan as proposed would cause an economic impact that could easily be mitigated with an impact fee. Based on this, the County Infrastructure Finance Section recommended that rather than have the Project pay an impact fee equivalent to $55/acre (gross), the Project should annex into the operations and maintenance district that funds ongoing operations of the pump station and associated facilities.[15]

The northernmost portion of the Specific Plan area is located in the 600-series sub-sheds tributary to a drainage originating north of the project in Placer County. This drainage enters the Elverta SP area just west of 16th Street, flows through ag-res zoning designated land uses west thereof, before leaving the Plan area near its northwest corner, flowing back into Placer County. This drainage originates in a proposed project in Placer County known as Placer Vineyards. That project, a master planned community of roughly 5,000 +/- acres abuts the Elverta Specific Plan area along its entire northern boundary. As part of the Placer Vineyards project, a drainage analysis was prepared by Civil Solutions, Inc. to address the impacts and required facilities of said project. Their analysis is contained in a document titled "Master Project Drainage Study, Placer Vineyards, Placer County, CA; Revised August 7, 2006". Flood plain mapping of this 600-series drainage for existing and developed/proposed conditions was completed for the Placer Vineyards project. As said flood plain mapping covers the portion of the drainage located within the boundary of the Elverta Specific Plan, the pertinent exhibits thereof have been included in this drainage master plan for the Elverta Specific Plan as Exhibits 10a-2 and 10b-2 for reference purposes.

3.2 SAC CALC WATERSHED RUNOFF ANALYSIS

As mentioned in Section 2.2 of this study, new drainage analyses contained within this drainage master plan are limited to analyses of those on-site shed areas where the Elverta Owners Group is proposing drainage corridor re-alignments and associated land use plan revisions. Affected corridors thusly included are the B, C, and D corridors within the B, C, and D sheds, draining into NESG Tributaries "G" and "I", respectively, as well as on-site sheds A and 702UP, as there is proposed Phase 1 development located in shed A and

14 ESP Final EIR, Volume 1, Chapter 7, Pages 5-8

15 ESP Final EIR, Volume 1, Chapter 7, Pages 25-29; and Volume 3, Chapter HY-2

because both of these sheds contribute to the existing backwater condition at the downstream former railroad embankment. For the 600 series within which no changes to the originally proposed land use and design are being proposed by the current Elverta Owners Group, the drainage analysis that was reviewed and approved by the County DWR in the fall of 2002 and subsequently incorporated into the certified FEIR for the Elverta Specific Plan is still applicable. Future development proposals within these sheds may have to update the 2002 study to bring it current with new drainage design standards, as well as to address any hydromodification impacts these developments might otherwise cause.

In accordance with the current Sacramento City/County Drainage Manual – Volume 2 (Hydrology Standards), runoff hydrographs for existing and developed conditions have been calculated using a Windows based application called the Sacramento Calculator (SacCalc) with what is commonly referred to as "the Sacramento Method". Using the SacCalc preprocessor within HEC-1 to process local hydrologic parameters and precipitation to create HEC-1 input data, HEC-1 was then run to calculate, route, and combine runoff hydrographs. The Elverta Specific Plan watershed is located in Rainfall Zone 2 of the Sacramento Method rainfall zone designations.

Though the previous models completed in 2002 using SacCalc required the same input data, the current effort reviewed all 'existing conditions' model input parameters for the analyzed shed areas and updated them, as necessary, to reflect up-to-date information. Starting with revisiting shed delineations, soil type data, and existing land use, lengths and slopes of each water course, centroid locations, and distance thereof to the associated water course were determined as part of developing the hydrology map for each shed (see Exhibit 8: *Existing Conditions Watershed Map*). Additionally, as described in Section 2.5 "FEMA Setting", the analysis of the B- and C-corridors was extended downstream by a little over 1 mile to allow for a flood analysis at the former downstream railroad embankment. Furthermore, a number of alternative scenarios were run with respect to the existing diversion berm at Gibson Ranch Park upstream of the Northborough project in the C-shed. The alternatives include a) the berm being in place (i.e. no upstream inflow into the C-shed occurring), b) the berm having been removed (i.e. the addition of a 135-acre sub-shed area to the C-corridor, and c) the berm breaking during a peak flow event.

For developed conditions, the existing conditions shed boundaries were laid on top of the proposed land use and adjusted, as appropriate, to account not only for the proposed drainage corridor alignments, but also to reflect implementation practicalities such as ownership boundaries, while avoiding major shed diversions. Percent Impervious Cover was then calculated utilizing the automatic routines in SacCalc (see Appendix 9.1). For the B-, C-, and D-corridors, lengths and slopes of the proposed drainage corridors, as well as the location of centroids and their distance to the proposed water courses were determined for input into the model (see Exhibit 9: *Proposed Ultimate Conditions Watershed Map*).

Within the smaller A and 702UP sheds, storm runoff will be conveyed within standard subdivision drainage pipes directly into its proposed combined water quality treatment, detention, and flow duration control facility to be located at the western project boundary.

[insert Exhibit 8: Existing Conditions Watershed Map]

The northern portion of the SP area drains west into Tributary F of NEMDC. As previously stated, the proposed zoning for this portion of the ESP is Ag-Res at 1 to 5 acres per unit. Such rural low-density development will have only slight impacts on existing storm drainage runoff, much less than urban densities in other parts of the plan area. Once development plans are known for these areas additional project-specific analysis will need to be provided to the County DWR to show how project-specific impacts will be mitigated to existing conditions (or better). These mitigation requirements will be project-specific and not a responsibility of the ESP as a whole. For this reason they are not addressed in this Drainage Master Plan.

Routing parameters of the main reaches the hydrographs were routed through include reach length, slope, channel shape, and Manning's roughness coefficient "n". For the existing conditions model, the reach length, slope, and channel length used are based on an analysis of the aerial topography of the site with a 1-foot contour interval. A site assessment of the existing drainage swales within the B-, C-, and D-sheds yielded a Manning's "n" of 0.06 for existing conditions.

It should be noted that the assumed roughness coefficient of the existing drainages swales in the northern sheds (600 series) equal to a Manning's "n" of 0.08 is consistent with the larger parcel sizes and associated less-intense agricultural land uses that exist within those sheds, thus leading to slightly heavier vegetated drainage swales. Nonetheless, given the proposed ag-res land use densities within the 600 series sheds and the fact that the existing drainages within the AA shed are not proposed to be preserved, any slight variation in the roughness coefficient used in the existing conditions analyses of these sheds is not going to have any notable impact on required drainage impact mitigation and associated drainage facilities to be implemented upon development. Project-specific drainage analysis to be submitted to DWR for review and approval for any project wishing to move ahead will allow the County to make the appropriate determination at the project level at that time.

For developed conditions for the B-, C-, and D-corridors, routing parameters are based on the proposed channel alignments and shape thereof. Preliminary earthwork analysis targeting a balanced site not requiring soil import, coupled with existing flow line constraints at the Project's boundary were used to establish proposed channel grades. Basic trapezoidal cross sections of varying depth with 4:1 side slopes and incorporating small, 1-foot deep low flow channels were used in the modeling runs to establish basic channel geometrics.

A Manning's "n" of 0.06 for developed conditions reflecting unmaintained, naturally overgrown channels was incorporated into the model runs for the proposed realigned channels within the B-, C-, and D- sheds. The natural habitat restoration planting proposal discussed further in Chapter 7.0 is consistent with this roughness coefficient. It should be noted that a high channel roughness leads to greater flow attenuation within a channel than a lower roughness coefficient based on a well-maintained channel or one in which vegetation has not yet matured. However, by utilizing cross-channel berms with carefully calibrated openings/notches to control flow through the berms, coupled with a very flat channel slope causing low runoff velocities, downstream conveyance is not very sensitive to changes in the channel roughness coefficient.

Design storms for the 2-, 10-, 100-, and 200-year recurrence interval were modeled; the 2-yr event to determine low flow event inundation levels to support proposed wetland and riparian habitat within the channels; the 10-year event to determine the water surface elevations in the channel used in the design of the piped trunk drainage system discharging into the channels; the 100-year design storm event for flood management and mitigation purposes; and the 200-yr event to analyze the proposed project against the Draft Urban Level of Flood Protection Criteria developed by the California Department of Water Resources. Tables that summarize peak flows from the various sub-sheds for existing, Phase 1, and Buildout conditions are included in Appendix 9.1.3.

At this point it should be noted that the County is in the process of evaluating the effect of flow duration control structures for purposes of hydromodification management on flood control analyses. In order to simulate the effect of the very long drain times through these flow duration control structures, much of the volume contained by these structures would likely not be available for effective flood control. The same would hold should a large 100-yr design event be preceded by a smaller, more frequently occurring event. To simulate this, the County has requested that a 10-yr scenario be analyzed whereby the peak water surface elevations resulting from a 2-yr design storm event under developed conditions was used as the starting water surface elevations for the 10-yr design storm event analysis. This “modified” 10-yr design hydrograph was thus run in addition to the standard (without preceding storm event/”dry”) 10-yr design storm hydrograph. Much in the same way, for the 100-yr design storm analyses, an alternative scenario was run whereby the peak water surface elevations resulting from a 10-yr design storm event under developed conditions was used as the starting water surface elevations for the 100-yr 24-hr design storm event analysis. This “modified” 100-yr design hydrograph was thus run in addition to the standard (without preceding storm event/”dry”) 100-yr 24-hour design storm hydrograph. Additionally, a standard 100-yr 10 day design storm hydrograph was run for developed conditions to ensure that the study did include an analysis of the design storm event yielding the highest potential runoff-rates and associated water surface elevations.

[insert Exhibit 9: Proposed Ultimate Conditions Watershed Map]

3.3 HEC-RAS 4.1.0 UNSTEADY STATE HYDRAULIC ANALYSIS

The 2002 drainage master plan analysis relied on the then-current Army Corps of Engineers Hydrologic Engineering Center (HEC) – River Analysis System (RAS), Version 3.0 computer modeling software to analyze the existing and proposed major drainage conveyance channels to serve the Elverta Specific Plan Area. The updated HEC RAS Version 4.1.0 software was utilized in the current analysis to model the existing and proposed "B", "C", and "D" drainage channels within the Elverta Specific Plan area. Both the old and new software versions allow one to perform one-dimensional unsteady flow simulation of natural and constructed channels.

Drainage alignments and locations of cross sections spaced in accordance with the County's requirements are determined in AutoCAD. For 'existing conditions', the software generates the channel geometry based on the terrain model of the Project Area's topography. For 'developed conditions', the modeler defines the basic channel geometry and "daylights" the top of the channel to the existing ground model or proposed top-of-bank elevations, where available. The program then exports geospatial data sets that are input into HEC RAS to define the conveyance geometry. The modeler then enters parameters for in-stream structures such as berms and culverts, before running the model. Model output files in GIS format are then imported into ArcMap's HEC GeoRAS extension. Using the channel geometry and computed water surface profiles, inundation depth, and floodplain boundary data sets are then created through HEC GeoRAS. (It's worth noting that the 2002 analysis did not utilize geo-referenced cross sections, but required the modeler to manually plug channel cross section parameters defining channel geometry into the RAS model. This approach does not change the modeling results, however, when compared to the current approach).

The proposed "702UP"- and "A"-shed, "B", "C", and "D" Corridor drainage conveyance channels and the following plans (design studies) were analyzed as part of the current analysis update (note that due to their downstream convergance, corridors B and C where analyzed in combined "B/C" models):

702UP-Shed	SacCalc analysis of 702UP Shed and detention basin
A-Shed	SacCalc analysis of AA Shed and detention basin
B/C Corridors	**Developed Conditions** Hydraulic Analysis of Drainage Channels B & C with diversion berm in place – (2 Yr, 10 Yr, 10 Yr on 2 Yr, 100 Yr-24 Hr, 100 Yr-24 HR on 10 Yr, 100 Yr-10 Day, & 200 Yr)
B/C Corridors	**Developed Conditions** Hydraulic Analysis of Drainage Channels B & C without diversion berm (FEMA) – (100 Yr-24 Hr)
B/C Corridors	**Developed Conditions** Hydraulic Analysis of Drainage Channels B & C with berm break – (100 Yr-24 HR on 10 Yr, & 200 Yr)
B/C Corridors	**Phase 1 Interim Conditions** Hydraulic Analysis of Drainage Channels B & C with diversion berm in place – (2 Yr, 10 Yr, 10 Yr on 2 Yr, & 100 Yr-24 Hr)
B/C Corridors	**Existing Conditions** Hydraulic Analysis of Drainage Channels B & C with diversion berm in place – (2 Yr, 10 Yr, 100 Yr-24 Hr,100 Yr-10 Day, & 200 Yr)

B/C Corridors	**Existing Conditions** Hydraulic Analysis of Drainage Channels B & C without diversion berm (FEMA) – (100 Yr-24 Hr)
D Corridor	**Developed Conditions** Hydraulic Analysis of Drainage Channel D – (2 Yr, 10 Yr, 10 Yr on 2 Yr, 100 Yr-24 Hr, 100 Yr-24 HR on 10 Yr, 100 Yr-10 Day, & 200 Yr)
D Corridor	**Existing Conditions** Hydraulic Analysis of Drainage Channel D – (2 Yr, 10 Yr, 100 Yr-24 Hr, 100 Yr-10 Day, & 200 Yr)

The study identifies 100-yr runoff rates and hydromodification potential at key "compliance points", i.e. locations at which proposed conditions have to meet existing conditions under the referenced scenarios. In Table 2, modeling results for pre- and post-development (with drainage improvements implemented) conditions for the 2-, 10-, and 100-year design storms are listed opposite of each other to allow a verification of design objectives to meet existing conditions at these specific nodes.

Of note is that at the detailed project design stage, fine-tuning of the cross-channel berms acting as in-stream flow duration control structures at the downstream project limits will allow for post-development conditions 100-yr peak flow rates to more closely match existing conditions runoff rates, if so desired by the County. Alternatively, the increased attenuation of such peak flows on-site below the existing conditions runoff rates as modeled would help reduce potential downstream flooding occurring under existing conditions. On Corridor D, 100-yr peak runoff reductions as modeled serve to eliminate the existing conditions flooding occurring at the intersection of Dry Creek Road with U-Street when coupled with proposed intersection improvements as depicted in Exhibit 12, as well as help reduce potential downstream flooding occurring during such peak rainfall events.

Projected flood plain limits for both existing and buildout conditions as calculated by HEC RAS are depicted in Exhibits 10a and 10b, respectively, full-sized copies of which can be found in the Appendix. These exhibits also reflect the peak stages occurring at each of the identified cross sections due to the 100-yr storm event. As previously mentioned, flood plain mapping for the 600-series shed area and associated drainage was completed by Civil Solutions, Inc. as part of the Placer Vineyards project located in Placer County immediately to the north of the Elverta Specific Plan. See Exhibits 10a-2 and 10b-2 included herein for reference purposes.

Note that runoff from the "D" basin leaving the site at Node D0 under developed conditions is approximately 45% of the calculated runoff under existing pre-development conditions. At present pre-development conditions, the intersection of Dry Creek Road with U-Street will flood under peak flow conditions. Limiting developed conditions runoff as noted and improving the intersection and downstream drainage conveyance as identified in the FEIR will eliminate this flooding under design storm peak runoff conditions (see Exhibit 12: *FEIR Plate HY-14 Dry Creek Road/U Street Intersection Improvements for Flood Mitigation*).

For the submittal of a CLOMR to FEMA, the on-site floodplain mapping will need to tie into the existing "detailed study" limits as mapped on the previously referenced FEMA FIRM Panel No. 0602620055F. Any remaining modeling discrepancies will have to be addressed at that time. Upon development of the ESP area, including buildout of the

proposed drainage corridors, peak post-development runoff from the B-, C, and D-sheds leaving the Plan area as modeled for the 100-yr storm event will be significantly less than under existing pre-development levels. This will have a positive impact on downstream flood elevations.

Also, any potential loss of floodplain storage due to the proposed fill of the FEMA mapped floodplain extending into the Plan Area at the downstream end of the C-corridor is being more than compensated for by the extensive upstream channel excavation being proposed. This is evidenced by the reduction in peak 100-yr runoff rates from 315.79 cubic feet per second (cfs) to 279.57 cfs. This is consistent with Rio Linda Elverta Community Plan Policy PF10/DR-1 which states:

> *"Significant increases in peak flows within the NESG, specifically NEMDC Tributaries F, G, and I, shall be mitigated through the implementation of regional detention facilities. In addition, restoration of any lost floodplain storage within the NESG (particularly Tributary G) shall require in-kind replacement, preferably on-site."*

The 'engineered' cross sections modeled in HEC RAS will be 'naturalized' as discussed in Chapter 7 and reflected in the Habitat Development Plans (Appendix 9.5) through the creation of habitat benches and depressional features within the drainage channel bottom and by varying the steepness of the side slopes of the channel along the length of each channel. The fine-grading and naturalization of each channel will occur in a way that either maintains or increases the hydraulic cross section defined in HEC RAS and depicted in Appendix 9.1, thereby ensuring that flood control as designed will either be maintained or enhanced. Implementation of the Habitat Development Plans will ensure that the created drainages not only look natural and function as designed from a flood control and hydromodification management perspective, but that they become functional and sustainable habitat forming an integral part of the community that surrounds them.

Flood mitigation and hydromodification management is designed to occur in-channel to the maximum extent practicable by means of flow retardation and attenuation behind cross-channel berms. These berms then release water at a specified rate through carefully calibrated V-notches in the berms. Details of these shallow cross-channel berms are shown in Exhibit 11.

TABLE 2:
PRE- AND POST-DEVELOPMENT (BUILDOUT) PEAK RUNOFF COMPARISON

Northern Sheds (results based on 2002 Drainage Master Plan analysis)

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		10yr Flow (cfs)		2yr Flow (cfs)	
			Existing	Developed*	Existing	Developed	Existing	Developed
B-2	Project boundary		296	311	176	187	79	87
600UP	Project boundary		27	39	16	23	7	10

(*Note: project-specific drainage analysis to identify detailed mitigation resulting in peak flow mitigation to existing conditions flows (or better)

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		10yr Flow (cfs)		2yr Flow (cfs)	
			Existing	Developed	Existing	Developed	Existing	Developed
702UP	Project boundary		29	26	17	11	n/a	n/a
A	Project boundary		95	88	57	49	n/a	n/a

Corridor B

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)**		10yr Flow (cfs)**		2yr Flow (cfs)	
			Existing	Developed	Existing	Developed	Existing	Developed
Downstream Compliance	11+50	11+50	173	138	89	69	42	35

Corridor C

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)**		10yr Flow (cfs)**		2yr Flow (cfs)	
			Existing	Developed	Existing	Developed	Existing	Developed
Upstream of 9th Street	18+020	181+41	283	262	169	154	80	84
Downstream Compliance	162+21	162+21	316	286	191	168	96	91
Downstream of UPRR	81+20	81+20	601	578	355	351	187	185

Corridor D

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)**		10yr Flow (cfs)**			
			Existing	Developed	Existing	Developed	Existing	Developed
Downstream of U-Street	0+98	15+00	146	68.00	98	59	41	31

(**Note: Developed Conditions hydrographs modeled 10-yr on 2-yr and 100-yr 24-hr on 10-yr)

Complete HEC-RAS model result summary tables are located in Appendix 9.1 of this study. The tables provide summaries of the specific HEC-RAS model design information used in the hydraulic model setup. The tables also summaries the projected water surface elevations that were calculated by the HEC-RAS model as part of the hydraulic analysis.

[insert Exhibit 10a: Existing Conditions 100-yr Floodplain]

[insert Exhibit 10b: Buildout Conditions 100-yr Floodplain]

[insert Exhibit 10a-2: Existing Conditions 100-yr Floodplain, 600-Series Shed Area]

[insert Exhibit 10b-2: Developed Conditions 100-yr Floodplain, 600-Series Shed Area

[insert Exhibit 11: Proposed Cross-Channel Berm Details]

[insert Exhibit 12: FEIR Plate HY-14 Dry Creek Road / U-Street Intersection Improvements for Flood Mitigation]

3.4 HYDROMODIFICATION MANAGEMENT PLAN

An assessment of potential hydromodification impacts due to development of the Elverta Specific Plan on the receiving waters within and downstream of the SP area was made by cbec ecoengineering, Inc. to inform the overall design of the planned multi-function open space corridors traversing the Project. These multi-function open space corridors are designed to provide drainage conveyance, flood control, water quality treatment, natural resources habitat, recreational opportunities, and aesthetic appeal, as practicable. The primary mechanism for attenuating urbanized runoff from the developed areas is through the integration of flood control measures into the design of the corridors, with the potential to also provide flow duration control of runoff due to the more frequently occurring storm events. The proposed flood control measures, as described in greater detail in Chapter 3.3, included a series of in-line cross channel berms spanning the width of the corridors with notches of varying dimensions.

The purpose of this assessment was to determine what additional controls or strategies were needed to minimize potential hydromodification impacts to the downstream receiving waters. Two possible strategies exist within the context of this project to achieve necessary flow duration control. First, it is possible to achieve the required flow duration control at the downstream end of each of the drainage corridors by creating additional low-flow attenuation (detention) behind the most-downstream in-line berms and integrating additional flow duration controls, i.e. specialized orifice plates, into these berms. An alternative strategy would be to implement additional incremental flow duration control at each in-line berm along the entire length of each of the corridors.

With the first option, significant amounts of additional detention storage and flow duration controls would be needed at four locations, one at the downstream limit of each of the three corridors as well as at the upstream compliance point at the Loop Road in Corridor C. With the second option, flow duration controls would be needed at each cross channel berm within the proposed limits of the corridors to achieve a similar degree of incremental flow duration control upon urbanization of the SP area.

This hydromodification assessment evaluated both options, i.e. the downstream attenuation option and the feasibility of implementing incremental flow duration control at each of cross-channel berm/weir locations for each of the corridors within the Specific Plan Area described above. The “incremental” approach seeks to fairly and evenly distribute the hydromodification impact mitigation requirements across the tributary sheds within each corridor, minimizes the overall land that has to be identified and preserved as open space for drainage purposes, and maximizes the habitat creation potential within the limits of the proposed drainage channels.

The results of the current hydromodification assessment identified the need for additional low-flow event detention storage and flow duration controls within each of the three channels to minimize potential hydromodification impacts to the downstream receiving waters beyond what would be required only for flood control. This necessitated additional widening of the drainage channel downstream of the Loop Road on the B-

corridor and throughout the on-site segments of the C-corridor (with the exception of the segment traversing the commercial center at the intersection of Elverta Road and 16th Street. Within the D-corridor, the significant flood attenuation to roughly 50% of existing peak flow rates as required to eliminate the flooding of the intersection of Dry Creek Road with U-Street also serves to reduce the hydromodification potential downstream of the project area to less than existing levels without requiring any further on-site channel excavation or widening.

Typical flow duration controls integrated into each cross-channel berm were simplified for modeling purposes and generally include a low flow orifice (e.g., 12 inches) and a V-notch weir of varying dimension (see Table 3 for the configuration of the modeled low and high flow orifices). The simplification of a specialized orifice plate as a low flow orifice plus V-notch weir for modeling purposes could be transformed into an appropriately sized orifice plate by replication of the stage-discharge relationship of each control structure.

Due to the rural nature of the ag-res densities approved within the on-site 600- and 700-series northern shed areas with lot sizes ranging from 1 to 5 acres per lot, it is anticipated that implementation of LID measures concurrent with development will mitigate for any increases in runoff both at the low flow and high flow events, thus not requiring further flood control or hydromodification mitigation. Alternatively, or in the case of the A-shed, previously identified flood control detention basins may be increased as modeled by Sacramento County's Sacramento Area Hydrology Model (SAHM) modeling software (see Appendix 9.1.1), along with implementation of flow duration control detention basin outlet works to mitigate the projected hydromodification impacts. Project-specific development proposals at the small-lot tentative map stage will have to be submitted to DWR for review and approval to demonstrate appropriate mitigation.

TABLE 3:
Flow Duration Controls

C-Corridor			
Condition	**River Station**	**Low Flow Orifices**	**High Flow Orifices**
Interim	119+00	3 x 11.5 inch	160° V notch w/ IE = 72.30 ft
Buildout	119+00	3 x 12.0 inch	6 x 5.0 ft x 1.0 ft box w/ IE = 71.60 ft
Buildout	97+90	2 x 12.0 inch	6 x 5.0 ft x 1.5 ft box w/ IE = 66.00 ft
Buildout	72+25	3 x 13.0 inch	60 ft x 1.5 ft culvert w/ IE = 60.50 ft
Buildout	57+50	3 x 12.0 inch	170° V notch w/ IE = 54.70 ft
B-Corridor			
Condition	**River Station**	**Low Flow Orifices**	**High Flow Orifices1**
Buildout	49+50	1 x 12.0 inch	2 x 3.5 ft x 1.6 ft box w/ IE = 61.40 ft
Buildout	23+70	1 x 15.0 inch	2 x 7.0 ft x 0.5 ft box w/ IE = 57.79 ft
Buildout	14+00	1 x 12.0 inch	120° V notch w/ IE = 54.25 ft
D-Corridor			
Condition	**River Station**	**Low Flow Orifices**	**High Flow Orifices [1]**
Buildout	73+20	-	114° V notch w/ IE = 66.88 ft
Buildout	61+77	-	113° V notch w/ IE = 64.20 ft
Buildout	43+70	-	3-ft wide parallel notch w/ IE = 59.92 ft
Buildout	36+75	-	113° V notch w/ IE = 58.40 ft
Buildout	24+74	-	2 ft wide parallel notch w/ IE = 58.4 ft
Buildout	18+90	1 x 48 inch	120° V notch w/ IE = 61.4 ft, 50 ft weir, crest El. = 62.82

4.0 DEVELOPMENT PHASING

As property ownership and/or developer involvement in ESP changes over time, the projected Phase 1 development area may change along with it. The following conceptual Phase 1 development plan was prepared on information available at the time this study was prepared, with the goal of providing flexibility in terms of which properties participate in the 1st phase of development. Phase 1 drainage and corridor habitat improvements have been designed in such a way that they will function in perpetuity on a stand-alone basis, as there is no way to predict if and when current non-participating properties will develop.

Each of the major drainage basins, including drainage Sheds B, C, and D addressed in this study, function independent of each other and as such, may present their unique phasing opportunities as well as constraints. The same applies to the individual properties within the ESP area. When modifications to the phasing plan are being proposed, the proponents thereof will need to provide the County DWR sufficient information in support thereof in accordance with the Agency's requirements to allow DWR to make the determination that proposed revised development phasing can occur in a responsible and safe manner and that potential impacts on existing downstream drainages are going to be fully mitigated to existing or better than existing conditions. Such information to be submitted will need to address the various DWR regulatory objectives within the drainage shed the subject property is located in, including appropriate flood control (mitigation of peak runoff volumes and stages), hydromodification management, and water quality treatment.

The current Elverta Owners Group is comprised of those property owners and developers with controlling interests in properties within the ESP area seeking U.S. Clean Water Act, Section 404 permits in order to be able to develop. In aggregate, they comprise the Phase 1 development area of the project. Of the total 1,744+/- acre Specific Plan area, the Elverta Owners Group owns or controls approximately 563+/- acres with the project as depicted in Exhibit 3.

As it is financially infeasible for less than 1/3rd of the land holdings to pay for the construction and associated mitigation of all drainage facilities in their entirety, including those located on non-developing non-participating properties, a facilities phasing plan had to be developed that would allow Phase 1 participants to develop in a safe and responsible manner consistent with all applicable requirements and regulations. This includes mitigation of any and all development impacts to existing or better than existing conditions not only at the downstream Plan Area boundary, but also at each location were drainage runoff flows from a developing property and/or drainage corridor onto a non-developing property.

To that end, this analysis has identified "compliance points" at each of those locations, points at which the analysis compares existing conditions impact with those projected to occur upon Phase 1 development after implementation of the drainage improvements stipulated in this study. "Compliance" with existing conditions, i.e. mitigation of all

projected impacts due to development, including increases to peak runoff rates, hydromodification, and water quality to existing or better than existing conditions can thus be evaluated. The following Table 4 compares peak flow conditions occurring under 'existing conditions' to those under 'proposed/developed conditions with mitigation' at each of the "compliance points".

As noted in Chapter 2.5 of this drainage study, a CLOMR for the existing conditions 100-yr floodplain will have to be filed with FEMA by the Elverta Owners Group (EOG) prior to submittal of any large-lot or small-lot tentative parcel maps (whichever comes first). Then, prior to placement of any fill within the mapped 100-yr floodplain, the EOG will need to process a CLOMR for the proposed conditions 100-yr floodplain with FEMA for approval.

TABLE 4:
PHASE 1 PRE- AND POST- DEVELOPMENT PEAK RUNOFF COMPARISON

Shed AA

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		
			Existing	Phase 1	Developed
Downstream Compliance	-	-	95	94	88

Shed 702UP

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		
			Existing	Phase 1	Developed
Downstream Compliance	-	-	29	23	26

Corridor B

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		
			Existing	Phase 1*	Developed
Downstream of Ph1 Compl.	38+46	38+46	184	183*	n/a
Downstream Compliance	11+50	11+50	173	n/a	138

*Note: Phase 1 participants within B-shed modeled as fully mitigating their Phase 1 impacts on-site on an interim basis - future site-specific analysis to be submitted to DWR for approval.

Corridor C

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		
			Existing	Phase 1	Developed
Non-participant	180+20	181+41	283	216	262
Downstream Compliance	162+22	162+21	316	265	286
Downstream of RR Levee	81+20	81+20	601	552	578

Corridor D

Location	Ex. Sta.	Dev. Sta.	100yr Flow (cfs)		
			Existing	Phase 1**	Developed
Downstream of U-Street	0+98	15+00	146	n/a	68
**Note: Phase 1 consists of buildout of Shed D					

(Phase 1 and Dev. Conditions results based on 100-yr 24hr storm with 10-yr storm starting WSE)

As noted in Table 4 above, peak flow conditions at all of the "compliance points" are mitigated to equal or better than existing conditions upon buildout of Phase 1 properties and associated drainage improvements described as follows and depicted in Exhibit 13: Proposed *Phase 1 Conditions Watershed Map*).

Shed "702UP and "A" improvement requirements under Phase 1:
Phase 1 development in these particular sheds is limited to a single 27-acre property, APN 202-0070-015, straddeling the common shed boundary between Shed 702UP and Shed AA. The property is zoned for up to 113 single-family residences under the 25% density bonus provision. As there are no distinct open channel drainages to be preserved or created within these sheds for flood conveyance, mitigation of drainage impacts incl. flood attenuation, hydromodification management, and water quality treatment is proposed to be handled by construction of a 0.41 ac-ft multi-purpose basin near the downstream boundary of Shed 702UP and another 3.5 ac-ft multi-purpose basin near the downstream boundary of Shed AA within the project area. The volumes of these basins may be constructed in phases over time, with each individual tributary project having to identify it's project-specific mitigation requirement and thus share of the ultimate basin to fully mitigate its impacts. Associated project-specific drainage studies will have to be submitted to Sacramento County DWR for review and approval prior to subdivision improvement plan submittal. Additionally, at the tentative map submittal stage, a location suitable for the ultimate basins will have to be identified.

Drainage Corridor "B" improvement requirements under Phase 1:
Currently, there are only 2 properties within the B-corridor shed area wishing to develop as part of Phase 1. APN 202-0080-58, a 6-acre parcel designated for up to 35 single-family residential dwellings under the 25% density bonus provision, is located between Loop Road west and Palladay Road. The northern portion of said parcel contains 0.7 acres of the proposed drainage corridor. Due to the effects of peak flow hydrograph timing, runoff from this property only needs to be treated for Water Quality impacts once hydromodification impacts are addressed. Without interim flood control as part of development of this parcel in Phase 1, combined peak flow downstream of this parcel on non-participating properties is less than under existing conditions.

The second Phase 1 participant within the B-corridor shed area is APN 202-0070-013, a 20-acre parcel designated for up to 130 single-family residential dwellings under the 25% density bonus provision. It is located immediately to the west of 16th Street, just south of the proposed drainage corridor. For it to develop, the applicant would have to construct an interim 1.5 ac-ft multi-use drainage basin on-site and then obtain off-site drainage easements to convey mitigated runoff to the existing natural channel. A project-specific drainage studiy will have to be prepared by the applicant and submitted to Sacramento County DWR for review and approval prior to subdivision improvement plan submittal. Additionally, at the tentative map submittal stage, a location for the needed temporary on-site basin will have to be identified.

Drainage Corridor "C" improvement requirements under Phase 1:
The proposed development phasing of properties within the "C" shed creates a more fragmented patchwork of properties wishing to develop as part of Phase 1 and those that are not participating in the Elverta Owners Group's efforts and thus not projected to develop in the foreseeable future.

Downstream of the proposed future Northborough development and the existing Rifle Ridge Estates subdivision, an existing concrete channel discharges onto a proposed Phase 1 development property in the ESP area. The proposed "C" corridor as modeled starts at this location. Approximately 1,300 LF of the "C" corridor will be constructed downstream of the Plan Area boundary at this location as part of Phase 1. It then crosses the proposed Loop Road and enters non-participating properties. As this upstream segment of the drainage corridor construction is intended to be permanent, the proposed culverts beneath Loop Road east to be constructed in Phase 1 are sized based on the mitigated peak flow rate. This 1,300 LF segment of the permanent drainage channel has sufficient capacity to fully mitigate the drainage impacts created by development of the tributary Phase 1 properties depicted on Exhibit 13.

The "C" drainage channel then continues in a southwesterly direction to its intersection with 16th Street in an existing unimproved condition. Assuming that a portion of 16th Street north of Elverta Road incl. the C-corridor culverts beneath 16th Street will be constructed as part of overall Phase 1 development, on the upstream side of 16th Street, there will be a step in grade down into the proposed culverts and the Phase 1 segment of the "C" corridor across the commercial center to be located at the northwest corner of the intersection of 16th Street with Elverta Road. To prevent scour and erosion, this grade differential will have to be armored as part of the proposed improvements.

Between 16th Street and Elverta Road the proposed "C" corridor turns southerly across the proposed commercial center, rather than following its natural alignment. This segment is a part of Phase 1 drainage improvements. The reasons for this proposed re-alignment are two-fold. First, the existing alignment snakes between two existing residences located on non-participating properties to the west of the proposed commercial center. Aligning the proposed channel on this course would require acquisition and condemnation of at least one of these structures. Second, although neither alignment alternative is ideal for the design of the commercial center, a crucial component of the overall land use master plan, the applicant's planner indicated the proposed alignment to nonetheless be a better land use fit. It does, however, require the acquisition of a couple of small, undeveloped non-participating properties just upstream of Elverta Road when the commercial center whishes to develop in order to avoid having to relocate a high-voltage power line tower as part of the center's drainage impact mitigation.

At Elverta Road, the proposed channel enters a temporary 54-inch diameter bypass pipe to be located within the Elverta Road right of way. It will carry upstream runoff from up to the 100-year event downstream to the west about 1,500 feet to avoid Phase 1 drainage impacts on the non-participating property (APN 202-0170-025) at the southwest corner of the intersection of Elverta Road and 16th Street.

The easternmost portion of sub-shed C70 located adjacent to the north side of Elverta Road is proposing to develop as part of Phase 1. Under existing undeveloped conditions, runoff from this property flows overland into a roadside ditch running westward along the north side of Elverta Road. Just east of the intersection with 16th Street, the ditch enters a small culvert and crosses Elverta Road to the south. After continuing westward for a very short distance in an open ditch, it enters another small culvert that crosses 16th Street. It then discharges onto the aforementioned non-participating property owner.

For this Phase 1 property in sub-shed C70 to develop and not cause drainage impacts on non-participating downstream properties, it will have to construct a small temporary on-site detention basin with an approximate flood control volume of 1.1 ac-ft. Under interim Phase 1 conditions, this basin will discharge into the existing roadside ditch along Elverta Road at existing conditions runoff rates. At buildout, the interim basin can be eliminated, as drainage mitigation will be provided within the ultimate C-corridor. At that time, drainage conveyance will be achieved by a permanent trunk drainage pipe to be located in Elverta Road. It will take the place of the existing roadside ditch when Elverta Road is widened as part of overall development. This trunk drainage pipe will run westerly within Elverta Road and ultimately discharge into the proposed drainage canal west of 16th Street.

Downstream of non-participating property APN 202-0170-025, the remaining on-site section of the "C" corridor is proposed to be constructed to its ultimate condition as part of Phase 1 improvements. Just downstream of the aforementioned non-participating property, the proposed channel widens significantly on account of attenuation requirements to manage hydromodification impacts. A cross-channel berm with a notched opening located just upstream of the Plan Area boundary will allow peak flow mitigation to existing conditions as well as hydromodification management through flow duration control so as to not cause downstream flood and erosion impacts. The proposed drainage channel will discharge through this flow duration control structure to the existing downstream drainage at existing grade. No additional downstream off-site improvements will be required on this corridor under either phased or built out conditions.

Buildout of this segment of the C-corridor provides sufficient hydromodification management volume and flood control attenuation to allow all additional participating Phase 1 properties located west of 16th Street to develop without requiring further interim drainage facilities. See Exhibits 3 and 13 for a depiction of these Phase 1 properties.

<u>Drainage Corridor "D" improvement requirements under Phase 1:</u>
The "D" corridor will be constructed in its entirety as part of Phase 1 improvements, as its entire length is located on participating properties. This includes downstream culvert and improvements at the intersection of Dry Creek Road with U-Street as depicted on Exhibit 12.

[insert Exhibit 13: *Phase 1/Interim Conditions Watershed Map*]

5.0 WATER QUALITY

In an urban environment, untreated post-development stormwater runoff may include a number of pollutants, including, but not limited to sediment, nutrients, trash, metals, bacteria, oil and grease, and organics/pesticides. Such pollutants have documented harmful effects on the natural environment. Under the federal Clean Water Act, stormwater discharges are therefore regulated through the National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permits. Regionally, the Central Valley Regional Water Quality Board issues and enforces NPDES stormwater permits. Through the Phase 1 Sacramento Areawide NPDES Municipal Stormwater Permit the local agencies regulate and manage the quality of urban runoff throughout their jurisdiction, including runoff from new development such as the Elverta Specific Plan.

The general purpose of the proposed water quality treatment features to be implemented in the Elverta Specific Plan is to reduce the urban runoff pollution from the proposed development to the maximum extent practicable (MEP). It is intended to satisfy the regulatory requirements of the Sacramento Areawide NPDES Permit. The goal of the identified treatment measures is to protect the quality of the proposed drainage corridors and the restored and enhanced wetland and riparian habitat being created within them.

At buildout of the various individual development proposals contained within the Plan Area, the network of water quality treatment facilities proposed will function in aggregate to reduce the projected pollutants to the maximum extent practicable. The network of envisioned facilities will include site-specific source control measures such as small-scale Low Impact Development (LID) measures, Best Management Practices (BMPs), point-of-discharge water quality treatment basins, and vegetated swale discharges there from.

Low Impact Development (LID) emphasizes the conservation and use of available on-site natural resources to protect the environment – especially water. Small-scale LID projects dispersed throughout the watershed combine with point-of-discharge water quality treatment basins, in-channel flood control and hydromodification management to manage post-development stormwater runoff and maintain or restore pre-development watershed conditions.

In general, LID replaces the traditional development approach of conveying runoff through miles of costly pipes to acres of expansive detention ponds with an approach that mimics nature, using natural vegetation and small-scale treatment systems to retard, treat, evaporate, and infiltrate stormwater runoff close to where it originates. LID reduces the effective imperviousness of development, thereby increasing stormwater infiltration and thus helping to recharge groundwater resources when the on-site soil profiles can accommodate such infiltration. Typically, reducing the amount of runoff at the source in the first place not only reduces the need for point-of-discharge facilities (detention and water quality basins), but reduces impacts on receiving waters carrying stormwater.

Based on the on-site soil types and as noted in the soils report, however, *the soil landscape of the project area is mostly treeless and is underlain by soils with strong*

rooting and permeability constraints (reference Section 2.4 *Soils* and the *Elverta Soils Report* included in the Appendix). Additionally, the proposed wetland and riparian restoration proposed for the open space drainage corridors would benefit from the increased recurrence of low volume runoff typical of urban development during summer months due to over-irrigation and washing of cars. Whereas developments typically seek to prevent such summer runoff from entering the receiving waters, in this Plan Area, the proposed landscape and planting palette of the open space drainage corridors has been designed specifically with the intent of receiving such runoff. Projected inundation levels within the D-corridor based on summer nuisance flows and 2-yr design storm runoff are depicted in Exhibits 15 and 16 included in Chapter 7 of this study**.**

Note: the D-corridor was designed in 3D contouring to allow a more detailed hydraulic analysis and subsequent resources restoration design than would be required at this level of entitlement. This was done so that the D-corridor might be used as a prototypical example of how the trapezoidal cross sections incorporated into the 2-dimensional hydraulic HEC RAS model for the B- and C-corridors might be shaped and "naturalized" as part of the final design thereof.

As previously mentioned, it is not yet known what individual project-specific LID proposals will be forthcoming. The LID toolbox provides for of a variety of environmentally sound and cost-effective techniques including green infrastructure, conservation design, and sustainable stormwater management practices. New development will typically be able to maximize the benefit of advanced stormwater management through the implementation of a number of these tools in combination to replicate the predevelopment hydrology of the site.

The numerical benefits of actual BMPs and LID features specific to land use and site layout have not been considered in the analysis of point-of-discharge water quality basins required to fully mitigate the water quality impacts of this project on the receiving drainage channels. It is projected that these benefits will be calculated and accounted for prior to actual design of the water quality treatment basins, thus allowing these basins to be reduced in size and possibly even be eliminated (depending on the level of LID implementation).

The following Table 5 identifies water quality basin design parameters for each pipe outfall into the proposed drainage corridors based on the Stormwater Quality Design Manual for the Sacramento and South Placer Regions. The proposed dry-extended basins were designed to release 75% of the water quality volume in a minimum of 24 hours and 100% within 48 hours total. It is anticipated that they will be incorporated into the upland drainage channel buffers where feasible. In any case, the water quality treatment basins are to be integrated seamlessly into the adjacent landscape design so that they may become community amenities rather than fenced off nuisances that the community would rather turn its back to. Additional basin detail regarding the dry weather treatment in the form of specifically designed vegetation beds suitable to such an environment is described further in the Conceptual Habitat Development Plan (see Appendix 9.5).

Water Quality Flow (WQF) volume noted in Table 5 as calculated in accordance with the requirements of the referenced design manual ($WQV=P_0 \bullet A/12$) will be split off in specially designed flow separation structures located upstream of each basin, in-line with the drainage pipe conveying runoff from the development to the open drainage channel. Peak flows in the pipe system will thus bypass the water quality treatment basins, preventing larger runoff volumes from washing pollutants that have collected in the treatment basins into the receiving waters. The treatment basins will be discharged by gravity through calibrated structures into vegetated swales draining into the drainage channels. A typical conceptual configuration of a water quality treatment basin and grassy swale outfall channel is shown in the Conceptual Habitat Development Plans (see Appendix 9.5).

Table 5: Prelim. Water Quality treatment Basin Sizing

SHED	AREA	WT. PI	STORAGE (FT.)	VOL. (AC.FT)	"C"	WQF	Inflow Pipe
	[ac.]		(from Fig. E-3)*	DRY		(CFS)	(IN.)
AA	77.5	37.9	0.023	1.78	0.27	3.74	21
702UP	22.8	15	0.013	0.30	0.14	0.58	12
B10	45.0	25.0	0.018	0.81	0.20	1.61	15
B20	105.7	26.2	0.019	2.01	0.20	3.89	21
B30	46.4	23.7	0.018	0.84	0.19	1.60	15
B40	43.3	56.9	0.035	1.51	0.39	3.01	18
B50	15.0	17.6	0.014	0.21	0.16	0.42	12
B60	37.4	50.0	0.031	1.16	0.34	2.28	15
B70	28.5	49.2	0.031	0.88	0.33	1.71	15
B80	16.1	47.7	0.029	0.47	0.32	0.94	12
B85	10.0	50.0	0.031	0.31	0.34	0.61	12
B90	35.2	51.0	0.031	1.09	0.35	2.19	15
C10	32.8	10.0	0.01	0.33	0.11	0.65	12
C20	105.6	24.5	0.018	1.90	0.20	3.71	21
C30	111.5	37.2	0.023	2.56	0.26	5.30	24
C40	37.5	46.9	0.03	1.12	0.32	2.16	15
C50	23.4	60.4	0.038	0.89	0.41	1.74	15
C65	5.8	90.0	0.065	0.38	0.73	0.77	12
C60	62.1	55.6	0.035	2.17	0.38	4.21	24
C70	42.2	62.9	0.039	1.65	0.43	3.28	21
C75	112.6	10.0	0.01	1.13	0.11	2.24	15
C80	22.7	62.7	0.039	0.89	0.43	1.76	15
C90	33.4	46.3	0.03	1.00	0.32	1.90	15
C100	42.1	53.3	0.032	1.35	0.36	2.74	18
C105	27.2	64.7	0.04	1.09	0.45	2.19	15
C110	62.7	64.2	0.04	2.51	0.44	5.00	30
C115	43.0	63.7	0.04	1.72	0.44	3.39	21
C120	51.1	48.1	0.03	1.53	0.33	3.01	18
C130	51.0	48.6	0.03	1.53	0.33	3.03	18
C140	27.8	10.0	0.01	0.28	0.11	0.55	12
D10	12.7	43.1	0.027	0.34	0.30	0.68	12
D15	5.3	10	0.01	0.05	0.11	0.11	12
D20	47.6	38.5	0.024	1.14	0.27	2.33	15
D30	26.4	50.3	0.031	0.82	0.34	1.62	15
D35	13.4	57.7	0.035	0.47	0.39	0.94	12
D40	19.2	42.8	0.027	0.52	0.30	1.02	12
D50	19.0	46.5	0.03	0.57	0.32	1.09	12
D60	15.6	63.5	0.04	0.62	0.44	1.23	12
D70	22.9	60.5	0.038	0.87	0.41	1.70	15
D80	37.0	45.1	0.028	1.04	0.31	2.06	15

Another key benefit of extensive LID implementation is the reduction of Stormwater runoff, specifically during the more frequently occurring low flow events. The numerical benefits of such runoff reduction may eventually be accounted for in the final design of the drainage conveyance channels, possibly resulting in reduced hydromod. attenuation

requirements. However, concrete development proposals that include specifics on proposed LID implementation are required before any resulting benefits thereof can be accounted for. Absent these specifics, the design included in this storm drainage master plan does not provide for any numerical credits for such features.

6.0 MISCELLANEOUS DRAINAGE SYSTEM COMPONENTS

Piped Trunk Drainage System:

The Trunk Drainage Shed Map (Exhibit 14) depicts a conceptual trunk (30 acres) pipe storm drainage system. In absence of proposed small-lot subdivision layouts, the Drainage Shed Map delineates the relative location of the trunk storm drainage pipe outfalls based on current interpretations of the proposed land use plan and drainage shed boundaries. Pipes were sized based on flows determined using the Nolte design method. To evaluate the hydraulic grade line elevations (HGL's) within the proposed pipe system, starting water surface elevations at the pipe outfall locations was based on the 10-yr storm event within the major drainage channels. Average pipe slopes of 0.2 percent (S=0.002) were then extended up the length of each pipe system. Based on the County's design standards regarding unimproved lands with no current development plans, the future gutter flow line is assumed at one and on-half feet (1.5') below the natural ground elevation for purposes of pipe hydraulics calculations.

Backwater elevations due to submerged outlet conditions of the furthest-downstream weirs near the western (downstream) Plan Area boundary were incorporated into the on-site drainage analysis of the open channels. The pipe outfalls incorporated these elevated starting water surface elevations into the HGL analysis to verify adequate cover on proposed schematic trunk drainage facilities. Lower-lying areas within the Plan Area, especially near the intersection of U-Street and Dry Creek Road will ultimately require some fill to be placed over the site and the piped system to provide adequate HGL cover. Plenty of usable fill dirt should become available as a result of the required channel excavations, but it is not yet known exactly if and how much fill may actually be needed. Future tentative map layouts and additional site-specific detailed grading and drainage analyses will be needed to establish actual needs.

The trunk storm pipe outlet locations, and drainage basin boundaries are considered to be schematic in nature, and are subject to future revisions based on the detailed lotting and development plans that will be prepared as part of the Tentative and Final Mapping process for individual projects within the ESP project area. Ultimately, it will be the responsibility of the future Tentative Map applicants to prove substantial compliance or reasonable alternatives to the approved Master Storm Drainage Study.

Drainage Corridor Maintenance Access:
Many areas of the drainage channels are adjacent to streets. In these locations, maintenance access is available from the adjacent street. A separate joint-use recreational/maintenance path subject to the County's and Rio Linda Park District's approval will be provided elsewhere. At appropriate intervals yet to be determined, maintenance access ramps will be provided to the drainage channel bottoms as required by County Water Resources Division improvement standards.

Trails:
The Elverta Specific Plan's Community Advisory Council has stressed their desire for a significant recreational trail system within the Plan Area. The drainage corridors are major components of that system. They will include an improved surface for a multi-use pedestrian/bike path on one side of the corridor. Separate equestrian trails may be provided on the opposite site where practicable. As described above, the pedestrian/bike path may be combined with the County's service/maintenance access path, while equestrian trails would be kept separate from both.

Along the edges of the B- and C-corridors where hydromod. attenuation requirements dictated extensive channel widening out to the edges of the open space corridor, there will be limited upland open space buffer available beyond the top of bank to locate the trail in. In such cases, the trail is proposed to be located on a terrace to be incorporated into the channel bank above the 2-yr event water surface elevation. During infrequent storm events with a recurrence interval less than the 2-yr event, such trails would be allowed to flood. The flooding, however, is projected to last at most, a couple of days, before once again receding below the trail elevations. Alternatively, the trails may become part of the adjacent roadway frontage improvements, as may be allowed based on future subdivision layout.

[insert Exhibit 14: Schematic Trunk Drainage System]

7.0 NATURAL RESOURCES IMPACT & RESTORATION

The hydrologic connectivity of the historic vernal pool and swale system in the Elverta Specific Plan area has been dramatically altered since at least the 1930s by extensive modification of the historic drainage network via topographic and land use changes. The present-day system of channels and swales in the ESP area clearly exhibits various stages of hydrologic, geomorphic and ecologic degradation. Land use modifications for grazing and urbanization continue to cause geomorphic degradation in the form of channel incision.

Two approaches to stormwater management have traditional been followed, including: (1) construction of *an engineered stormwater channel* consisting of either trapezoidal or rectangular concrete- or grass-lined waterways; or (2) setting aside *a "preserved" channel* that responds to regulatory resource concerns. An alternative to either of these approaches is being proposed in the ESP, where existing ill-defined and degraded drainage corridors would be modified, stabilized, rehabilitated, and re-contoured in place to function more resiliently under future urbanized conditions and hydrology. As such, the D-corridor was designed and modeled in 3D contouring to allow a more detailed hydraulic analysis and subsequent resources restoration design than would normally be required at this level of entitlement. This was done so that the D-corridor might be used as a prototypical example of how the trapezoidal cross sections incorporated into the 2-dimensional hydraulic HEC RAS model for the B- and C-corridors might be shaped and "naturalized" as part of the final design thereof.

The enhanced, multiple use drainage corridors being proposed will incorporate hydromodification measures such as flow duration control structures and low impact design (LID) source control features. Upland buffers will feature multi-use pedestrian/bicycle trails on one side and, where practicable, equestrian paths on the other. Additionally, water quality/sedimentation basins at end-of-pipe discharge locations will be located within or near the limits of the drainage corridors, yet outside the limits of the actual drainage channels. At locations where the upland buffer area within the drainage corridors is insufficient to accommodate the required water quality basin footprint, they will be incorporated seamlessly in to adjacent landscaping as part of the adjacent subdivision design. (Full WQ treatment in accordance with the NPDES permit requirements of Sacramento County will result from a combination of LID measures and off-channel WQ treatment basins - see Chapter 5). These multi-objective drainage corridors will thus not only provide additional stability and resiliency for the channel system, but also improved water quality, habitat, recreational, and aesthetic function. "*Elverta Specific Plan - Drainage Corridors B, C, and D – Conceptual Habitat Development Plan*" by Restoration Resources (see Appendix 9.5) provides further details of this proposal.

The design of these conceptual plans allows for a complex of valley floor upland, riparian, and wetland habitats appropriate to the proposed site conditions and is based upon extensive soils studies, combined with models of future topographic and hydrologic conditions. In addition to the designed habitats, the plan requires the salvaging of

existing vernal pool inoculums and clay soils for later reapplication to proposed restored pools and other wetland features.

Using base maps of the overall corridor extents, the excavated drainage corridor, cross-channel berms, hydrologic models displaying frequency and depth of flooding, and soil profiles, Restoration Resources developed diverse habitats with species in each palette capable of adapting to wetter or drier conditions than what was originally modeled. The corridor excavation operations will, in many locations, cut through the existing duripan and into more readily drainable sub-soils, allowing for the establishment of wetland and transitional riparian vegetated habitats (reference the duripan profiles, Appendix 9.4). Salvaged topsoil from excavation operations will be reapplied to over-excavated channel and bank habitats to meet proposed finished grades and create a 6 inch planting medium. Seasonal wetland basins and terraces designed within the corridor bottom will provide valuable wetland species habitat and will be excavated below the modeled corridor bottom. The fill generated from this habitat construction activity will be used on the side slopes of the excavated channel, creating gentler slopes and increased habitat diversity while maintaining or increasing the minimum hydraulic cross section of the drainage channel determined utilizing HEC RAS modeling. This method of maintaining the average channel cross section reflected in the calculations this drainage master plan is based on, while undulating the channel bottom and side slope to create natural looking drainages capable of supporting sustainable habitat of a wide variety, will ensure the hydraulic integrity of the flood control as modeled (increasing the hydraulic cross section without modifying the proposed cross-channel berms and outlet structures/notches will enhance the storage capacity of the drainage channels, thus increasing conveyance attenuation and thus overall flood control).

The plan is designed to create naturalistic perennial drainage patterns with varying channel widths and depths and off-channel seasonal and perennial wetland basins that will support seasonal wetland and freshwater marsh habitats. To that end, very detailed 2-dimensional hydraulic analyses of low flow conditions occurring during summer nuisance and 2-year design storm events were prepared by cbec, Inc. for the D-corridor drainage channel using SRH2D modeling software. Exhibits 15 and 16 depict the resulting inundation levels calculated by the model. These inundation depths calculated for the D-corridor drainage channel were then extrapolated to the B and C corridor drainage channels using the water surface elevations (and thus inundation depths) calculated for the 2-year design storm event using HEC RAS as described in Chapter 3.4, thus allowing Restoration Resources to design appropriate habitat mosaics for these channels as well. (Note: the habitat restoration design for the B- and C-corridors as currently reflected in the plans by Restoration Resources as includes in Appendix 9.5 of this study has yet to be adjusted to reflect the latest channel widening based on the latest hydraulic modeling design. These adjustments will be made as part of the 404-permit processing and well ahead of any final drainage design).

The regularly inundated corridor bottom outside of the low flow channel and created wetland basins and terraces, but still within the 2 year flood zone, will support seasonally flooded riparian habitats such as riparian grassland, willow riparian woodland, and some

cottonwood riparian woodland. Less frequently inundated riparian habitats within the corridor and along the corridor side slopes are designed with appropriate plant species associated with cottonwood riparian woodland, oak riparian woodland, and the drainage corridor bank habitat types. On the upland grassland buffer outside the drainage corridor banks, the soils and depth to duripan were analyzed to determine the location of proposed vernal pools, grasslands, and oak plantings for the creation of oak savanna grassland and vernal pool grassland habitats. The overall goal of the restoration plan is to create a mosaic of upland and wetland habitats so that over time, a person walking through the drainage corridors on one of the designed trails 10 years after establishment will see a complex and dynamic system of diverse habitats, encompassing a wide variety of plants and animals interacting with each other and the surrounding environment.

The re-construction and enhancement of existing, ephemeral drainages within the ESP area will result in an initial loss of approximately 29 acres of seasonal wetlands, swales, and vernal pools. Ultimately, however, approximately 33 acres of wetlands (willow riparian, seasonal wetland, seasonal freshwater marsh, and vernal pools and swales) will be created and enhance in the proposed, multi-use corridors. An additional approximately 26 acres of transitional wetlands (cottonwood riparian, oak riparian, and riparian grassland) may be created dependent on year-to-year rainfall fluctuations or an increase in total water conveyance within the corridors. Consequently, there could be a net gain of up to almost 59 acres of wetlands associated with creation of the proposed drainage corridors, including creation of new freshwater emergent marsh, willow riparian scrub, and riparian woodland habitats where none currently exist. (Note: the habitat numbers listed will need to be updated based on the final design for the B- and C-corridors).

Table 6:
Elverta Specific Plan Proposed Post-Project Wetland Acreage

Drainage Corridor	Wetland Acres	Transitional Wetland Acres*
B (Northern)	7.94	11.07
C (Central)	17.51	3.16
D (Southern)	7.14	12.01
Total	**32.59**	**26.24**

* Dependent on yearly rainfall or increase in drainage runoff conveyance

Extant wetlands in the ESP provide minimal hydrologic input to the Sacramento River watershed (via the Natomas East Main Drainage Canal); transform and cycle elements; retain and remove dissolved substances; accumulate and retain inorganic sediments; and maintain plant communities and some level of energy flow within the system. However, these services are extremely limited as a result of the impacts of historic anthropogenic changes to the surrounding landscape, including the complete extirpation of pre-settlement natural communities via land use (e.g. agricultural) conversion, alteration and/or truncation of natural drainage patterns and hydrologic regime, and elimination of critical species habitat for a number of plant and wildlife species. While the ESP area is

not small, increasing urban build-out will eventually result in even more fragmentation of remaining wildlife habitat, contributing to the overall decline of native biodiversity within the area. Some of these impacts to local and regional wildlife resources can be mitigated to a great extent by the proposed creation of three perennial drainage corridors within the framework of the Elverta Specific Plan, thereby resulting in more ecologically complex and diverse habitats than presently exist.

[insert 2D inundation Exhibit 15 created by cbec for summer nuisance flows]

[insert 2D inundation Exhibit 16 created by cbec for 2-year flows]

8.0 REGIONAL DRAINAGE BASIN IMPACT ANALYSIS

As concluded in the Rio Linda Elverta Community Plan (RLECP) Update Final EIR and by the Sacramento Area Flood Control District, regional buildout of the NESG drainage basin has the potential to cause significant increases in the runoff volumes the receiving water of Steelhead Creek has to deal with and pump out to the American and Sacramento Rivers. This may cause adverse backwater conditions, exacerbating local flooding conditions. However, the RLECP Update Final EIR also concluded that the Rio Linda Elverta Community of which the Elverta Specific Plan is a part of makes up such a small share of the overall NESG drainage basin that buildout of the community alone *would have little impact on NEMDC* [Steelhead Creek] *flooding*.

According to the County of Water Resource Division's own analysis, buildout of the Elverta Specific Plan may cause an increase in the water surface elevation of Steelhead Creek of about 0.2 feet. At the same time the County acknowledged that the receiving water's 100-yr water surface elevations are not only controlled by peak flows, but also by the performance of the D15 pump station and the storage in its very wide floodplain.

As described in Chapter 3.1 of this study, SAFCA had a consultant analyze potential impacts on the D15 pump station. SAFCA's consultant concluded that rather than causing an environmental impact, buildout of the Elverta Specific Plan as proposed would cause an economic impact [on the D15 pump station] that could easily be mitigated with an impact fee. ended that rather than have the Project pay an impact fee equivalent to $55/acre, the Project should annex into the operations and maintenance district that funds ongoing operations of the pump station and associated facilities.[16]

As directed by the County of Water Resources Division staff, an existing backwater condition on Tributary G downstream of the confluence of the B- and C-channels at the former UP railroad embankment was analyzed under pre-and post-development conditions to ensure that any increases in the runoff volumes caused by development of the Elverta Specific Plan area would not negatively affect this existing backwater condition, i.e. that it would not cause an increase in the existing floodplain elevations upstream of the railroad embankment.

For the existing conditions analysis downstream to the former railroad embankment MacKay & Somps utilized information contained in the County's flood analysis prepared by Borcalli & Associates entitled the "Flood Insurance Study For Natomas East Stream Group Tributaries And The Natomas East Main Drain Canal, Sacramento, California" prepared in 1997. MacKay & Somps converted the original analysis into an HEC RAS model and then calibrated the existing conditions model to the results of the Borcalli study.

For the analysis reflecting buildout of the Elverta Specific Plan area, MacKay & Somps modeled a number of different scenarios to ensure compliance with existing FEMA

16 ESP Final EIR, Volume 1, Chapter 7, Pages 25-29; and Volume 3, Chapter HY-2

floodplain mapping, i.e. no negative impact on existing floodplain elevations. As shown in the summary table contained in the digital files of the appendix, under none of the developed conditions scenarios analyzed by MacKay & Somps do the floodplain elevations upstream of the former railroad embankment increase over mapped conditions. Instead, current modeling shows a slight decrease of the floodplain elevations by 1 to 3 inches, depending on the model scenario.

9.0 APPENDICES

9.1 Drainage Model Data Files, Result Summary, Profiles, & Sections

9.1.1 SacCalc Hydrologic Calculator:

Elverta B-shed
Elverta C-shed
Elverta D-shed
Elverta 702UP-shed… SAHM

9.1.2 HEC-RAS 4.0 Hydraulic Model Data Files:

B Corridor	
C Corridor	(with existing diversion berm in place)
C Corridor	(standard 100-yr 24-hr hydrograph – "FEMA Analysis")
C Corridor	(Berm Break)
D Corridor	

9.1.3 Modeling Results Summary (SacCalc & HEC-RAS)

9.1.4 B-Corridor Sections (included in *Electronic Files* in back of report)

9.1.5 C-Corridor Sections (included in *Electronic Files* in back of report)

9.1.6 D-Corridor Sections (included in *Electronic Files* in back of report)

9.1.7 Trunk Drainage Pipe System Analysis (Hydrology & Hydraulics)

9.2 Hydromodification Analysis (cbec)

9.3 Soils Analysis (David B. Kelley)

9.4 Duripan Profiles

9.5 Drainage Corridor Habitat Development Plans (Restoration Resources)

9.6 Large-Scale Exhibits

9.7 ELECTRONIC FILES