4.4 HYDROLOGY AND WATER QUALITY

This section describes and evaluates the existing hydrologic features of the Project site, including surface waters and ground water, and discusses the impacts that result from the Project. The information and analysis provided in this section is based on hydrology reports for the Forest Green Estates property prepared by Balance Hydrologics, Inc. in 2003 and 2005; a hydrology report by John Wollman & Associates in 2003; hydrology testing completed by Allan Kropp & Associates in 2005, and a geotechnical evaluation of proposed storm drainage mitigation by TERRASEARCH, Inc. in 2003. Earth Investigations Consultants, hired by the City as an independent geotechnical reviewer, conducted a peer review of this information and prepared a letter report summarizing their findings regarding the methodologies and conclusions reached in the applicant's study (October 5 and December 11, 2005).

4.4.1. Existing Setting

Hydrology

The site occupies the upper portion of the San Pablo Creek watershed, in Contra Costa County Area 73. The Area 73 region is controlled by the regional drainage of San Francisco Bay. Projects within the area are subject to Contra Costa County Flood Control Ordinance No. 88-68.

The site is subject to a Mediterranean climatic zone, typical of central California. Mean annual rainfall of 25 inches is sometimes exceeded by 200 percent during the recorded wettest years. The recorded driest years produce cumulative rainfall approximately 43 percent of the annual average. Temperatures rise sharply in the late spring, and remain elevated through early fall. Evaporation and evapotranspiration rates also rise in response to the warmer weather, typically depleting root-zone soil moisture by early May, thus slowing or stopping native vegetation growth until rainfall in early October. Extreme variations in soil temperature result in the pervasive surface cracking and rodent burrows present on the site which tend to increase infiltration or surface runoff until surface soil saturation is achieved, commonly after there has been at least 10.5 inches of seasonal, antecedent rainfall (Campbell, 1975).

The 81-acre site occupies an approximately 193-acre watershed, excluding runoff from the adjacent Waldorf School. Approximately 38 acres will be developed as a residential subdivision. The existing runoff at the northern boundary of the property is 124 cubic feet per second (cfs) for a 10 percent (10-year) storm event, and 230 cfs for a one percent (100-yr.) event. Runoff from the site and surrounding areas eventually flows beneath San Pablo Dam Road in a 36-inch diameter culvert to discharge into San Pablo Creek.

Drainage courses include an unnamed, main intermittent stream that extends diagonally across the site from the southeast to northwest, and five smaller, intermittent tributaries. The main watercourse will remain undisturbed by grading required for the Project, with the exception of replacement of the 48-inch diameter culvert beneath Wesley Way with a bottomless arch culvert for a wildlife access corridor. The locally incised and/or actively eroding main and tributary channels streams drain to San Pablo Creek, approximately one-quarter-mile to the north, and eventually to the regional base level elevation controlled by San Pablo Bay.

Site runoff begins as excess and/or saturated overland flow when the infiltration capacity of the clayey soils covering the hillside property is exceeded. Overland runoff is carried to the stream channels during rainfall by rills, gullies and swales. The adjacent Waldorf School contributes uncontrolled, concentrated runoff to the northern part of the site drainage system. Active erosion by "flashy", peak flows from the school grounds to the tributary of the main stream in the northeast part of the site has undercut and dislocated the culvert system, and eroded a deep gully across the site. Given the existing conditions at this location, continued gully erosion, and associated downstream sedimentation is expected to impact the drainage system in the northwestern part of the site.

Existing surface water bodies that contribute to site runoff include a small stock pond in the southeast corner of the site, and two known springs: one just offsite of the southeast property corner, and another in the northwest corner between proposed Lots 49 and 102. When connected by a line, the points of seepage describe a northwest trend subparallel to the regional geologic structural trend.

The maximum difference between existing and unmitigated storm runoff volume from the main channel at the north end of the site for a one percent storm is 1.42 acre-feet [(ac-ft); John Wollman & Associates, 2003].

Ground water was encountered at variable depths throughout the site (1998, 2003, 2005a). TERRASEARCH, Inc. characterized it as perched ground water on the basis of observed "pinpoint" seepages from shears or other discontinuities exposed in their wide diameter borings. This interpretation concurs with ground water encountered in the active La Colina Landslide west of the site (Alan Kropp & Associates, 2000). In reviewing boring logs, evidence of perched ground water or of past high soil moisture can be inferred on the basis of mottling, blue-grey and blue-green soil color, and the presence of caliche in the upper 30 feet of virtually all of the explorations. Ground water in piezometers constructed at 40-, 80-, and 120-foot-depths suggest the site is underlain by perhaps a series of confined aquifers.

Floodplain

The Project site is not located within the area of the 100-year flood, based on FEMA Flood Insurance Rate Maps. The area of the 100-year floodplain in the project vicinity is generally located within the San Pablo Creek channel, in some cases extending beyond the Creek channel but remaining on the north side of San Pablo Dam Road. Therefore, the extent of the 100-year floodplain lies well outside of the project site boundaries.

Contra Costa Clean Water Program

The California Regional Water Quality Control Boards for the San Francisco Bay Region and Central Valley Region (RWQCBs) have mandated that Contra Costa municipalities impose new, more stringent requirements to control runoff from development projects. The RWQCBs added Provision C.3 to the municipalities' stormwater NPDES permit in February 2003. The municipalities are phasing in the requirements from 2004 through 2006.

Since the early 1990s, Contra Costa municipalities have required contractors to implement temporary BMP's to minimize the amount of sediment and other pollutants that enter site runoff during construction. These BMP's are outlined in a Storm Water Pollution Prevention Plan (SWPPP). For several years, the municipalities have also encouraged applicants to design their projects to minimize new impervious area and to incorporate into their plans permanent treatment BMP's—features and devices that detain, retain, or treat runoff for the life of the project. As before, the standard for these BMP's is "maximum extent practicable," or MEP. However, the new permit requirements define MEP more specifically and include design criteria.

For projects where the C.3 requirements apply, a Stormwater Control Plan is required with the Planning and Zoning application. A Stormwater Control Plan is a separate document from the Storm Water Pollution Prevention Plan (SWPPP). The SWPPP provides for temporary measures to control sediment and other pollutants during construction at sites that disturb one acre or more. The Stormwater Control Plan specifies permanent controls that should last for the life of the project.

4.4.2. Proposed Improvements

The proposed Project includes several hydrologic design components, including detention basins, water quality basins, new seasonal wetlands, reconstruction of an ephemeral channel, and bottomless arch culverts. These components are included specifically to reduce storm water flows offsite to San Pablo Creek and will also provide protection for the proposed housing units. These components are described below in more detail.

Detention Basins

Four detention basins[1] have been designed to detain peak storm flow for a 50-yr. storm (2 percent event) with freeboard and overflow facilities to accommodate a 100-yr. storm (1 percent event; John Wollman, 2003). As shown in Table 4.4.1, the basins range in size from 2990 square feet (DB-1) to 5002 square feet (DB-3), with a combined site coverage of 0.3 acres and storage capacity of 129,565 cubic feet (3 acre-ft.). The basins are designed for downstream protection from storm water by inducing desiltation, and biofiltration before discharging into the site drainage system. The basins are designed to hold water for a period of approximately 12 hours after a storm event for peak flow attenuation, and will also hold some water for up to 48 hours for water quality treatment. The basins would be constructed in accordance with a two-stage design: A lower stage, consisting of a micro-pool to hold 15-25 percent of the runoff volume, filling more often and allowing the basin to be dry and sediment-free most of the time. The forebay would be constructed so that larger particles settle in depressions in the basins inlets, reducing the potential for erosion or re-suspension resulting from inflow. The runoff retained in the forebay and silt deposit pools would evaporate over time.

Hydrologic functions of the detention basins include:

1. Reduction and control of storm flows into the drainage system;
2. Desiltation and biofiltration of runoff before entering the drainage system;
3. Channel erosion reduction.
4. Provide for small wetlands with a range of hydrophilic and other tolerant vegetation;
5. Provide water treatment using combination of flow-through processes and temporary ponding;
6. Removal of suspended solids by settling and filtration through vegetation;
7. Removal of dissolved pollutants through chemical and biological mechanisms mediated by the plant and soil material.

[1] One of the detention basins is comprised of two separate ponds.

Water Quality Basins

Seven water quality basins are proposed, having a combined area of approximately 0.4 acres, constructed in the northern and western parts of the site to remove a wide range of pollutants found in urban runoff. The basins would have a combined storage capacity of 35,362 cf (0.81 ac-ft.), capable of treating 80-90 percent of average annual runoff for 48 hours prior to release to the site drainage system. The basins would be lined with clay to prevent seepage and/or infiltration. The earthen side slopes will be shaped to a gradient of 3:1. Riprap or similar material will be placed at each basin inlet and outlet to dissipate energy. The treated volume would discharge through perforated riser pipes screened to preclude obstruction by debris. The top of the riser would be left open to accommodate larger storm discharge.

Hydrologic functions of the water quality basins include:

1. Provide for small wetlands with a range of hydrophilic and other tolerant vegetation;

2. Provide water treatment using combination of flow-through processes and temporary ponding;

3. Removal of suspended solids by settling and filtration through vegetation;

4. Removal of dissolved pollutants through chemical and biological mechanisms mediated by the plant and soil material.

Table 4.4.1 Characteristics of the Detention and Water Quality Basins

Basin	Area Drained	Pond Area	Treatment Volume	Pond Size	Pond Depth	Comments
DB #1	1.9 ac	-	0.0890	2990	2.0	Multi-use basin, depth does not include freeboard or detention volume, bottom area is 1,500 sf
DB #2	3.1 ac	-	0.1453	5002	2.0	Multi-use basin, depth does not include freeboard or detention volume, bottm area is 3,000 sf
DB #3	1.9 ac	-	0.0890	4157	1.0	Multi-use basin, depth does not include freeboard or detention volume, bottom area is 3,500 sf
WQB #1	3.1 ac	3000	0.1453	2913	5.0	Near Lot 53/54
WQB #2	1.2 ac	2000	0.0562	1858	3.5	Near Lot 104
WQB #3	1.5 ac	2000	0.0703	2000	4.0	Near Lot 46

WQB #4	3.8 ac	4000	0.1781	3845	4.5	Near Lot 34
WQB #5	2.1 ac	2000	0.0984	2052	5.0	Near Lot 118/Only one-half foot of freeboard possible
WQB #6	3.2 ac	4000	0.1500	3345	4.5	Near Lots 24, 26, 27
WQB #7	2.4 ac	3000	0.1125	2680	4.5	Near Lots 5 & 6

Source: Project Application 2005

New Seasonal Wetland

Basins

The Project proposes a new seasonal wetland covering an area of 0.2 acres in the southeastern portion of the site, adjacent to the easement for emergency vehicle access (see figures 3.2 and 3.3). The applicant's geotechnical consultant will confirm specific design details; however, conceptually the design will:

1. Be similar to detention basins, except will generally have shallower ponding depth(approximately 6 inches or less);

2. Have gentle, complex slopes to allow for large changes in wetted area caused by small changes in ponding depth;

3. Comprise excavation of 1 to 4 feet of soil with a finished grade that slopes toward the designated overflow area, which appears to be an interceptor ditch extending across the south and southwestern margin of the site;

4. Compact the excavated area to reduce infiltration/percolation until a wetland sub-area is developed in approximately 10 years;

5. Place 1 foot of granular material in the bottom of the excavated area, and if necessary, install a drainpipe network to collect seepage from the wetland and direct it to the proposed interceptor ditch;

6. Compact one to two feet of clay over the granular material and construct a clay berm, covered with geotextile, on the downslope side to prevent runoff from the wetland;

7. Spread amended fill with wetland seed mix over the clay, with planting of woody vegetation in the adjacent upslope area;

8. Armor the clay berm to prevent erosion and overflows;

Hydrologic functions of the new seasonal wetlands include:

1. Retention and stabilization of sediment generated in the upslope area;

2. Reduction of peak and total flows in the proposed interceptor ditch and its discharge facility, and reception of water discharged from the ground water withdrawal system in the southeastern part of the site;

3. Bio filtration of excess nitrogen and removal of pollutants derived from the upland watershed;

4. Provision of a habitat for aquatic species and water sources for upland wildlife;

5. Provision of a more natural setting to local residents.

6. Temporary storage of groundwater pumped from drainage shaft(s)

Relocation of an Ephemeral Channel

The Project includes relocation of approximately 360 feet of the 400-foot Ephemeral Channel in the northeast part of the site receiving runoff from the adjacent Waldorf School, and creation of approximately 0.024 acres of associated seasonal wetlands. The proposed Project would fill the existing channel for building pads, and relocate the channel approximately 50-75 feet to the south. The slope of the existing channel measures 14 percent in the lower half and more than 25 percent in the upper half. The new channel will have an effective slope of approximately 14 percent.

Eighteen to twenty-four, two-foot high check dams spaced at regular intervals to create an artificial slope of 14 percent have been recommended to establish a stable channel configuration. Stormwater runoff from the East Bay Waldorf School to the relocated channel will be modified with a flow diversion structure to prevent flows from the East Bay Waldorf School in the relocated channel from exceeding 2.5 cfs. Additional flows will be routed away from the channel into the project's storm drain system. When local runoff is added, maximum flow for the channel in the 100-year storm event would be 3.5 cfs. A typical profile and cross section of the relocated channel is shown in Figures 4.4-1 and 4.4-2.

Hydrologic functions of the relocated channel include:

1. Capacity to carry storm runoff for a 100-year storm (4cfs);

2. A check dam profile with a stable channel gradient

3. The capacity to retain sediment and establish woody riparian vegetation;

4. Side channel seasonal wetlands produced by the check dams, which will provide areas for discharge of subdrains, and offer a habitat to encourage growth of riparian vegetation that will improve erosion resistance;

5. Vegetation to remove and transform excess nutrients and remove pollutants derived from The East Bay Waldorf School watershed, once established;

6. A reduction in volume of sediment generated from the watershed.

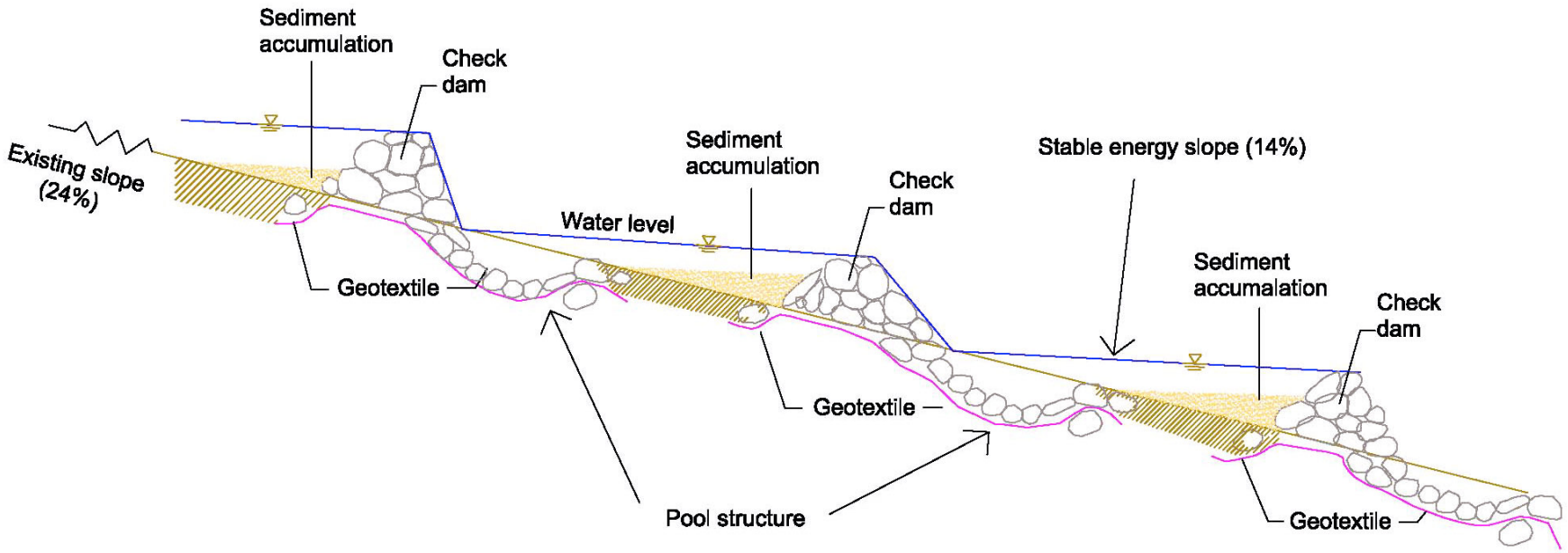
7. Provision of an aesthetic, healthy riparian corridor, wildlife and aquatic habitat, and natural hydrologic setting.

Buttress Channel

Section 4.3 Geology and Soils includes a discussion of a buttress that will be installed to provide slope stability. Construction of this buttress will affect the upper 134 feet of a tributary to the project site's main channel. The applicant proposes to reconstruct this channel after completion of the buttress.

The "buttress channel" would be located approximately 15 to 30 feet west of the current channel location. The buttress channel would be a total of 150 feet in length and would rejoin the existing drainage channel at the northern end of the buttress channel. A 50-foot-wide road with a bottomless arch culvert would cross the channel at its southern end. The upper 50 feet of the channel would have a slope of 10 percent or less, the next 50 feet would have slopes of up to 40 percent, while criteria set by the project engineer dictate that the 50 feet of channel under the roadway not exceed three percent slope.

The relatively low gradient of the upper 50 feet of the channel would provide an opportunity to design meanders into the channel. The next 50-foot section would be designed with 5 to 7 check dams to allow for the steeper slope gradient. Channel substrate under the bridge would be that of the natural channel downstream of the crossing (rounded gravels and cobbles mixed with sand and silt). Downstream of the crossing a series of three check dams would be installed to gradually bring the channel grade to the elevation and alignment of the natural channel.



NOT TO SCALE

Figure 4.4-1

Typical Profile and Schematic of the Proposed Relocated Channel

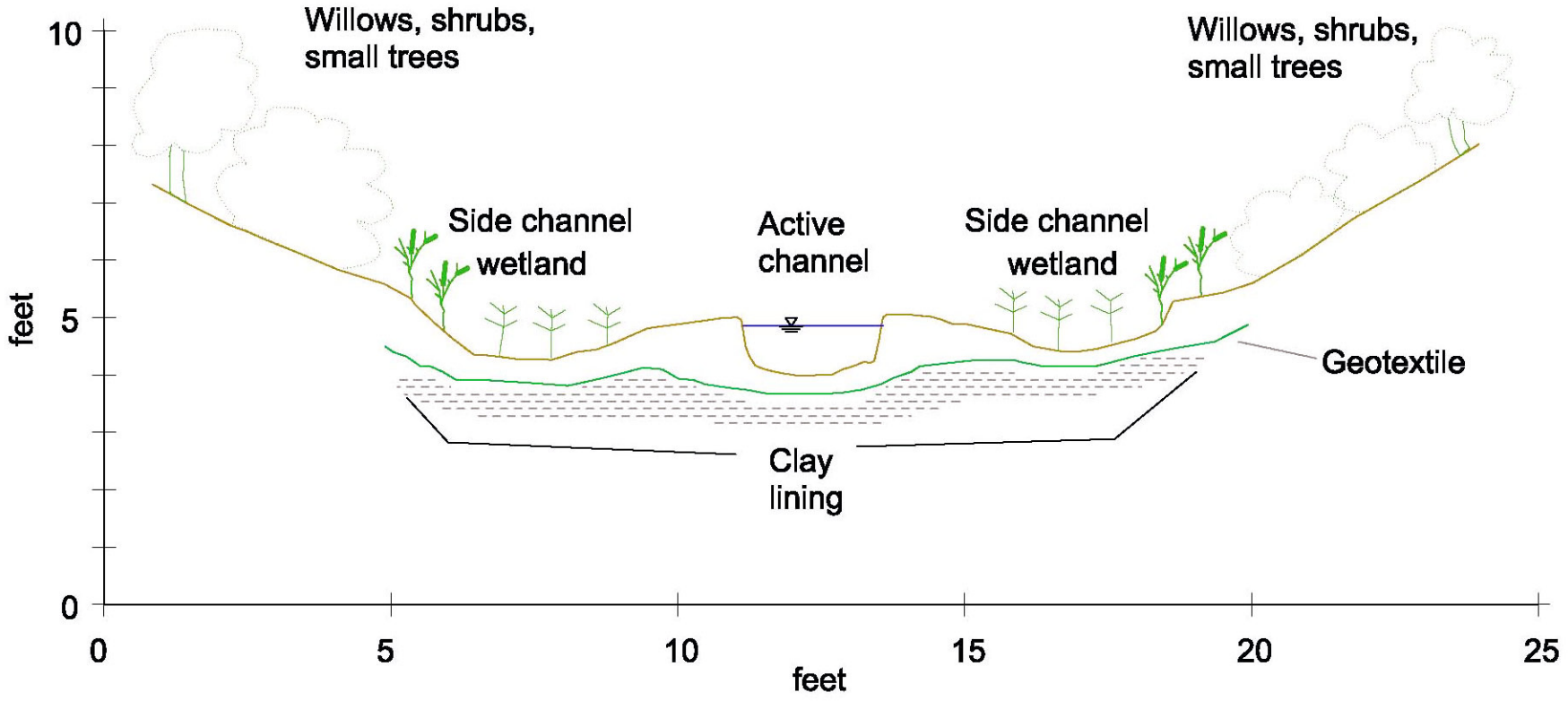


Figure 4.4-2

Typical Cross Section of the Proposed Relocated Channel

Bottomless Arch Culverts

Bottomless arch culverts will be installed where streets cross three of the tributary streams. The hydrologic function of the bottomless arch culverts is to allow for natural flow lines and unimpeded wildlife access.

4.4.3. Impacts and Mitigation Measures

Thresholds of Significance

The Project would have a significant impact on Hydrology if any of the following criteria are met:

- Violate any water quality standards or waste discharge requirements;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted;
- Substantially alter the existing drainage patterns of the site or area including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on-or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted run-off;
- Otherwise substantially degrade water quality;
- Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;

- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or

- Inundation by seiche, tsunami, or mudflow.

Less Than Significant Impacts

The following discussion describes less-than-significant impact related to hydrology.

Substantially deplete groundwater supplies or interfere substantially with groundwater recharge.

The proposed Project would be served by municipal water sources and would not utilize groundwater. Large areas of the site would remain undeveloped and the proposed detention basins and water quality basins would incrementally promote groundwater recharge. Therefore, implementation of the revised Project would not substantially affect the quality of any public water supply.

Two large site extraction wells would draw ground water from the site to reduce the potential for landslides. Water from those wells will be used to feed the on-site, created wetland. According to the hydrology analysis complete for the Project, the quantity of water removed should not be of a volume great enough to deplete local aquifers or impact runoff feeding local creeks, seeps or springs.

Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map.

Place within a 100-year flood hazard area structures which would impede or redirect flood flows.

Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.

According to the FEMA Flood Insurance Rate Map (1987), the site does not occupy the 100-year floodplain. The implementation of the proposed detention basins and water quality basins would reduce the rate of storm water runoff from the site such that the Project would facilitate flood control efforts along San Pablo Creek. The capacity of the detention basins and water quality basins was determined based on the Flood Control District's hydrographs of the Project site.

According to East Bay Municipal Utility District (EBMUD), the Project site is in the inundation area for a failure of the San Pablo Reservoir Dam. Although the dam is currently constructed to withstand a Maximum Credible Earthquake (MCE) on the Hayward fault, a recent study commissioned by EBMUD revealed that some of the soils and foundation that make up the dam at the reservoir are susceptible to liquefaction.[2] The study showed that if a 7.5 earthquake occurred on the Hayward Fault, the dam would slump and decrease in height, allowing water to flow over the top, resulting in flooding downstream. EBMUD lowered the water level in the reservoir in mid-2004 to prevent flooding from occurring as a result of an earthquake. In addition to lowering the water level, EBMUD is currently examining retrofit options that will provide a long-term solution. As a result, the potential impacts related to flooding are less than significant.

Expose people or structures to a significant risk of loss, injury or death involving inundation by seiche or tsunami.

The Project site is located upland and over two miles from the San Pablo Bay and is therefore not likely be affected by a tsunami. The nearest enclosed body of water is the San Pablo Reservoir, which is also over two miles from the site. Therefore, the Project would not be affected by a seiche.

Significant Impacts

The following discussion describes significant impacts to hydrology resulting from the Project.

Impact HYD-1: Development of the currently undeveloped site will create impervious surfaces on the site (i.e., pavements and hardscapes, building roofs, and compacted soil surfaces) that would result in increased volume of stormwater runoff potentially contributing to downstream flooding. Disposal of water from the proposed system of dewatering shafts and other subsurface drainage facilities will increase runoff to the detention basins and new wetlands.

Approximately 38 acres of the 81-acre site will be developed as a residential subdivision. Runoff from the area is directed to the unnamed, main seasonal watercourse along the east side. At the northern boundary, the existing undeveloped runoff is 124 cubic feet per second (cfs) for a 10% (10-yr. storm) event, and 230 cfs for a 1% (100-yr. storm) event. Total discharge from the site post-development conditions, including impervious surfaces without any

[2] Personal Communication, Fred Star, Water Resources Engineer, EBMUD, April 28, 2005.

mitigation, would be 136 cfs, or an increase of 12 cfs (approximately 10 percent increase). This increase would be offset by the proposed storm water collection system, including detention basins, water quality basins and new wetland areas.

Ground water from the proposed, deep dewatering shafts is roughly estimated to produce up to 1000 gpm (Wollman & Associates, 2005), which would be pumped onto the site surface as irrigation of the wetlands and open space/park, with an unspecified volume to be directed to the existing site drainage system.

Implementation of the following mitigation measures would reduce Impact HYD-1 to less than significant:

Mitigation HYD-1a: The final site design shall limit paving on individual lots and offstreet parking bays. The final site design shall include "porous paving" in areas that will not adversely impact soil stability, as assessed by the applicant's civil and geotechnical consultants.

Mitigation HYD-1b: The proposed drainage system shall be designed to comply with requirements of the City of Richmond, Contra Costa County Department of Public works, Contra Costa County Flood & Water Conservation District to reduce stormwater discharges from the Project site so that during rainstorms, downstream flows to San Pedro Creek would remain at existing flow levels or lower when combined with flow from other tributaries. The design shall account for not only volume of site runoff from all potential sources, but also for rate of discharge and trimming of peak flows relative to upstream and downstream peak flow conditions. In addition, all ponds shall be designed to detain low flow runoff events (up to 2-yr, 12-hr. storm flow) in order to provide treatment of "first flush" flows. Geotechnical input shall be required in design of storm drain facilities (particularly the detention ponds). Ultimately, construction of the Project storm drainage system shall be coordinated, reviewed, and approved by representatives of the governing agencies, the applicant's geotechnical consultant and the City Peer Reviewer(s).

Mitigation HYD-1c: To assure satisfactory, long-term operation of the storm drain system, the GHAD or HOA (required by Mitigation Measure GEO-8a) shall be responsible for retaining a licensed and qualified contractor to complete regular maintenance activities, such as desilting culverts and basins, and removing vegetation and debris from stream channels to assure that the facilities operate at their design capacities and to prevent downstream flooding problems. A maintenance funding source shall be established for these services, as required by Mitigation Measure GEO 8c.

Mitigation HYD-1d: The storm water detention basins and other structural water quality BMP's shall be designed to ensure public safety during low and high water conditions in order to minimize nuisance and vectors (e.g., mosquitoes, rodents, excess algae, etc.), and to be compatible with biological habitat considerations along stream corridors and open space areas. The applicant's geotechnical consultant and City civil and geotechnical Peer Reviewers shall carefully review and approve the design of all surface water storage basins as they relate to capacity, basin stability and there long-term erosion resistance. To achieve long-term performance of the proposed surface water detention systems, the GHAD/HOA shall maintain adequate funds for regular maintenance by a qualified, licensed contractor having specific experience with earthen basins and wetland maintenance.

Significance after Mitigation: Less than Significant.

Impact HYD-2: Development of the currently undeveloped Project site will alter surface and subsurface drainage patterns on the site due to relocation and recontouring of on-site streams, and influence ground water movement and elevations beneath the site by deep withdrawal in the southern and west-central parts of the site. These hydrologic and geohydrologic modifications will affect seasonal wetlands and other natural communities dependent upon the presence of water.

The proposed Project will alter the site drainage patterns, although, overall, the unnamed main channel will remain unmodified by grading or other construction activities except in the north end of the site for replacement of the culvert at Wesley Way with an arch culvert. Within the proposed lots, surface runoff naturally directed by overland flow to the seasonal, main and tributary channels will be diverted to the developed street storm drainage system. The proposed detention, water quality basins and wetlands would provide for temporary storage of runoff generated from the site.

The severely eroded, unstable seasonal tributary that receives runoff from the adjacent Waldorf School will be relocated to allow for building pad development and reduce sedimentation into the main channel and ultimately San Pablo Creek. It has been determined that the relocated channel will convey 100-yr. stormwater runoff up to and including the natural watershed conditions (4 cfs), including the school property. Check dams (18-24 riprap structures) will be installed in the channel to reduce the reconstructed channel gradient to 14 percent; a gradient that conforms to other stable channels within the watershed. The check dams will provide for additional seasonal wetlands totaling approximately 0.024 acres designed to retain and stabilize sediment. Prior to abandonment of the eroded

channel, all unstable soil, vegetation, and construction material will be removed. Remedial grading to abandon the existing channel will conform to adjacent main channel banks. Specifications for engineering fill and subdrainage for this work will be provided the applicant's geotechnical consultant.

Arch culverts will be installed at roadway crossings. The culverts are designed to allow for more natural flow patterns and to offer unimpeded wildlife access along the drainage courses. Engineered fill and subdrainage will be required for these features. Armor with riprap for erosion control on the up and down stream sides of the culvert crossings will modify local channel gradients and have the potential for inducing downstream erosion/siltation if constructed with abrupt, steeper transitions to the unconsolidated alluvial deposits forming the natural channel bottoms.

A channel through the area where the buttress would be constructed would also require the use of check dams to recreate approximately 134 feet of an existing tributary. The buttress channel would be located between lots 83 and 84 and would extend across the proposed access drive where it would reconnect with the existing tributary. A series of 5 to 7 check dams would be installed above the roadway and approximately 3 check dams would be installed below the roadway to bring the gradient of the channel back in conformance with the existing level.

Shallow ground water behind retaining walls and other residential subdrainage systems, and deep ground water below the ground surface will be intercepted by buttress subdrainage up to 60 feet deep on the west-central part of the site and the up to 120 feet deep at the dewatering shaft locations in the southern part of the site.

Mitigation Measure HYD-2a: The Project applicant shall comply with requirements of the California Fish and Game Streambed Alteration Permit as well as Corps of Engineers and California Regional Water Quality Control Board (RWQCB). (See discussion in the Regulatory Setting section of 4.5 Biological Resources). A qualified civil engineer having experience in hillside development shall prepare detailed grading and drainage plans. Such plans shall be submitted to the City of Richmond and Contra Costa County Flood Control & Water Conservation District for review and approval. The applicant's geotechnical consultant shall carefully review and approve in writing the proposed grading and drainage plan, and submit the letter to the City of Richmond Public Works Department.

Mitigation Measure HYD-2b: Plans and specifications for the proposed channel relocation and associated reclamation of the eroded channel draining The

East Bay Waldorf School site shall be evaluated and approved by the applicant's civil and geotechnical consultant to assure that appropriate grading and subdrainage measures are accomplished according to the approved plans and geotechnical recommendations. The applicant's geotechnical consultant shall provide recommendations as needed for reinforcement of the engineered fill to rebuild the abandoned channel segment at gradients steeper than 2H:1V. To mitigate potential impingement erosion, the segment of reclaimed channel shall conform to the extent practical with adjacent channel bank segments. Similarly, guide specifications for placement of the check dam riprap, and erosion control measures shall be prepared in a cooperative effort by the applicant's civil and geotechnical consultant to assure a stable bank configuration for the relocated channel.

For period of at least 10 years, or as determined and funded by the GHAD or HOA, the applicant's civil engineer and geotechnical consultant shall make annual inspections of potential erosion and siltation associated with the channel relocation mitigation, and produce their findings in a letter report. The GHAD or HOA shall hire a qualified, licensed contractor to implement recommendations by the applicant's civil engineer and geotechnical consultant for a stable environment.

Mitigation HYD-2c: A detailed and specific erosion and sediment control plan shall be prepared by the applicant's civil engineer in accordance with recommendations by the applicant's geotechnical consultant to mitigate surface erosion and siltation and watershed erosion. The plan shall include short-term artificial measures, and long-term measures including deep-rooted plant materials that conform to acceptable biological considerations. The plan shall be submitted to the City of Richmond and Contra County Flood Control & Water Conservation District for approval. The applicant's geotechnical consultant shall oversee the installation and approve in writing the as-built construction.

Mitigation HYD-2d: Planning and design of the proposed basins and ground water withdrawal systems shall incorporate specific civil and geotechnical recommendations to accommodate potential quantities of ground water that will be received by the deep dewatering measures and to avoid surface water infiltration downstream of the dewatering systems. The applicant's geotechnical consultant shall confirm preliminary information through monitoring of piezometers and pump testing. Supplemental measures to mitigate elevated ground water on the site shall be provided in a design-level geotechnical report.

Significance after Mitigation: Implementation of the proposed mitigation scheme should reduce potential impacts related to alteration of drainage patterns and the presence of elevated groundwater to less-than-significant level. However,

the proposed mitigations are potentially constrained by the following uncertainties:

(1) Lack of ground water data to confirm proposed mitigation design; and

(2) The possible requirement for adjacent property owner permission to complete the dewatering system on the south side of the Project.

Consequently, the potential impact would remain potentially significant and unavoidable until Project mitigations have been completed, and verified by the City's Geotechnical Peer Reviewer.

Impact HYD-3: Project construction could result in increased erosion and sedimentation, could potentially result in release in chemicals to stormwater, and could temporarily increase turbidity and decrease water quality in surface waterways.

Construction of the proposed Project would require extensive cut and fill operations. Construction activities involving soil disturbance, such as excavation, stockpiling, and grading, could result in increased instability and erosion of hillsides and sedimentation in surface waters, especially if construction occurs during the rainy season. Due to the extent and proximity of streams and drainages on the Project site, construction activities could result in soil erosion and decreased water quality to adjacent streams and downstream waterways unless proper erosion control and sedimentation precautions are employed. Sedimentation of streams would not only degrade water quality but also could also increase channel siltation, reduce the flood-carrying capacity of waterways, and affect associated aquatic and riparian habitats.

Construction activities would introduce construction vehicles, machinery and equipment to the Project site throughout the duration of Project construction. Use and storage of motor-powered vehicles and equipment on-site would increase the potential for spills and leaks of petroleum products and other chemicals that, in turn, could be carried via stormwater runoff to on-site and downstream waterways and affect water quality. Construction activities such as refueling, or chemical and fuel storage, could result in accidental releases of chemicals to surface water, unless proper precautions are employed.

Deep shaft and buttress dewatering systems could introduce adverse water quality to the drainage system.

Implementation of the following measures would reduce water quality-related impacts to a less-than-significant level:

Mitigation Measure HYD-3a: The Project applicant shall comply with requirements of the RWQCB construction stormwater permit. As part of the permit requirements, the Project applicant shall be required to develop and implement a SWPPP for the Project site. The SWPPP shall be consistent with the terms of the State Construction Storm Water General Permit, the manual of Standards for Erosion & Sedimentation Control Measures by the Association of Bay Area Governments, policies and recommendations of the City of Richmond and Contra Costa County, and the recommendations of the RWQCB. The SWPPP shall be a condition of Project approval. Implementation of the SWPPP shall be enforced during the construction period by the City, through the use of citations, or stop work orders, if necessary. The applicant's geotechnical consultant shall monitor on-site implementation of the SWPPP throughout the duration of construction activity.

The SWPPP shall implement an erosion-control plan during and after construction. The erosion-control plan should be prepared by the applicant's geotechnical consultant and reviewed by the City's Geotechnical Peer Reviewer for conformance to geotechnical recommendations. The following specific measures shall be considered in developing the erosion control plan and shall be implemented as determined necessary by the SWRCB, the RWQCB, and the City:

(1) Phase construction to limit areas of exposed soil and to minimize length of time the site is cleared and graded. The applicant shall submit to the City a plans and specifications pertaining to location(s) and methodology for placement/containment of proposed temporary earth stockpiling.

(2) Stabilize denuded areas as soon as possible with seeding, mulching, or other effective methods. Replanting of these areas shall be consistent with the requirements of Chapter 12.44 of Article XII of the Municipal Code. In addition, the planting scheme shall be designed and maintained to minimize fire hazards and preserve the aesthetic quality of the area.

(3) Coordinate the implementation of the erosion control plan with on-going maintenance practices of the City's Department of Public Works for cleaning, inspection and maintenance of the storm drain system, including cleaning of detention ponds, catch basins and culverts and clearing of stream channels.

(4) Strategically place velocity control dikes, hay bales, filter fabrics, silt fencing and/or other applicable erosion-control practices to maximize effectiveness of erosion control and to prevent sediment discharge to streams and waterways. This measure is particularly important for temporary stockpiling of earth during site grading. The applicant shall prepare and submit to the City a

specific program for cleaning, repair and replacement of these facilities over the course of construction.

(5) Coordinate implementation of the erosion-control measures with the phasing of the construction of the new storm drain system, so that erosion control measures are in place for whichever system(s) or portions thereof are operating for the duration of construction activities at the Project site.

(6) Schedule excavation and grading activities during the dry season, between April 15 and October 15.

Mitigation Measure HYD-3b: The construction contractors shall enforce strict on-site handling rules to keep construction and maintenance materials out of receiving waters. The rules typically include measures to:

(1) Store all reserve fuel supplies only within the confines of a designated construction staging area.

(2) Refuel equipment only within designated areas within the designated construction staging area.

(3) Regularly inspect all construction vehicles for leaks.

(4) Require the preparation of an Emergency Response Plan to be implemented in the event of an accidental spill.

(5) Require that the construction staging areas be designed to contain surface runoff so that contaminants such as oil, grease, and fuel products do not drain towards receiving waters. If heavy-duty construction equipment is stored overnight adjacent to potential receiving water, drip pans shall be placed beneath the machinery engine block and hydraulic systems.

Significance after Mitigation: Less than Significant.

Impact HYD-4: Stormwater runoff from the proposed development could potentially contribute to long-term pollutant discharges to surface waters, including on-site streams and downstream to San Pablo Creek.

Runoff from residential developments typically contains pollutants such as sediment, oil, grease, heavy metals, pesticides and fertilizers. With the exception of sediment, these substances are not expected to be present in existing runoff discharged from the Project site, since the site is currently undeveloped. During long-term use and occupancy of the revised Project, stormwater runoff from the

site would likely contain pollutants typical of other residential development. While these pollutants are currently present elsewhere within the watershed, additional pollutants in the stormwater runoff from the Project site would contribute to adverse downstream water quality in the San Pablo Creek watershed. Discharge of potentially varying levels of pollutants would occur year-round, from withdrawal of ground water, through irrigation runoff in the summer months, and stormwater runoff in the rainy season.

The proposed Project would construct detention and water quality basins for management of stormwater runoff generated by the proposed residential development. These features constitute a common Best Management Practices (BMP's) for protection of water quality. The basins offer opportunities for removal of pollutants primarily through gravitational settling of suspended solids, such as sediment and heavy metals, and they, along with grassy swales could effect removal of floatable materials. However the basin system and grassy swales would provide minimal filtration of pollutants derived from deep ground water withdrawal. The basins are appropriate water quality mitigation measures for large (i.e., 10 acres or more) developments and in areas of low permeability soils. These measures constitute other common water quality BMP's. The GHAD/HOA would be responsible for maintenance of these facilities.

Discharges would be subject to the water quality requirements of the RWQCB under the NPDES permit for stormwater discharge. In addition, the City of Richmond requires the preparation of Final and Interim Erosion and Sedimentation Control Measures for grading operations proposed by a Project. The plans are required to comply with guidance for temporary and permanent erosion control measures presented in the Association of Bay Area Government (ABAG) "Manual of Standards for Erosion and Sediment Control Measures" and/or the "California Storm Water Best Management Practices Hand Books." These guidance documents present performance standards for the design and maintenance of construction-period BMP's and post-construction period BMP's, including extended detention ponds and vegetated channels.

The runoff from the Project site would be subject to the requirements of the Contra Costa County Clean Water Program (CCCCWP) for runoff control as part of NPDES permit requirements. The City, as a participant in the program, is required to implement BMP's, public education and outreach, inspection activities and special studies to reduce loading of urban pollutants to stormwater runoff.

Implementation of the following mitigation measures would reduce surface water pollution impacts to a less-than-significant level:

Mitigation Measure HYD-4a: Viability of the proposed dewatering system will be contingent upon verification that ground water will not adversely impact the quality of water draining to San Pablo Creek. Hence, the applicant's hydrologist and geotechnical consultant shall thoroughly evaluate the quality of ground water (i.e., temperature and chemistry) expected to be removed by the deep dewatering shaft and buttress subdrainage systems. After implementation of the dewatering system, periodic chemical analyses of ground water shall be undertaken following construction of the Project to assure continuous clear-water discharge into the site drainage system. The duration of such monitoring shall be determined by the City in consultation with their geotechnical and hydrological Peer Reviewer. The GHAD/HOA shall be required to fund all maintenance, monitoring and mitigations associated with the dewatering systems.

Mitigation Measure HYD-4b: The City, in consultation with the Contra Costa County Clean Water Program, shall implement its stormwater management program at the Project site and proposed residences. The applicant shall develop and implement a Stormwater Plan, including a SWPPP as required in Mitigation Measure HYD-3a (including provisions for erosion and sediment control), which provides BMP's for both construction and post-construction periods. The City shall review to ensure compliance with the provisions of Article XII of the Municipal Code. Approval of this Plan shall be a condition of approval of the Final Development Plan.

Mitigation Measure HYD-4c: Pesticides on the site shall be restricted to residential use to minimize contamination of waterways and shall not be used for maintenance of open space and other common areas. The applicant shall retain a City-approved specialist in integrated pest management to develop an effective program. This program should address measures to reduce or eliminate pesticide use on residential property. Program requirements and recommendations shall be submitted to the City Planning Department for review and approval, and ultimately reflected in the HOA codes and covenants.

Mitigation Measure HYD-4d The GHAD/HOA shall be required to fund all maintenance of basins and all other on-site drainage facilities, including any measures to remediate polluted ground water, and to maintain underground arch culverts. Vegetation shall be managed to minimize fire hazards. Mosquito abatement shall be performed in compliance with guidance from the Contra Costa County Mosquito and Vector Control District.

Mitigation Measure HYD-4e The applicant shall include provisions in the Stormwater Plan for maintenance of water quality and detention basin and associated mitigations. Provisions for regular inspections and maintenance shall

be included. In addition, a methodology for characterization of sediment removed from water quality and detention basins, new seasonal wetlands shall be provided. Chemical characterization of the sediment shall be conducted by a qualified professional and shall, at a minimum, include analyses for salts and heavy metals (cadmium, chromium, nickel, lead, and zinc). Based on results of the characterization, the professional shall determine whether soils can be reused on-site or must be disposed of at an appropriate landfill. The disposal option shall be determined by comparing analytical results to EPA's Preliminary Remediation Goals (PRG's) for residential land uses for each constituent analyzed. If analyzed levels exceed the PRG's, sediments shall be properly disposed of off-site. If levels are below PRG's, the sediment can be disposed of on-site or at a local landfill. The City of Richmond Department of Public Works shall review the Stormwater Plan to ensure that the requirements listed above are included in the plan.

Mitigation Measure HYD-4f The GHAD/HOA shall minimally conduct annual water quality sampling during the "first flush" storm event at the furthest downstream point (northeast corner of the Project site) of the seasonal main stream. The samples shall be analyzed at a state-certified laboratory for pH, total organic carbon, nitrate, total suspended solids, metals, and organo-phosphate pesticides. The analytical results of the water quality sampling shall be evaluated by a licensed engineer or certified hydrogeologist to determine if water quality objectives have been maintained. If water quality objectives have been violated, a corrective action plan shall be developed. A report of the results of the analysis and recommendations for any necessary corrective actions shall be submitted for approval to the City of Richmond Planning Department.

Significance after Mitigation: Less than Significant.