4.4 HYDROLOGY AND WATER QUALITY

This section describes the existing hydrologic conditions for the Specific Plan area, including tidal influence, site drainage, sedimentation, flood hazards and water quality. This description of existing conditions is based on a review of existing regional and site information, on site reconnaissance conducted by Philip Williams & Associates (PWA) staff, and by quantitative analyses performed by PWA. Existing information reviewed includes topographic maps (U.S. Geological Survey 1993), historical topographic maps, Flood Insurance Rate Maps (FIRMs) (Federal Emergency Management Agency [FEMA] 1984), and previous studies including *Larkspur Creek Channel Study* (BSI Consultants, Inc. 1989), *Irving Group Property Residential Development Drainage Study* (Brian Kangas Foulk 1998), and *City of Larkspur Flood Insurance Study* (FEMA 1983). Water quality information includes the *Water Quality Control Plan for the San Francisco Bay Basin* (San Francisco Bay Regional Water Quality Control Board [San Francisco Bay RWQCB] 1995) and the *Corte Madera Watershed Resource Evaluation and Information Report* (San Francisco Bay RWQCB 1994). Guidelines for managing water quality impacts, particularly from urban runoff, are described in reports from the Marin County Storm Water Pollution Prevention Program (MCSTOPPP) including *Action Plan 2005: Protecting and Enhancing Marin County's Watersheds* (Marin County Department of Public Works 2001) and the *Condensed Planning and Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices* (MCSTOPPP 2003).

4.4.1 EXISTING SETTING

REGIONAL SETTING

Tidal Processes

Regional Tidal Characteristics

Tidal characteristics from the Corte Madera Creek gauge, approximately 1 mile east-northeast of the Specific Plan area, are shown in Table 4.4-1. Mean tide conditions are from the National Ocean Service (National Ocean Service 1983). The 10- and 100-year estimated high tides, which have a respective 10% and 1% probability of occurring in any given year, are from the U.S. Army Corps of Engineers (USACE) (U.S. Army Corps of Engineers 1984).

Historically, the Specific Plan area was located at the interface between the adjacent hills and the vast tidal marsh that extended from the bay to the base of Mt. Tamalpais. The site would have consisted of tidal marshplain (bisected by tidal slough channels) in the northern portions, then would have transitioned to upland areas in the southwestern corner. Fill was placed on the site over time to accommodate development, raising it above regular tidal influence.

Tidal Flooding

Flooding within the city of Larkspur is driven primarily by high tides in San Francisco Bay and concurrent high flows in Corte Madera Creek. Extreme high tides in San Francisco Bay result

Table 4.4-1
Tidal Characteristics

	Datum	
	MLLW (feet)	NGVD (feet)
Estimated 100-Year High Tide	9.14	6.40
Estimated 10-Year High Tide	8.34	5.60
Mean Higher High Water (MHHW)	5.80	3.06
Mean High Water (MHW)	5.21	2.47
Mean Tide Level (MTL)	3.14	0.40
National Geodetic Vertical Datum, 1929 (NGVD)	2.74	0.00
Mean Low Water (MLW)	1.07	-1.67
Mean Lower Low Water (MLLW)	0.00	-2.74

Notes:
Average tide levels are for the Corte Madera Creek gauge (#941 4874). Ten-year and 100- year high tides are for the nearby Point San Quentin tide gauge (#941 4873) because these data are not available for the Corte Madera Creek gauge (U.S. Army Corps of Engineers 1984).
Datums:
NGVD = National Geodetic Vertical Datum. This represents a nationwide vertical benchmark, and is the standard survey datum used by most cities and agencies. It corresponds approximately with mean sea level.
MLLW = mean lower low water, the datum commonly used by mariners. It represents the average of daily low tides over a 19-year tidal epoch. In Larkspur, it is 2.74 feet below NGVD.

Sources: National Ocean Service 1983, U.S. Army Corps of Engineers 1984

from the combined effects of astronomical high tides and other factors including winds, barometric pressure, ocean temperatures, and fresh water runoff. Exhibit 4.4-1 shows areas mapped within the 100-year and 500-year floodplain on the 1984 City of Larkspur FIRM (FEMA 1984). According to analysis conducted for FEMA flooding downstream of the Tamalpais Creek confluence (located upstream of the Bon Air Road Bridge [Exhibit 4.4-1]) is controlled by extreme high tide events. Flooding upstream of the Tamalpais Creek confluence is controlled by extreme rainfall-runoff events on Corte Madera Creek.

Tidal flooding in the San Francisco Bay area is expected to gradually increase in the future as a result of relative sea level rise. Relative sea level rise is a function of local subsidence and global sea level rise. Information about local subsidence in the vicinity of the Specific Plan area is sparse. The closest sites for which local subsidence rates have been estimated are Point Orient, approximately 5 miles to the east across the bay, and Sausalito, approximately 6 miles to the south; local rates at these sites are -0.002 foot/year, and +0.004 foot/year, respectively (San Francisco Bay Conservation and Development Commission 1987). Given this information, PWA has determined that local subsidence is not significant.

Relative sea level rise, therefore, is equal to the global sea level rise. Current predictions of global sea level rise range from 0.2 feet to 1.1 feet over the next 50 years, with a midrange estimate of 0.6 foot (Watson et al. 1996).

Exhibit 4.4-1

Surface Water Hydrology and Sedimentation

Drainage

The Specific Plan area is located on Larkspur Creek, which drains an area of 1.75 square miles to its confluence with Corte Madera Creek. The Specific Plan area occupies about 21.9 acres, or approximately 2% of the local watershed. Larkspur Creek's headwaters originate in the steep slopes of Mt. Tamalpais; its midregion flows through an urbanized area where an approximately 500-foot reach is culverted. The Specific Plan area is located in the lower watershed areas, where the stream channel slope is considerably flatter. In the lowest reaches adjacent to Piper Park, the channel is extremely flat, and widens significantly before its confluence with Corte Madera Creek (which discharges to San Francisco Bay 1 mile further east [Exhibit 4.4-1]). Approximately 51% of the watershed contains urban development, concentrated mostly in the lower watershed (BSI Consultants, Inc., 1989). The 100-year peak flow on Larkspur Creek at the Meadowood Drive bridge crossing, at the southwest corner of the Specific Plan area, is estimated at 1,463 cubic feet per second (cfs) based on hydrologic modeling reported in the *Larkspur Creek Channel Study* (BSI Consultants, Inc., 1989). This study analyzed the 100-year, 12-hour rainfall event for the Larkspur Creek watershed. The study used USACE's HEC-2 hydraulic model to estimate water surface elevations in Larkspur Creek from the junction of Corte Madera Creek approximately 4,000 feet upstream (including the reach adjacent to the Specific Plan area) to the Meadowood Drive bridge. The study concluded that the creek could convey the 100-year estimated peak discharge along most of this length without significant overbank flows. Two reaches of flood protection structures were recommended on the south and east sides of the channel (opposite bank from the Specific Plan area) to prevent flood encroachment onto homeowner properties.

In its review of BSI Consultants' study, Brian Kangas Foulk (BKF) indicates that the 1989 model is still valid, as there have been no significant changes in watershed drainage since that time (BKF 1998).

Corte Madera Creek drains an area of approximately 28 square miles and enters San Francisco Bay just south of San Quentin State Prison. The 100-year flow at U.S. 101 (approximately 1 mile east-northeast of the Specific Plan area) is 9,000 cfs (FEMA 1983). There is a USGS streamflow gauging station on Corte Madera Creek at Ross (approximately 2.3 miles northwest of the Specific Plan area, #11460000) with records from 1951 through 1993. The Marin County Flood Control and Water Conservation District has operated this gauge since 1993. The lower reaches of Corte Madera Creek are subject to ongoing siltation from sediment supplied by both San Francisco Bay and the Corte Madera Creek watershed. Watershed sediment is supplied during major rainstorm events during the winter months, while sediment from the bay (originally supplied from the Sacramento and San Joaquin Rivers to the bay) is suspended by summer winds and circulated throughout the bay by tidal currents. To maintain navigation access to lower Corte Madera Creek, periodic dredging has been required. Dredging was conducted in 1994 and additional dredging is currently proposed (Foreman, pers. comm., 2002). This dredging includes Corte Madera Creek, the Larkspur Creek

channel, and the Lucky Creek channel. There is some disagreement regarding the relative contribution of sediment from the bay and watershed to sediment accumulations in the lower creek channel (downstream of Doherty Drive). According to Foreman (pers. comm., 2002), sediment from the Larkspur Creek watershed is a significant contributor of sediment to the tidal portions of the Larkspur Creek channel. However, as discussed in the 1989 BSI Consultants report, USACE staff involved in the sedimentation studies in Corte Madera Creek attribute sediment accumulation to tidal sources.

Regional Flood Issues

In the past 50 years there have been several severe flood events on Corte Madera Creek from combined high tides and upland runoff. Significant flood damage occurred in 1951, 1955, 1958, 1960, 1962, 1963, 1967, 1969, 1982, 1983, and 1986 (USACE 1999). USACE began construction of the Corte Madera Creek Flood Control Project in 1967 in an effort to reduce the risk of flooding for surrounding communities. The portion of the project that was built includes an earthen channel from the bay to a location downstream of the College of Marin in Kentfield, and a 1-mile concrete channel from Kentfield to the Ross Post Office. Significant sedimentation occurs in the concrete channelized section, resulting in decreased hydraulic capacity and increased flood hazards in some reaches, and the need for periodic dredging of the channel.

LOCAL SETTING

Tides

Tidal Characteristics

Larkspur Creek flows under the Doherty Drive bridge at the northeast corner of the Specific Plan area, approximately 2,400 feet upstream of its confluence with Corte Madera Creek. Field observations of channel morphology and vegetation indicate that Larkspur Creek is tidally influenced along the east side of the Specific Plan area, to approximately 900 feet upstream of the Doherty Drive bridge crossing.

Tidal Flooding

The 1984 FIRM shows that the 100-year flood elevation from high tides is included within the banks of Larkspur Creek in those areas where it borders the Specific Plan area (Exhibit 4.4-1). The remainder of the Specific Plan area, with the exception of Doherty Drive from the Doherty Drive bridge to Rivera Circle, are mapped as between the 100- and 500-year flood elevations (which have a 1% and 0.2% probability of flooding, respectively, in any given year). These areas are not considered to be within the jurisdictional (100-year) flood zone by FEMA. According to observations by the Twin Cities Police Department and Sloat Nursery employees, Doherty Drive adjacent to the Specific Plan area did not flood during the February 1998 storms (BKF 1998).

A small portion of the Specific Plan area, in and adjacent to the concrete drainage ditch located in the northwestern part of the site (Exhibit 4.4-2), appears to be subject to tidal flooding during extreme tide events. This flood hazard is not shown on the FIRM map (Exhibit 4.4-1), but is hypothesized based on the storm drainage configuration and observations of flooding at high tide by persons familiar with the Specific Plan area. The ditch was observed by PWA staff to drain to a culvert under Doherty Drive, which then appears to be routed to an ungated outfall into a tidal channel, which connects to Corte Madera Creek. A nursery employee stated that extremely high tides "back up" in the concrete ditch, causing local flooding. Winter storm runoff may also contribute (see below).

Surface Water Hydrology and Sedimentation

Drainage

Exhibit 4.4-2 shows drainage features and approximate drainage area boundaries within the Specific Plan area. The Specific Plan area is gently sloped, with elevations ranging from 6.9 feet to 13.5 feet NGVD (BKF 1998). The following are descriptions of the approximate drainage patterns within the Specific Plan area.

The north-central portion of the Specific Plan area currently drains to a concrete ditch located within the Specific Plan area and to the east of the existing Larkspur Plaza shopping center. The BKF study states that water draining to this ditch has backed up and overflowed several times during winter storms (BKF 1998) either as a result of inadequate capacity, or because during high tides, water ponds in the drainage channel and adjacent low-lying areas until either the tide drops, or sufficient hydraulic head develops to allow drainage to the tidal channels located north of Doherty Drive. It is unclear whether this flooding is caused solely by high rainfall runoff during storms, or by a combination of high rainfall runoff and high tides.

The eastern part of the Specific Plan area ponds locally during rain events (BKF 1998), except for the Sloat Nursery parking lot, which drains to an outfall on Larkspur Creek just downstream of the Doherty Drive bridge.

The south-central part of the Specific Plan area drains through a series of culverts and earthen ditches to a 24-inch-diameter outfall, which connects this portion of the Specific Plan area to Larkspur Creek approximately midway along the southeastern property line. Little information is available about drainage on the western edge of the Specific Plan area, which was not included in the 1998 BKF drainage study. Approximate drainage patterns for the southwestern corner of the Specific Plan area included in Exhibit 4.4-2 are based on observations during the field site visits.

Exhibit 4.4-2

Flood Hazards

In the lower reach of Larkspur Creek and the lower part of the Corte Madera Creek watershed, 100-year flooding is governed by extreme tide events coupled with large rainfall-runoff events. The 100-year high tide is estimated to flood the area to an elevation of 6.4 feet NGVD, while 100-year surface flows from rainstorms are estimated to cause flooding to a lower peak elevation (BSI Consultants, Inc., 1989). Current flood mapping (Exhibit 4.4-1) indicates that the Specific Plan area is not within the jurisdictional 100-year flood zone, with the exception of Doherty Drive from the Doherty Drive bridge to Rivera Circle. It is mapped within the 500-year flood zone. Both the 1989 BSI Consultants study of rainfall runoff processes in the Larkspur Creek watershed and studies of channel hydraulics adjacent to the Specific Plan area, indicate that the 100-year rainstorm is also contained within the channel along the Specific Plan boundary with the potential exception of Doherty Drive from the Doherty Drive bridge to Rivera Circle.

While the Specific Plan area is not subject to significant flood hazards, localized ponding is likely during concurrent intense rainstorms and high tides.

Sedimentation

Sediment processes within a watershed are typically divided into three classes: sediment production (occurs in the upper watershed), sediment transport (occurs in the middle reaches), and sediment deposition (occurs in the lowest channel reaches). For Larkspur Creek, sediment is produced in the steeper, upper watershed areas, and transported through the middle reaches to the lower channel reaches. Sedimentation rates in the reach of Larkspur Creek furthest downstream (northerly from Doherty Drive) are high because of the combined influence of low channel slopes and the tides. Sediment from Corte Madera Creek and San Francisco Bay is conveyed on incoming tides, adding to the sediment load. In response to ongoing siltation, the reach of Larkspur Creek adjacent to Piper Park has been dredged for navigational use, resulting in a deep channel that effectively traps and accumulates sediment. In addition, the historical conversion of surrounding tidal marsh to upland development has reduced the tidal flows, which formerly maintained the channel dimensions by tidal scour. Little information is available on sedimentation in Larkspur Creek adjacent to Specific Plan Subarea 3. It appears to be primarily a "transport reach," conveying sediment produced upstream to the lower channel reaches. Some deposition may be occurring in the wetland fringes adjacent to the low-flow channel just upstream of the Doherty Drive bridge. The 1989 BSI Consultants study considered sediment detention facilities in this area and concluded that they were not cost effective due to physical constraints and mitigation required to preserve the scenic quality, or beneficial in terms of flood hazard reduction.

Surface Water Quality

According to the San Francisco Bay RWQCB and the County Flood Control and Water Conservation District, no official water quality monitoring data are available for Larkspur Creek. However, regional water quality data from the *Corte Madera Watershed Resource*

Evaluation and Information Report (San Francisco Bay RWQCB 1994) can be used to infer the general state of water quality in Larkspur Creek based on proximity and similar geological, hydrologic, and land use characteristics. The study reports that the water quality of Corte Madera Creek is generally good, although there are some problems, primarily because of nonpoint source pollution.

The main existing water quality problems are erosion/siltation and presence of high coliform bacteria during the wet winter months. In addition, organic constituents from urban landscaping, metals, and chemicals from the drainage of swimming pools into the creek may be causing degradation of the creek's waters. Unauthorized diversion of water from the creek can also affect water quality by reducing already low summer flows. The *Water Quality Control Plan for the San Francisco Bay Basin* (San Francisco Bay RWQCB 1995) indicates that Corte Madera Creek provides the following beneficial uses:

< Cold freshwater habitat

< Preservation of rare and endangered species

< Noncontact water recreation

< Warm freshwater habitat (note that this habitat is found in different reaches of Corte Madera Creek than those reaches with cold freshwater habitat)

< Wildlife habitat

In addition, the Basin Plan indicates that the creek could potentially provide the following beneficial uses:

< Fish migration
< Water contact recreation
< Fish spawning

In addition to the Corte Madera Creek data, there are also unofficial water quality data from Larkspur Creek. With guidance from Friends of Corte Madera Creek Watershed (Friends of Corte Madera Creek Watershed 1999), the Exploratorium, and the California Department of Fish and Game (CDFG), students from four local schools undertook a water quality monitoring project to track selected water quality parameters in Corte Madera Creek and several of its tributaries. Students from Redwood High School monitored water depth, temperature, pH, dissolved oxygen, turbidity, and conductivity (i.e., salinity) in Larkspur Creek near Redwood High School five times between February and December 1997. Friends of Corte Madera Creek Watershed indicates in its monitoring summary that the data are inconclusive. Some of the data collected are outside of typical ranges or may not be representative of the creeks because of the students' inexperience with sampling techniques, inconsistency in the time of day monitoring was performed, and lack of dry-season data (Friends of Corte Madera Creek Watershed 1999).

Groundwater Hydrology

The geotechnical study for the Niven Nursery portion of the Specific Plan area (Harza Engineering Company 1998a) included eight boreholes to a maximum depth of 38 feet. The boring logs indicated that the groundwater table was encountered at depths between 3 and 20 feet below the ground surface. Most of the wells indicated stabilized groundwater levels at about 5 to 7 feet below the surface, corresponding to groundwater levels at about 0.0 to +3 feet NGVD. In general, shallow groundwater depths at approximately these elevations would be expected in the Specific Plan area. These shallow ground water depths would be consistent with the Specific Plan area's low relief and location adjacent to Corte Madera Creek, Larkspur Creek, and San Francisco Bay, where MTL is about 0.5 foot NGVD. The shallow groundwater depths result from precipitation in the watershed that infiltrates into the soil and gradually migrates downhill, intercepting Corte Madera Creek at an elevation of about mean sea level. Depth to the groundwater table increases gradually upstream of this lower boundary.

Groundwater Quality

In general, brackish groundwater conditions would be expected in the vicinity of the Specific Plan area. This would be consistent with the Specific Plan area's low elevation and location adjacent to tidal saltwater. The primary issues associated with groundwater quality relate to the potential presence of hazardous materials associated with prior or existing land uses on or adjacent to the Specific Plan area. These are described in Section 4.12, Hazardous Materials.

REGULATORY SETTING

Federal, state, and local agencies each may have a role in permitting development activities anticipated under the Specific Plan, depending on the nature of the development. These agencies and their potential permit requirements related to hydrology and water quality are discussed in this section.

Federal

Section 404 of the Clean Water Act

Waters of the United States (including wetlands) are subject to USACE jurisdiction under §404 of the federal CWA. Section 404 regulates the filling and dredging of waters of the United States. A §404 permit would be required for Specific Plan construction activities involving excavation of, or placement of fill material into, waters of the United States or adjacent wetlands. This regulation applies to Larkspur Creek on the south and east margins of the Specific Plan area. In reviewing §404 permit applications, USACE stresses avoidance of impacts, minimization of unavoidable impacts, and mitigation of unavoidable impacts. In addition, a water quality certification (or waiver thereof) from the appropriate state agency stating that the fill is consistent with the state's water quality standards and criteria, pursuant to §401 of the CWA, is required for §404 permit actions. This would need to be requested from the San Francisco Bay RWQCB. Additional environmental analysis, apart from this EIR

document, may be needed as a part of the §404 permit process. The Specific Plan does not anticipate any filling or dredging in the creek.

National Flood Insurance Program

FEMA has produced a FIRM for the City showing areas and elevations of 100-year flood hazard. FEMA requires that finished floor elevations for development within this 100-year flood area be equal to or greater than the 100-year flood elevation. Because the City has more stringent requirements than FEMA, the City's requirements will guide potential development (see below).

State

Sections 1601 and 1603

CDFG has direct jurisdiction, under California Fish and Game Code §§1601–1603, over any activities that would divert or obstruct the natural flow or change the bed, channel, or bank of any river, stream, or lake designated by CDFG in which there is at any time an existing fish or wildlife resource, or from which these resources derive benefit. This applies to Larkspur Creek on the south and east margins of the Specific Plan area. The Specific Plan does not propose any activities that would require a CDFG permit.

The California Fish and Game Code requires that CDFG be formally notified and that a subsequent agreement, including mitigation measures, be completed before such changes can be initiated. General project plans must be submitted to CDFG that are sufficient to indicate the nature of a project for construction if the project would divert, obstruct, or change a streambed; use material from the streambeds; or result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into a stream. The requirements of §1601 and §1603 are similar to those for the §404 permit, but the area of jurisdiction is typically defined on a case-by-case basis for the location, nature, and extent of disturbance, and mitigation.

Storm Water Pollution Prevention Plan

As mandated by the 1987 amendments to the federal CWA, discharge of stormwater from developed areas is regulated under the National Pollutant Discharge Elimination System (NPDES). In California, the State Water Resources Control Board (SWRCB) administers the NPDES program via the RWQCBs. In addition, the State Porter-Cologne Act requires the development of basin plans for drainage basins within California. The basin plans are also implemented through the NPDES program.

The San Francisco Bay RWQCB developed and maintains the *Water Quality Control Plan for the San Francisco Bay Basin* (San Francisco Bay RWQCB 1995). This plan includes objectives for the quality of surface waters in the region, including Corte Madera Creek. The plan includes

numerical and narrative objectives that "define the level of water quality that shall be maintained within the region."

The San Francisco Bay RWQCB seeks to reasonably control activities that will adversely affect beneficial uses of the waters within the region. To achieve the goals of the Water Quality Control Plan, the RWQCB, in collaboration with individual counties and cities, has developed regulatory programs to manage and reduce urban runoff pollutants. The most recent regulations derive from the 1999 U.S. Environmental Protection Agency (EPA) regulations under the CWA that require the SWRCB to issue NPDES permits for stormwater discharge. The initial application of the NPDES program (Phase I) applied to larger communities, and applied to projects more than 5 acres in size. The most recent application of the NPDES program (referred to as "Phase II," applying to small municipal separate storm sewer systems) applies to smaller communities, and specifically includes Marin county and the city of Larkspur; it requires permitting/management on sites greater than 1 acre in size. To comply with the RWQCB requirements and receive an NPDES permit for its stormwater system, each county and city must develop a compliance program. Part of this compliance program includes regulation of new development/redevelopment as proposed in the current Specific Plan. A more complete description of the regulations, permit applications, and description of the required management actions is available on the San Francisco Bay RWQCB website (<http://www.swrcb.ca.gov/rwqcb2/>).

Project applicants must submit a Notice of Intent (NOI) to the SWRCB to be covered by the Construction Activities Storm Water General Permit before they may initiate construction on sites that are 1 acre or larger. This requirement also applies to smaller sites that are part of a larger project. The General Permit requires the implementation of a SWPPP, which must be prepared before construction begins. The SWPPP must include:

< Specifications for BMPs that will be implemented during project construction to minimize the potential for accidental releases of pollutants or contamination, and to minimize runoff from the construction areas, including storage and maintenance areas and building materials handling areas.

< A description of a plan for communicating appropriate work practices to field workers.

< A plan for monitoring, inspecting, and reporting any release of hazardous materials.

< Specifications for BMPs that will be incorporated into the project itself to minimize runoff of pollutants after the project has been completed.

< A description of a plan to monitor stormwater runoff after the project has been completed.

Local

The practice of the City Department of Public Works and Engineering is to review any development plans for compliance with its storm drainage design criteria as a part of the design review process required prior to the issuance of Building Permits. The City

Department of Public Works also reviews development plans of certain types of projects (i.e., subdivision projects, projects that propose a total amount of either excavation or fill exceeding one thousand cubic yards) for compliance with the Grading Ordinance and the Subdivision Code and General Plan Action Program [12]: Require site plans to locate structures outside or above the 100-year flood zone wherever possible. Thus, all future development proposed within the Specific Plan area would be required to submit the engineering plans for storm drainage with their applications for development approval. For a description of the types of permits required, see Chapter 1, Introduction. Because the Specific Plan area is entirely within the city limits of Larkspur, additional review by the County Department of Public Works will not generally be necessary. The City's criteria specify that: (1) stormwater drainage facilities must pass the 25-year storm event, and (2) finished floor elevations must be at least 1 foot above the 100-year flood elevation. The City will also review any SWPPPs developed for construction activities in the Specific Plan area. The City may ask for assistance in this review from the County Department of Public Works if necessary (Hill, pers. comm., 2002).

4.4.2 ENVIRONMENTAL IMPACTS

THRESHOLDS OF SIGNIFICANCE

Implementation of the Specific Plan would have a significant impact on hydrology and water quality if it were to result in:

- exposure of people or structures to a high risk of loss, injury, or death involving flooding, including flooding as a result of failure of a levee or dam;
- placement of structures or improvements within a 100-year flood hazard area as mapped on the FEMA *Flood Insurance Rate Map* City of Larkspur, Marin County, California (Community Panel #065040 0001B) or any other flood hazard delineation map (the City also requires that finished floor elevations be at least 1 foot above the 100-year flood elevation);
- creation or contribution of runoff water that would exceed the capacity of an existing or planned stormwater drainage system;
- substantial alteration of the existing drainage pattern of the Specific Plan area, including the alteration of the course of either marine or fresh water, or a substantial increase in the rate or amount of surface runoff in a manner that would result in flooding onsite or offsite;
- the discharge of sediment or contaminants into surface water or wetlands, other adverse changes in surface water quality, or that could result in a violation of water quality standards or waste discharge standards;
- substantial degradation or depletion of groundwater supplies or substantial interference with groundwater recharge, lowering of the local groundwater table level, or changes in the direction or rate flow of groundwater; or

< the contamination of a public water supply or other substantial degradation of water quality.

PROJECT-LEVEL IMPACTS

Impact **4.4-1**

Potential Hazards from Tidal Flooding or Stormwater Flooding. *The area within the banks of Larkspur Creek adjacent to the Specific Plan area is mapped as below the 100-year flood elevation on the FIRM, and finished floor elevations are required to comply with the City's minimum requirements of 1 foot above the 100-year flood elevation of 6 feet NGVD. The rainfall flood events up to the 100-year event would be contained within the Larkspur Creek channel, thus the Specific Plan area would not be subject to the 100-year flood events. This impact is considered* ***less than significant****.*

Development in the Specific Plan area could potentially be subject to flood hazards from either tidal flooding (from Corte Madera Creek and Larkspur Creek) or stormwater flooding (from Corte Madera Creek or Larkspur Creek). As described above, FEMA and the City require the avoidance of stormwater flooding based on the 100-year storm event. While the risk of flooding from a greater storm event (e.g., 500-year storm event, with a 0.2% probability of occurring in any given year) exists, the likelihood of such an event is not typically deemed considerable for flood control purposes according to federal, State, and local laws and regulations.

The 100-year floodplain designation is assigned by FEMA to natural drainage channels (e.g., Larkspur Creek) and areas below the 100-year flood elevation that are connected to these channels either directly or by culverts or drainage channels that are known to FEMA at the time the FIRMs were done. The only part of the Specific Plan area and the immediate vicinity mapped by FEMA as below the 100-year flood elevation on the FIRM (FEMA 1984) is the area within the banks of Larkspur Creek adjacent to Specific Plan Subarea 3 (Exhibit 4.4-1). The 1989 BSI Consultants study indicates that the rainfall flood events up to the 100-year event are contained within the Larkspur Creek channel along the Specific Plan area. Thus, the Specific Plan area is not part of the jurisdictional floodplain.

However, there are a number of culverts and drainage ditches, which connect the Specific Plan area to Larkspur Creek and Corte Madera Creek, that were presumably not known to FEMA and thus not considered during the FIRM mapping process. During severe storm events, including the 100-year flood event, these culverts and drainage ditches may allow flood waters to flow into portions of the Specific Plan area that are below the 100-year flood elevation. Thus, localized flooding occurs in the Specific Plan area, although these areas are not mapped by FEMA as within the jurisdictional floodplain.

Because the Specific Plan specifies a minimum building setback of at least 25 feet from the top of the bank of Larkspur Creek, (Land Use Standard 16 [Standard for Buffer Width] and Community Design Standard 65 [Creek Setback]), and as all finished floor elevations within the Specific Plan area are required to comply with the City's minimum requirements of 1 foot above the 100-year flood elevation of 6 feet NGVD, future development in the Specific Plan area is not expected to be flooded during a 100-year storm or tidal event. Building

construction in the Specific Plan area would be required to comply with the City's Building Codes, including building standards (i.e., anchoring, flood damage-resistant materials, flood proofing) designed to minimize flood hazards.

Impact **4.4-2**

Increased Flood Hazards to Downstream Areas from Rainfall Runoff. *The Specific Plan area does not contribute significantly to offsite flooding through surface runoff because the storm drains originating within the area drain directly to adjacent tidal creeks and channels, where flood hazards are controlled primarily by tidal water elevations. In addition, much of the Specific Plan area is already developed, and the additional development proposed in the Specific Plan is unlikely to significantly increase surface runoff. This impact is considered* ***less than significant****.*

Development in the Specific Plan area could increase rainfall runoff from the area, increasing flood hazards to downstream areas. In general, however, the Specific Plan area is relatively small (approximately 2% of the watershed area), and this type of potential impact is more cumulative in nature. In particular, the Specific Plan area does not contribute significantly to offsite flooding through surface runoff because the storm drains originating within the area drain directly to adjacent tidal creeks and channels, where flood hazards are controlled primarily by tidal water elevations. In addition, much of the Specific Plan area is already developed with a majority of land covered by impervious surface. Furthermore, Policy 12 (Subarea 3 Drainage Improvements) directs the City to receive stormwater in detention areas before it is discharged into Larkspur Creek. As such, the additional development proposed in the Specific Plan is unlikely to significantly increase surface runoff.

To confirm this conclusion, calculations were made of peak storm runoff from the two onsite drainage areas that currently contain a significant degree of pervious area. Calculations were made both of current conditions and of worst-case future conditions, where the drainage areas were completely covered with impervious surfaces. This was done for the 100-year runoff event using the rational method based on the guidelines in the County Department of Public Works' *Hydrology Manual Simplified Instructions* (Marin County Department of Public Works 2000). The potential increase in surface runoff from implementation of the Specific Plan was calculated. The estimation technique, parameters, and results are shown in Table 4.4-2. The maximum potential increase, approximately 5 cfs, is less than 0.4% of the peak 100-year discharge in Larkspur Creek (to which the two drainage areas drain) of 1,463 cfs (BSI Consultants, Inc., 1989). This is consistent with the conclusion in the 1998 BKF study (BKF 1998). Due to the small contribution of stormwater runoff from the Specific Plan area under paved conditions and because downstream flood hazards are controlled primarily by tidal water elevations, this impact is considered less than significant.

Impact **4.4-3**

Exceedance of Capacity of Existing Onsite or Adjacent Drainage System. *There is evidence that the existing stormwater drainage facilities that service the Specific Plan area are insufficient. However, under the Specific Plan, the East Ward Street culvert and the culvert at the northeastern corner of Subarea 3 under Doherty Drive would both be upgraded, and various BMPs would be implemented to reduce the overall quantity of stormwater and its impact on site drainage facilities. Required design of facilities would need to meet the 25-year flood event criteria. This impact is considered* ***less than significant****.*

Table 4.4-2
Runoff Calculations—Rational Method

Runoff coefficient C					
pervious	0.70				
impervious	0.95				
Rainfall data					
Zone C-2					
L_{60} (in)	1.3				
Q10/Q100	0.715				
Parameter		Existing NE (A)	Existing SE (B)	Fully Paved NE (A)	Fully Paved SE (B)
Total Area (acres)		2.65	2.42	2.65	2.42
Impervious Area (acres)		1.25	0.00	2.65	2.42
Pervious Area (acres)		1.40	2.42	0.00	0.00
Composite C		0.82	0.70	0.95	0.95
% Impervious			47%	0%	100%
Longest Run (feet)		490	410	490	410
Delta Elevation (feet)		6	6	6	6
Slope (feet/feet)		0.012	0.015	0.012	0.015
Tc (minutes)		16	18	11	10
100 I_{tc}* (inches per hour)		2.40	2.29	2.85	2.97
Q100/A (cfs per acre)		1.96	1.60	2.71	2.82
Q100 (cfs)		5.20	3.88	7.17	6.83
10y I_{tc}* (inches per hour)		1.72	1.64	2.04	2.12
Q10/A (cfs per acre)		1.40	1.15	1.94	2.02
Q10 (cfs)		3.72	2.77	5.13	4.88
		NE (A)	SE (B)	Total	
Increase in flow, existing to fully paved (cfs)		1.97	2.95	4.92	

Note: This table provides a comparison of existing conditions vs. fully paved conditions for the two drainage areas (A and B in Exhibit 4.4-2) at the eastern end of the Specific Plan area. Using fully paved conditions provides a worst-case estimate of increase in runoff from those two parcels; all other parcels would have significantly less potential for an increase in runoff.

Sources: Runoff coefficient (pervious), rainfall data, time of concentration equation: Marin County Department of Public Works 2000

Runoff coefficient (impervious): U.S. Army Corps of Engineers 1994

Impervious area: from Exhibit 4.4-2 (source: Zander and Associates)

Slope: Thomas Cooke, pers. comm. – maximum for whole site, conservative for each segment as used in this analysis

I_{tc} = intensity of rainfall, in inches per hour, from Chart K Zone C in Marin County Department of Public Works 2000

Source: PWA 2003

As noted in Existing Setting above, there is evidence that the existing stormwater drainage facilities that service the Specific Plan area are insufficient. If these conditions were not changed as part of the development that occurs under the Specific Plan, this problem could persist. Future Specific Plan development that drains to these facilities could exacerbate the existing deficiencies. The Specific Plan includes several components to improve drainage conditions. These include the following:

< upgrading the 32-inch-diameter East Ward Street culvert to 42 inches (see "Stormwater Drainage" in Chapter 6, Utilities, of the Specific Plan);

< upgrading the culvert at the northeastern corner of Subarea 3 under Doherty Drive to 42 inches (see "Stormwater Drainage" in Chapter 6, Utilities, of the Specific Plan); and

< implementing various BMPs designed to reduce the runoff of contaminants from the Specific Plan area during storms, which would also reduce the overall quantity of stormwater and its impact on site drainage facilities (Utilities Policy 11 [Pollutants]).

Typically, storm drain facilities are designed for the 25-year flood event. According to the City, required design of facilities would need to pass the 25-year flood event (Hill, pers. comm., 2002), and drainage plans would have to be reviewed and approved by the City Engineer or the Director of Public Works prior to the issuance of permits (see Applicable Regulations above). This impact is considered less than significant.

Impact **4.4-4**

Resource Degradation Resulting from Contribution of Sediments or Contaminants to Freshwater or Wetland Areas. *Construction of future development projects within the Specific Plan area has the potential to generate significant quantities of sediment from grading activities as well as petroleum hydrocarbons from equipment operation, fueling, and maintenance. In the longer term, increased motor vehicle use from future development could increase runoff of vehicle-associated pollutants such as fuel hydrocarbons, other automotive fluids, and brake pad material. Because pollutant or sediment transport to Larkspur Creek or directly to offsite tidal creeks could increase, this impact is considered* ***potentially significant****.*

Surface water runoff from the Specific Plan area could potentially convey sediment and various contaminants from the Specific Plan area to Larkspur Creek, or other associated tidal/wetland systems downstream of the Specific Plan area. This potential impact is considered over two separate timeframes: during project construction and in the long term (post construction).

Construction of future development projects within the Specific Plan area has the potential to generate significant quantities of sediment from grading activities as well as petroleum hydrocarbons from equipment operation, fueling, and maintenance. Most of the development projects in the Specific Plan area would involve areas larger than 1 acre in size, and thus, a SWPPP would need to be prepared and implemented pursuant to the general NDPES permit for construction sites (see Applicable Regulations above). The SWPPP would need to include stormwater quality BMPs that would reduce runoff of pollutants during construction to the extent feasible and required by the RWQCB.

Operational activities associated with the future development in the Specific Plan area would also generate pollutants. Typically, runoff from lowland urban areas contains pollutants including sediment, nutrients, oxygen-demanding substances, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. According to the SWRCB, suspended sediments constitute the largest mass of pollutant loadings from urban runoff. Automobiles are the source of most petroleum hydrocarbon contamination. Fertilizers, pet wastes, faulty septic tanks, and organic yard waste are significant sources of nutrients and bacterial pollutants. Many of the pollutants entering California's waterways arrive via untreated stormwater runoff. Often the "first flush" of runoff from storms immediately following the dry summer and fall months is likely to contain high levels of contaminants that have accumulated during the extended period without surface runoff.

Regarding the scale of this potential impact, much of the Specific Plan area is already developed with urban land uses. As a result, the redevelopment of the area to the range of land use activities allowed by the Specific Plan would not result in a major increase in the runoff of many categories of pollutants from the Specific Plan area. However, increased motor vehicle access would accompany new development under the Specific Plan. This increased vehicle use has the potential to increase runoff of vehicle-associated pollutants such as fuel hydrocarbons, other automotive fluids, and brake pad material. These pollutants can be managed through implementation of postconstruction stormwater quality BMPs required in the SWPPP for each project involving more than 1 acre of land (see Applicable Regulations above).

Some of the postconstruction features that may be included in the SWPPP are already incorporated into the Specific Plan (Policy 69 [Storm Water]). These include treatment control features like permeable parking areas and driveways that are set in sand beds (Standard 72 [Driveways and Parking Areas]), onsite grass/vegetated swales (Standard 73 [Grassy Swales]) and detention basins (Standard 74 [Stormwater Detention]), that detain the first flush of stormwater and allow pollutants to filter or settle out before discharge into Larkspur Creek (Utilities Policy 12 [Subarea 3 Drainage Improvements]). In addition, the SWPPP should include appropriate source control BMPs that reduce the generation of pollutants from activities such as lawn maintenance, vehicle use, fueling and maintenance, material storage, and waste collection and recycling. In particular, to address increased motor vehicle access and the continued presence of a gas station, the use of filters to remove petroleum distillates would be evaluated in the BMP selection process.

Because not all potential projects in the Specific Plan area may require the preparation of SWPPP, pollutant or sediment transport to Larkspur Creek or directly to offsite tidal creeks could increase; this impact is considered potentially significant.

Impact **4.4-5**

Temporary Lowering of Groundwater Table and Potential Increase in Salinity. *Implementation of the Specific Plan would not alter the regional or local groundwater table elevations on a long-term basis or lead to significant impacts on groundwater recharge or flow direction. However, construction period dewatering activities could result in a temporary lowering of the water table. Prolonged pumping and lowering of the water table could result in some increase in salinity if it allowed tidally influenced water to migrate toward the Specific Plan area. This impact is considered* ***potentially significant****.*

As discussed in Existing Setting above, levels of groundwater underneath the Specific Plan area are governed by regional processes of rainfall infiltration throughout the watershed, overall down-watershed groundwater migration, and downstream tidal water control of the groundwater table elevation. Implementation of the Specific Plan would not alter the regional or local groundwater table elevations on a long-term basis. The majority of the Specific Plan area is developed and paved (i.e., greenhouses with paved floors, driveways, buildings). Development of the Specific Plan area would convert a maximum of 3.82 acres of pervious surface into impervious area. This represents only approximately 0.22 percent of the total Ross Valley Groundwater Basin area of 1,765 acres (DWR, 2003). On a regional basis, existing land uses and land uses proposed in the Specific Plan would not differ substantially in the amount of impervious surface; therefore, substantial changes in infiltration rates to groundwater are not expected as a result of Specific Plan implementation. In addition, the current water supply through the Marin Municipal Water District (MMWD) would be maintained under the Specific Plan, precluding the need to construct new wells to pump groundwater. As a result, implementation of the Specific Plan would not lead to significant impacts on groundwater levels, recharge, or flow direction in the area.

Construction period dewatering activities associated with individual project elements, however, could result in a temporary lowering of the water table in the immediate vicinity. Prolonged pumping and lowering of the water table could result in some increase in salinity if it allowed tidally influenced water to migrate toward the Specific Plan area. This impact is considered potentially significant.

Impact **4.4-6**

Degradation of Groundwater Quality. *Substantial changes in recharge rates to groundwater are not expected as a result of Specific Plan implementation. During construction and operation of the projects in the Specific Plan area, pollutants generated by equipment, vehicles, and urban land uses may infiltrate the ground and degrade groundwater quality. This impact is considered* ***potentially significant****.*

As discussed under Groundwater Hydrology above, significant changes in recharge rates to groundwater are not expected as a result of Specific Plan implementation. During construction, petroleum hydrocarbons from equipment operation, fueling, and maintenance may infiltrate the ground. Once occupied, the permitted commercial and residential uses would generate pollutants, including fertilizers, pet wastes, and organic yard wastes. Vehicles may also generate petroleum hydrocarbons. These pollutants may infiltrate the ground and degrade groundwater quality. While the Specific Plan area contains existing uses that already generate these pollutants, additional development permitted by the Specific Plan may increase the amount of pollutants generated.

Source control BMPs that would be implemented through the SWPPP, which is required for some projects that may occur in the Specific Plan area, would minimize pollutant infiltration to the extent practicable. However, not all projects that would be permitted in the Specific Plan would be required to prepare and implement SWPPP. The Specific Plan may result in an increase in the amount of pollutants that may infiltrate the ground and degrade groundwater quality; thus this impact is potentially significant.

Please also refer to Section 4.12, Hazards and Hazardous Materials, for impact analysis and mitigation for existing groundwater contamination in the Specific Plan area.

CUMULATIVE IMPACTS

The potential for addition of urban runoff to adjacent receiving waters (described above as Impact 4.4-4, Resource Degradation Resulting from Contribution of Sediments or Contaminants to Freshwater or Wetland Area) is considered a significant cumulative impact. The Specific Plan area represents approximately 2% of the Larkspur Creek watershed. Adverse water quality conditions in the adjacent streams result from human activities throughout the entire Larkspur Creek watershed. In addition, adverse water quality conditions in Corte Madera Creek result from the combined activities throughout the much larger watershed. Potential pollutants from the Specific Plan area represent a small contribution to the larger scale source of urban and construction-period impacts. Nonetheless, the Specific Plan area would contribute incrementally to an existing impact; therefore, this cumulative impact is considered significant.

Additional development in the city would contribute additional pollutants that may infiltrate into the groundwater in the region. The Specific Plan area represents approximately 1.25 percent of the total Ross Valley Groundwater Basin area of 1,765 acres (DWR, 2003). As such, degradation of groundwater quality (described above as Impact 4.4-6) is a considered a significant cumulative impact.

Impact 4.4-5, Temporary Lowering of Groundwater Table and Potential Increase in Salinity, would not be a significant cumulative impact due to the short duration of the construction dewatering activities and the lack of development adjacent to the Specific Plan area that may contribute to this impact.

4.4.3 MITIGATION MEASURES

PROJECT-LEVEL MITIGATION MEASURES

No mitigation measures are required for the following less-than-significant impacts.

4.4-1: Potential Hazards from Tidal Flooding or Stormwater Flooding

4.4-2: Increased Flood Hazards to Downstream Areas from Rainfall Runoff

4.4-3: Exceedance of Capacity of Existing Onsite or Adjacent Drainage System

The following mitigation measures are recommended for potentially significant impacts.

Impact 4.4-4 mitigation

Resource Degradation Resulting from Contribution of Sediments or Contaminants to Freshwater or Wetland Areas.

Implement MM 4.3-3

The City shall include the following new policy in the Specific Plan.

New Policy: The City shall require implementation of Mitigation Measure 4.3-3, Prepare and Implement SWPPP, to reduce the contribution of sediments or contaminants to freshwater and wetland areas.

Impact 4.4-5 mitigation

Temporary Lowering of Groundwater Table and Potential Increase in Salinity.

Implement Groundwater Testing Program in Conjunction with Dewatering

The City shall include the following new policy in the Specific Plan.

New Policy: A groundwater testing program shall be implemented in conjunction with any dewatering of the Specific Plan area. This program shall include measures to ensure that dewatering for construction will not result in salinity intrusion. Any water removed during dewatering shall be stored and tested for residual contamination consisting of metals or chlorinated pesticides before disposal.

Impact 4.4-6 mitigation

Degradation of Groundwater Quality.

Implement Mitigation Measures 4.4-3 and 4.4-5

The City shall include the following new policy in the Specific Plan.

New Policy: The City shall require implementation of Mitigation Measure 4.4-3, Prepare and Implement SWPPP, and Mitigation Measure 4.4-5, Implement Groundwater Testing Program in Conjunction with Dewatering, for all development in the Specific Plan area in order to reduce the increase in pollutants conveyed to the groundwater table to a less-than-significant level and ensure that site dewatering for construction will not result in groundwater quality impacts.

CUMULATIVE MITIGATION MEASURES

With implementation of Mitigation Measures 4.4-4, 4.4-5, and 4.4-6, the Specific Plan's contribution to potential cumulative impacts would be less than significant.

4.4.4 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Following implementation of the above mitigation measures, all impacts related to hydrology and water quality would be less than significant.