Lotus Ranch Technical Study

# Hydrology and Water Quality

## Introduction

This technical study provides a detailed discussion of the hydrology and water quality issues related to the proposed Lotus Ranch project (project) in the City of El Centro (City). This study includes a review of existing conditions based on available literature; a summary of local, state, and federal policies and regulations related to hydrology and water quality; and an analysis of direct, indirect, and cumulative environmental impacts of the project. Where feasible, mitigation measures are recommended to reduce the level of impacts.

## Impact Summary

The hydrology and water quality impacts are summarized in the Table HYD-1 below.

**Table HYD-1.** Hydrology and Water Quality Impact Summary

| Potential Impact | Level of Significance | Mitigation Measure | Level of Significance after Mitigation |
|---|---|---|---|
| HYD-1: Impacts to Surface Water Quality and Groundwater Quality Due to Construction-Related Earth Disturbing Activities and Construction-Related Hazardous Substances | Potentially significant | HYD-1: Comply with NPDES General Construction Permit and City's Stormwater Program<br>HYD-2: Implement a Spill Prevention and Control Program<br>HYD-3: Implement Measures to Maintain Groundwater or Surface Water Quality | Less than significant |

| Potential Impact | Level of Significance | Mitigation Measure | Level of Significance after Mitigation |
|---|---|---|---|
| HYD-2: Water Quality Impacts from Construction Below the Water Table | Potentially Significant | HYD-1: Comply with NPDES General Construction Permit and City's Stormwater Program<br>HYD-2: Implement a Spill Prevention and Control Program<br>HYD-3: Implement Measures to Maintain Groundwater or Surface Water Quality<br>HYD-4: Provisions for Dewatering | Less than significant |
| HYD-3: Impacts to Groundwater and Surface Water from Infrastructure Failure | Less than significant | No mitigation required | – |
| HYD-4: Increased Amount of Surface Runoff and Associated Impacts to Drainage Facilities | Potentially significant | HYD-5: Preparation of Drainage Report to City Standards<br>HYD-6: Implement Best Management Practices to Maximize Storm Water Quality | Less than significant |
| HYD-5: Decreased Groundwater Recharge | Less than significant | No mitigation required | |
| HYD-6: Flooding Hazards | Less than significant | No mitigation required | |
| HYD-7: Seiche, Tsunami, and Mudflow Hazards | Less than significant | No mitigation required | |
| HYD-8: Water Quality Impacts from Discharge to 303(d) Listed Surface Water Bodies | Cumulatively less than significant | No mitigation required | |

# Environmental Setting

The City of El Centro, California is located in Imperial County, approximately 15 miles north of the U.S.-Mexico border. The City currently encompasses 10.75 square miles and is surrounded by agriculture land uses. Its general topography is characterized as flat with a gentle slope from the southwest toward the northeast. The Lotus Ranch project occupies a 213-acre tract of land immediately southwest of the existing city limits. The site is bounded by Interstate-8 to the north, La Brucherie Road to the east, agricultural fields to the south, and Lotus Drain to the west. Surrounding land use is mostly agriculture with some residential development to the northeast and a high school across Interstate-8 to the north. Land use for the site currently is, and historically has been, agricultural. The proposed plan for the site includes 616 single-family residences and a possible elementary school.

# Methodology

## Literature Reviewed

The following literature was reviewed for analysis of hydrology and water quality issues related to the proposed Lotus Ranch project.

- California Department of Water Resources. 2003. California's Groundwater Bulletin 118, Individual Basin Descriptions—Imperial Valley Groundwater Basin.
- Colorado River Basin Regional Water Quality Control Board (RWQCB). 2005. The Water Quality Control Plan (Basin Plan) for the Colorado River Basin Region.
- Colorado River Basin Regional Water Quality Control Board (RWQCB). 2003. 2002 CWA Section 303(d) List of Water Quality Limited Segment. Approved by U.S. Environmental Protection Agency.
- City of El Centro. 2004. City of El Centro General Plan.
- City of El Centro. 2005. City of El Centro Retention Basin Standards.

# Existing Conditions

This section discusses the existing conditions relating to hydrology and water quality in the project study area. As necessary, the environmental setting discussion is divided into discussions of the individual components that compose the proposed project.

## General Climate

The project site and vicinity can be described as flat with a gentle slope from the southwest toward the northeast. El Centro has an arid, desert climate with an average annual temperature of 88 degrees Fahrenheit, ranging from average winter lows in the high 60's to average summer highs above 100 degrees. Annual average precipitation is 2.6 inches, with most rainfall occurring between August and March (Western Regional Climate Center 2005).

## Regional Hydrology

### Surface Water

Major hydrologic features of the region include the New and Alamo rivers, and the Central Main Canal, which flow north towards the Salton Sea. The rivers were formed in the mid to late 1800s when the Colorado River occasionally escaped the normal channel and flowed northward towards the present day Salton Sea (California Department of Water Resources 2003).

The primary land use in the Imperial Valley is agriculture. Almost all of the water used to irrigate Imperial Valley originates from the Colorado River. Local drainage patterns within the valley have been altered through agricultural activities. When irrigating, the field is flooded for several days at a time and agricultural runoff is collected via surface flow into an earthen swale that conveys runoff to a catch basin that is connected to the Imperial Valley Drains system. Water that percolates into the soil is high in salts, which is harmful to crops. A system of underground tile drains is used to drain subsurface water, thus protecting the crops. This tile drain system is connected to the Imperial Valley Agricultural Drains system. The Imperial Irrigation District (IID) maintains around 1,600 miles of irrigation drainage structures, which collect surface water runoff and subsurface drainage from some 32,200 miles of agriculture (tile) drains and channel the flow into the New and Alamo Rivers, which ultimately drain to the Salton Sea. The canals and laterals are generally often left open and unprotected.

El Centro is located in the Alamo River Watershed. The Alamo River conveys agricultural irrigation drainage water from farmlands in the Imperial Valley, surface runoff, and lesser amounts of treated municipal and industrial waste waters from the Imperial Valley to the Salton Sea. The City discharges runoff and treated wastewater into the Central Main Canal, located to the west of the city, which flows north before emptying into Alamo River.

The project site is bounded by Lotus Drain to the west. Lotus Drain flows into the Central Main Canal and ultimately discharges to the Alamo River. Lotus Drain is owned and operated by the IID. Lotus Drain is an open ditch that currently receives, and will continue to receive, runoff from the project site. There are three existing 12” connection points to Lotus Drain within the project site. In preparation for the Lotus Ranch development, the IID will place Lotus Drain in an underground pipe throughout the length of its alignment with the Lotus Ranch project.

## Water Quality

Surrounding land uses largely affect surface water quality, with both point- and nonpoint-source discharges contributing contaminants to surface waters. The major land use in the Imperial Valley, including the existing condition of the project site, is agriculture. This type of land use contributes pesticides, herbicides, nutrients, and sediment to receiving waters. The City of El Centro anticipates rapid growth of its urban Sphere of Influence over the next fifteen years. Pollutant sources in urban areas include parking lots and streets, rooftops, exposed earth at construction sites, and landscaped areas. Water quality impacts from construction are of particular concern. Grading for construction activity removes vegetation and exposes soil to wind and water erosion. The erosion can result in sedimentation that ultimately flows into surface waters. Urban runoff from streets and residences is also a potential source of sediment, hydrocarbons, metals, pesticides, bacteria, and trash.

Polluted runoff can result in adverse effects on aquatic ecosystems, public use, human health, damage to or destruction of wildlife habitat, decline in fisheries, and loss of recreational opportunities. High levels of nutrients may lead to eutrophication in water bodies. Suspended particulates can restrict light penetration into water and limit photosynthesis of aquatic biota. Metals and petroleum hydrocarbons washed from roadways and parking lots, as well as fertilizers, pesticides, and herbicides from landscaped areas, may cause toxic responses in aquatic life or contaminate possible water supply sources such as reservoirs and aquifers. Salts are also a pollutant of concern in the Imperial Valley due to their negative effects on crops.

Federal CWA Section 303(d) establishes the Total Maximum Daily Load (TMDL) process to assist in guiding the application of state water quality standards, requiring states to identify streams in which water quality is impaired (i.e., affected by the presence of pollutants or contaminants) and to establish the TMDL, or the maximum quantity of a particular constituent that a water body can assimilate without experiencing an adverse effect (RWQCB 2003). The Colorado River Basin RWQCB 2002 CWA Section 303(d) List Of Water Quality Limited Segments list identifies the Salton Sea as being impaired for nutrients, salt, and selenium. It also identifies both the Alamo River and Imperial Valley Agricultural Drains as being impaired for pesticides, sedimentation/siltation, and selenium. The Colorado River Basin RWQCB has approved a TMDL that addresses sedimentation and siltation in the Alamo River and Imperial Valley Agricultural Drains and is currently developing a TMDL to address nutrients in the Salton Sea. These TMDLs are discussed further in the regulatory section below. TMDLs to address other listed impairments to the Alamo River, Imperial Valley Agricultural Drains, and the Salton Sea have yet to be developed.

## Groundwater

The project is located within the Imperial Valley Groundwater Basin subbasin. The basin has two major aquifers, an upper and a lower, separated by a semi-permeable aquatard averaging 60 feet in thickness. Recharge to the aquifer is primarily from deep percolation of applied irrigation water and irrigation return flows. Other recharge sources are deep percolation of rainfall and surface runoff, underflow into the basin, and seepage from unlined canals which traverse the valley. The total storage capacity for the Imperial Valley Groundwater Basin subbasin basin is estimated to be 14,000,000 acre feet (af) (California Department of Water Resources 2003).

Principal areas of recharge from surface runoff are in the East Mesa and West Mesa, where the surface deposits are more permeable than in the central valley (Loeltz and others 1975). Primary underflow into the basin is from Mexicali Valley to the south and through the alluvial section between the Cargo Muchacho Mountains and Pilot Knob. Another area of groundwater recharge occurs along the lower reaches of the New River, near Calexico (California Department of Water Resources 2003).

Groundwater within the basin generally flows toward the axis of the valley and then northwestward towards the Salton Sea. Groundwater levels vary widely within the basin due to differing hydraulic heads and the localized confining clay beds in the area. Groundwater levels remained stable within the majority of the basin from 1970 to 1990 because of relatively constant recharge and an extensive network of subsurface drains (California Department of Water Resources 2003).

Groundwater quality varies extensively throughout the basin. Total dissolved solids (TDS) content ranges from 498 to 7,280 mg/L in the basin. Department of Health Services data from five public supply wells show an average TDS concentration of 712 mg/L and a range from 662 to 817 mg/L (California Department of Water Resources 2003).

In general, groundwater beneath the basin is unusable for domestic and irrigation purposes without treatment. TDS values typically exceeding 2,000 mg/L are reported from a limited number of test wells drilled in the western part of the basin. Groundwater in areas of the basin has higher than recommended levels of fluoride and boron (California Department of Water Resources 2003).

Approximately 7,000 acre feet per year (AFY) of groundwater recharge comes from the New River which drains the Mexicali Valley. This groundwater is related to surface flow in the highly polluted New River and negatively affects groundwater quality in the basin (California Department of Water Resources 2003). The New River is listed as impaired under the Clean Water Act section 303(d) for bacteria, dissolved oxygen, nutrients, pesticides, sedimentation/siltation, trash, and volatile organic compounds (VOCs).

According to the California Department of Water Resources, there are no groundwater wells located within the City of El Centro or within the project site. One groundwater well, located approximately two miles south of El Centro has a recorded groundwater depth of approximately 14.5 feet below ground level as measured in March of 1989.

## Flooding

Flooding occurs in varying degrees throughout Imperial County. Floodwaters rise either from sudden downpours or as a result of slow heavy precipitation. Surface levels of the Salton Sea fluctuate yearly but recent rising surface elevations are causing serious drainage problems in adjacent cultivated areas.

Most of the flat irrigated valley, with its low-lying canal/drain systems, is subject to minor, shallow flooding and ponding due to the lack of local topographic relief, occasional intense storm events, and low soil infiltration rates that produce rapid runoff flows. Development in the valley increases the amount of impervious surfaces and adds to the runoff that can result in downstream flooding. The IID currently limits the capacity of its drainage system in order to reduce downstream flooding potential from combined agricultural and storm runoff, and is in the process of preparing a Preliminary Master Drainage Plan.

The Federal Emergency Management Agency (FEMA) provides information on flood hazard and frequency for cities and counties on its flood insurance rate maps. FEMA identifies designated zones to indicate flood hazard potential. In general, flooding occurs along waterways, with infrequent localized flooding also occurring due to constrictions of storm drain systems or surface water ponding. The El Centro General Plan Safety Element identifies areas within the city's sphere of influence that are located in 100-year flood area. According to the General Plan, a small portion of land in the eastern part of the City has been identified as a 100-Year Flood Area and is subject to flooding. The project site is not located within this flood area and is not subject to flooding during the 100-year storm event.

# Regulatory Setting

This section discusses the federal, state, and local policies and regulations that are relevant to the analysis of hydrology and water quality in the proposed Lotus Ranch project area being considered by the City of El Centro.

## Federal Policies and Regulations

### Clean Water Act and Associated Environmental Compliance

The CWA is the primary federal law that protects the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. It operates on the principle that all discharges into the nation's waters are unlawful unless specifically authorized by a permit; permit review is the CWA's primary regulatory tool. There are several sections of the federal Clean Water Act (CWA) that pertain to regulating impacts on *waters of the United States*, which include oceans, bays, rivers, streams, lakes, ponds, and wetlands. The discharge of dredged or fill material into waters of the United States is subject to permitting specified under Title IV (Permits and Licenses) of the CWA and specifically under Section 404 of the act (Discharges of Dredge or Fill Material). Section 401 (Certification) specifies additional requirements for permit review, particularly at the state level.

The California State Water Resources Control Board (State Water Board) is the state agency with primary responsibility for implementation of state and federally established regulations relating to water resource issues. Typically, all regulatory requirements are implemented by the State Water Board through regional boards established throughout the state. The Colorado River Basin RWQCB is the agency responsible for regulating discharges to the Salton Sea and its tributaries, including Alamo River and Imperial Valley Agricultural Drains.

## Section 303 – Total Maximum Daily Loads

The State of California adopts water quality standards to protect beneficial uses of state waters as required by Section 303 of the CWA and the Porter-Cologne Water Quality Control Act of 1969 (Porter-Cologne). Section 303(d) of the CWA established the TMDL process to guide the application of state water quality standards (see discussion of state water quality standards below). To identify candidate water bodies for TMDL analysis, a list of water quality-limited streams was generated and last approved by the USEPA in 2003. The streams on the list are impaired by the presence of pollutants, including sediment, and are therefore more sensitive to disturbance. For the project area, the USEPA has approved a TMDL and implementation plan for sedimentation/siltation in the Alamo River. The USEPA has yet to approve a sedimentation/siltation TMDL for the Imperial Valley Agricultural Drains (RWQCB 2005a). The RWQCB is currently developing a nutrient TMDL for the Salton Sea (RWQCB 2006). TMDLs are enforced through CWA Section 402 NPDES permits and issuance of Waste Discharge Requirements (WDRs) under Porter-Cologne.

**Sedimentation/Siltation TMDL for the Alamo River** The TMDL report for sedimentation/siltation in the Alamo River was developed by the RWQCB and approved by the State Office of Administrative Law on May 3, 2002. It was then approved by the U.S. EPA on June 28, 2002. As stated in the TMDL report, the main sources of suspended sediment and siltation in the Alamo River are agricultural return flows discharged into the river via agricultural drains operated and maintained by the Imperial Irrigation District (RWQCB 2002). The numeric target established by this TMDL is an annual average instream total suspended solids concentration of 200 milligrams per liter, applying along the entire length of the Alamo River. This target corresponds to about a 50% reduction of current annual mean suspended solids concentration in the Alamo River at its outlet, where concentrations are the highest. The total sediment load to the Alamo River corresponding to the numeric target is approximately 175,000 tons per year. This total load is then allocated among the sources of sediment to the River. The load allocations contain a margin of safety to account for data uncertainty and are established for all drains discharging to each of six reaches of the River, as well as for natural sources. The TMDL implementation plan includes actions that agricultural dischargers must take to achieve the necessary reductions in sediment loading; a time schedule for action by the responsible parties; and monitoring and surveillance requirements to track the progress towards TMDL targets.

## CWA Permits for Fill Placement in Waters and Wetlands

CWA, Section 404 regulates the discharge of dredged and fill materials into waters of the United States. Project proponents must obtain a permit from the U.S. Army Corps of Engineers (Corps) for all discharges of dredged or fill material into waters of the United States, including wetlands, before proceeding with a proposed activity. Before any actions that may impact surface waters are carried out, a delineation of jurisdictional waters of the United States must be completed, following Corps protocols in order to determine whether the project area encompasses wetlands or other waters of the United States that qualify for CWA protection. These include any or all of the following:

- Areas within the ordinary high water mark of a stream, including non-perennial streams with a defined bed and bank and any streamchannel that conveys natural runoff, even if it has been realigned.
- Seasonal and perennial wetlands, including coastal wetlands.

*Wetlands* are defined for regulatory purposes as areas "inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3, 40 CFR 230.3).

CWA, Section 404 permits may be issued only for the least environmentally damaging practicable alternative. That is, authorization of a proposed discharge is prohibited if there is a practicable alternative that would have less adverse impacts and lacks other significant adverse consequences. If the project proponent intends on discharging any fill material, then this permit would be applicable to ensure the least environmentally damaging alternative.

## CWA Permits for Discharge to Surface Waters

CWA, Section 402 regulates discharges to surface waters through the National Pollutant Discharge Elimination System (NPDES) program, administered by the U.S. Environmental Protection Agency (EPA). In California, the State Water Board is authorized by the EPA to oversee the NPDES program through the RWQCBs (see related discussion under *Porter-Cologne Water Quality Control Act* below). The NPDES program provides for both general permits (those that cover a number of similar or related activities) and individual permits.

### Construction Activities

Most construction projects that disturb one acre of land or more are required to obtain coverage under the NPDES General Permit for Construction Activities (General Construction Permit), which requires the applicant to file a public notice of intent to discharge stormwater and to prepare and implement a storm water pollution prevention plan (SWPPP). The SWPPP includes a site map and a description of proposed construction activities, along with demonstration of compliance with relevant local ordinances and regulations, and an overview of the best management practices (BMPs) that would be implemented to prevent soil erosion and discharge of other construction-related pollutants that could contaminate nearby water resources. Permittees are further required to conduct annual monitoring and reporting to ensure that BMPs are correctly implemented and effective in controlling the discharge of stormwater-related pollutants. The project proponent would need to obtain the NPDES General Construction Permit prior to any construction activities exceeding one acre.

#### Dewatering Activities

Small amounts of construction-related dewatering are covered under the General Construction Permit. However, the RWQCB should be consulted and may require that an individual NPDES permit and Waste Discharge Requirement (WDR) be obtained for dewatering activities.

#### Municipal Stormwater Runoff

The City of El Centro applied for a municipal stormwater permit in 2003 and is currently awaiting issuance of a permit by the Colorado River Basin RWQCB (Heinz 2005).

### CWA Water Quality Certification

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate, or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect the quality of the state's waters (including projects that require federal agency approval, such as issuance of a Section 404 permit) must also comply with CWA Section 401. Section 401 certification or waiver is under the jurisdiction of the RWQCB.

# State Policies and Regulations

## Porter-Cologne Water Quality Control Act of 1969

The Porter-Cologne act established the State Water Board and divided the state into nine regional basins, each with an RWQCB. The SWRCB is the primary state agency responsible for protecting the quality of the state's surface and groundwater supplies.

Porter-Cologne authorizes the State Water Board to draft state policies regarding water quality in accordance with Section 303 of the CWA. In addition, Porter-Cologne authorizes the State Water Board to issue WDRs for projects that would discharge to state waters. Porter-Cologne requires that the State Water Board or the RWQCB adopt water quality control plans (basin plans) for the protection of water quality. A basin plan must:

- identify beneficial uses of water to be protected,
- establish water quality objectives for the reasonable protection of the beneficial uses, and
- establish a program of implementation for achieving the water quality objectives.

Basin plans also provide the technical basis for determining waste discharge requirements, taking enforcement actions, and evaluating clean water grant proposals. Basin plans are updated and reviewed every 3 years in accordance with Article 3 of Porter-Cologne and Section 303(c) of the CWA. The Colorado River Basin RWQCB, which has jurisdiction over the project area, adopted the most recent amendments to the basin plan in October 2005.

## Colorado River Basin Regional Water Quality Control Board Basin Plan

Water quality in streams and aquifers of the region is guided and regulated by the Colorado River Basin Regional Water Quality Control Board Water Quality Control Plan (Colorado River Basin RWQCB Basin Plan) for the Colorado River Basin – Region 7 (Colorado River Basin Regional Water Quality Control Board 2005). State policy for water quality control is directed at achieving the highest water quality consistent with the maximum benefit to the people of the state. To develop water quality standards consistent with the uses of a water body, the Colorado River Basin RWQCB attempts to classify historical, present, and future beneficial uses as part of its basin plan.

As identified by the Colorado River Basin RWQCB Basin Plan, Imperial Valley Drains have existing beneficial use for freshwater replenishment, water contact recreation, non-contact water recreation, warm freshwater habitat, wildlife habitat, and preservation of rate, threatened, or endangered species. Alamo River has the same existing beneficial uses as Imperial Valley Drains and a potential beneficial use for hydropower generation. The Salton Sea has existing beneficial uses of aquaculture, water contact recreation, non-contact water recreation, warm freshwater habitat, wildlife habitat, and preservation of rate, threatened, or endangered species. The Salton Sea has potential beneficial uses for industrial service supply.

Water quality objectives for all waters in the region have been established for tainting substances, toxicity, temperature, pH, dissolved oxygen, suspended solids and settleable solids, total dissolved solids, bacteria, biostimulatory substances, sediment, turbidity, radioactivity, chemical constituents, and pesticide wastes. Specific water quality objectives identified for the Salton Sea total dissolved solids and selenium. Water quality objectives identified for Irrigation Supply Canals address proper application of herbicides in canals.

Wherever the existing quality of water is better than the quality established by the Colorado River Basin RWQCB Basin Plan as objectives, such existing quality must be maintained unless otherwise exempted by the Colorado River Basin RWQCB.

# Local Policies and Regulations

## City of El Centro General Plan 2004

Within the General Plan there are three elements containing policies related to hydrology and water quality: the Conservation/Open Space Element; the Public Facilities Element and accompanying Implementation Program; and the Safety Element and accompanying Implementation Program.

***Conservation/Open Space Element***

**National Pollutant Discharge Elimination System (NPDES).** Under the NPDES storm water permit issued to the City of El Centro, all development and significant redevelopment must be implemented with runoff pollution control measures known as Best Management Practices (BMPs). Proposed development projects (both public and private) within El Centro must incorporate structural and non-structural BMPs to preclude significant water quality impact from non-point source pollutants.

**Conservation/Open Space Goal 2:** Maintain and improve the quality of water used by the City and surrounding agricultural areas.

> **Policy 2.2:** Promote water conservation by El Centro residents, businesses, agriculture, and government to reduce overall demand for water.

**Conservation/Open Space Goal 6:** Direct future urban growth and expansion of the City to minimize hazards from areas requiring special management and/or separation from other land uses, such as seismic fault zones, unstable soil areas, flood plains, and areas required for protection of water quality.

> **Policy 6.2:** Develop controls to restrict access to the irrigation canal system, especially adjacent to residential areas.

> **Policy 6.3:** Monitor and control agricultural activities within the City, such as pesticide and crop dusting adjacent to residential areas.

***Public Facilities Element Implementation Program***

**PF-12: Improve Surface Water Quality:** Reduce pollutants in urban runoff, by requiring new development projects and substantial rehabilitation projects to incorporate Best Management Practices pursuant to the National Pollutant System Discharge Elimination System Permit (NPDES) to ensure that the City complies with applicable State and federal regulations.

**PF-14: Water Quality Education:** Coordinate in the development and implementation of a public education program to inform the public of the harm caused by pollutants and litter that can be carried on the surface of land to the drainage systems, creeks, rivers, groundwater, and Salton Sea.

***Safety Element***

**Policy 2.5:** Require all proposed development projects to submit a hydrological analysis of a project's expected runoff that will enter the City's drainage system, as well as the cumulative impact of the project and surrounding development (existing and planned) on the drainage system and flood prone areas.

**Policy 2.6:** Avoid new development that would create runoff volumes or velocities that may cause the City's existing drainage system to exceed its design capacity until appropriate site design and mitigation steps are taken.

***Safety Element Implementation Program***

**S-6: Storm Drainage Facilities:** Enforce the City's Public Works Standards, which give specific requirements for design of drainage facilities to ensure that they are properly sized to handle storm runoff and flash floods. Require new development to provide adequate flood control facilities, if needed, to control runoff generated by the project. Identify new public and private funding sources to fund needed improvements.

# Impact Analysis

## Significance Thresholds

For the purposes of this analysis, an impact pertaining to hydrology and water quality was considered significant if it would result in any of the following, which are based on professional practice and Appendix G of the CEQA Guidelines (14 CCR 15000 et seq.).

- Substantial alteration in the quantity or quality of surface runoff.
- Substantial degradation of water quality; violation of any water quality standards or waste discharge requirements.
- Substantial alterations of the existing drainage pattern of the site area, such that flood risk and /or erosion and siltation potential would increase.
- Placement of structures that would impede or redirect flood flows within a 100-year floodplain.
- Exposure of people, structures, or facilities to significant risk from flooding, including flooding as a result of the failure of a levee or dam.
- Creation of, or contribution to runoff that would exceed the capacity of an existing or planned stormwater management system.
- Substantial reduction in groundwater quantity or quality.
- Exposure of people, structures, or facilities to significant risk from seiche, tsunami, or mudflow.

# Assessment Methodology

The evaluation of hydrology and water quality effects is based on professional standards and the conclusions of technical reports prepared for the project area. The key effects were identified and evaluated based on the physical characteristics of the project study area and the magnitude, intensity, and duration of activities. It is assumed that the Lotus Ranch project would conform to City building standards, grading permit requirements, and erosion control requirements.

# Impacts and Mitigation Measures

## Short-Term Impacts

### Impact HYD-1: Impacts to Surface Water Quality and Groundwater Quality Due to Construction-Related Earth Disturbing Activities and Construction-Related Hazardous Substances (Less than Significant with Mitigation)

Construction-related earth disturbing activities would occur as part of the development of the Lotus Ranch project. These activities could cause soil erosion and sedimentation to local waterways.

Construction of new sewer pipelines and grading activities would require heavy equipment such as earth moving devices. Large trucks would be used to transport construction materials to or from the site. Such machines have potential to leak hazardous substances such as oil and gasoline. In addition, improper use of fuels, oils, and other construction-related hazardous substances, such as pipe sealant, may also pose a threat to surface or groundwater quality. These impacts are considered potentially significant. Implementation of the mitigation measures described below would ensure that impacts would be lowered to **less than significant** levels.

#### Mitigation Measure HYD-1: Comply with NPDES General Construction Permit and City's Stormwater Program

To reduce or eliminate construction-related water quality impacts, before onset of any construction activities, the City of El Centro shall require that construction contractors shall obtain coverage under the NPDES General Construction Permit and comply with the construction requirements of the City's Stormwater Program. The City of El Centro will be responsible to ensure that construction activities comply with the conditions in the permit and program, which will require development of a SWPPP, implementation of BMPs identified in the SWPPP, and monitoring to ensure that effects on water quality are minimized.

As part of this process, the City of El Centro will require the implementation of multiple erosion and sediment control BMPs in areas with potential to drain to surface water. These BMPs will be selected to achieve maximum sediment removal and represent the best available technology that is economically achievable. BMPs to be implemented as part of this mitigation measure may include, but are not limited to, the following measures.

- Temporary erosion control measures (such as silt fences, staked straw bales/wattles, silt/sediment basins and traps, check dams, geofabric, sandbag dikes, and temporary revegetation or other ground cover) will be employed to control erosion from disturbed areas.
- Drainage facilities in downstream offsite areas will be protected from sediment using BMPs acceptable to the County and the RWQCB.
- Grass or other vegetative cover will be established on the construction site as soon as possible after disturbance.

Final selection of BMPs will be subject to review by the City. The City will verify that a notice of intent (NOI) and a SWPPP have been filed before allowing construction to begin. The City or its agent shall perform routine inspections of the construction area to verify that the BMPs specified in the SWPPP are properly implemented and maintained. The City will notify contractors immediately if there is a noncompliance issue and will require compliance.

#### Mitigation Measure HYD-2: Implement a Spill Prevention and Control Program

The City of El Centro will require that development contractors develop and implement a spill prevention and control program to minimize the potential for, and effects from, spills of hazardous, toxic, or petroleum substances during construction activities for all contractors. The program shall be completed before any construction activities begin. Implementation of this measure will comply with state and federal water quality regulations and reduce the impact to a less-than-significant level.

The City shall review and approve the spill prevention and control program before onset of construction activities. The City will routinely inspect the construction area to verify that the measures specified in the spill prevention and control program are properly implemented and maintained. The City will notify contractors immediately if there is a noncompliance issue and will require compliance.

The federal reportable spill quantity for petroleum products, as defined in the EPA's CFR (40 CFR 110) is any oil spill that (1) violates applicable water quality standards, (2) causes a film or sheen upon or discoloration of the water surface or adjoining shoreline, or (3) causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor's superintendent will notify the City of El Centro and the City will need to take action to contact the appropriate safety and clean-up crews to ensure the spill prevention plan is followed. A written description of reportable releases must be submitted to the RWQCB. This submittal must include a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.

If groundwater quality or surface water quality levels have been degraded in excess of water quality standards, Mitigation Measure HYD-3 will be required and will reduce this impact to a less than significant level.

### Mitigation Measure HYD-3: Implement Measures to Maintain Groundwater or Surface Water Quality

If an appreciable spill has occurred and results determine that project activities have adversely affected surface or groundwater quality, a detailed analysis will be performed by a Registered Environmental Assessor to identify the likely cause of contamination. This analysis will conform to the American Society for Testing and Material (ASTM) standards, and will include recommendations for reducing or eliminating the source or mechanisms of contamination. Any existing agriculture wells that are abandoned will need to be properly destructed. Prior to destruction of abandoned wells, a sample of the upper most water level column should be sampled for contaminants such as oil. The presence of oil could be an indicator that this lubricating oil was used to maintain the well pump. The oil should be removed from the well prior to placement of fill material for destruction. In addition, the oily water will need to be handled in accordance with federal, state, and local laws. Based on this analysis, the contractors will select and implement any other measures to control contamination, with a performance standard that groundwater quality must be returned to baseline conditions. These measures will be subject to approval by the City before they are implemented.

## Impact HYD-2: Water Quality Impacts from Construction Below the Water Table (Less than Significant with Mitigation)

Trenching and excavation associated with the proposed project may reach a depth that can expose the water table, in which an immediate and direct path to the groundwater basin would become available for contaminants to enter the groundwater system. Primary construction-related contaminants that could reach groundwater would include sediment, oil and grease, and construction-related hazardous substances. In addition, discharge of construction-related dewatering effluent could result in the release of contaminants to surface or groundwater. These impacts are considered potentially significant. Implementation of Mitigation Measures HYD-1 through HYD-3 described above, in conjunction with Mitigation Measure HYD-4, would ensure that impacts would be lowered to **less than significant** levels.

### Mitigation Measure HYD-4: Provisions for Dewatering

Before discharging any dewatered effluent to surface water, the City shall require contractors to obtain an NPDES permit and WDRs from the RWQCB. Depending on the volume and characteristics of the discharge, coverage under the RWQCB's General Construction Permit is possible. As part of the permit, the permittee will design and implement measures as necessary so that the discharge limits are met. As a performance standard, these measures will be selected to achieve maximum sediment removal and represent the best available technology that is economically achievable. Implemented measures may include retention of dewatering effluent until particulate matter has settled before it is discharged, use of infiltration areas, and other BMPs. Final selection of water quality control measures will be subject to approval by the City.

The City will verify that coverage under the appropriate NPDES permit has been obtained before allowing dewatering activities to begin. The City or its agent shall perform routine inspections of the construction area to verify that the water quality control measures are properly implemented and maintained. The City will notify contractors immediately if there is a noncompliance issue and will require compliance.

## Long-Term Impacts

### Impact HYD-3: Impacts to Groundwater and Surface Water from Infrastructure Failure (Less than Significant)

The project will include the installation of infrastructure such as water supply and wastewater pipelines and storage tanks. The possibility of a pipeline rupturing due to exceedances of pipeline or tank capacity, improper design, installation, maintenance, seismic activity, or other catastrophic events could pose a negative impact on water quality resulting from increased erosion and sediment, as well as discharge of any contaminants contained in the water released from the pipeline (e.g., sewage from influent pipelines). The infrastructure system(s) would be designed and engineered with sufficient capacity to accommodate anticipated peak flows, minimizing the potential for upset. In addition, infrastructure would be designed to relevant seismic and other standards to minimize the potential for upset from seismic activity or other geologic hazards. Because all facilities would be adequately sized, and designed and constructed to current standards which are considered adequately protective (i.e., the Uniform Building Code), including standards related to seismic safety and geologic hazards, impacts are considered **less than significant**.

### Impact HYD-4: Increased Amount of Surface Runoff and Associated Impacts to Drainage Facilities (Less than Significant with Mitigation)

Construction of the Lotus Ranch project would result in new impervious surfaces resulting in an increase in drainage flows. The drainage basin and the storm drains leading to it may not have sufficient capacity to accommodate the level of development being proposed. Unless the project is properly designed, the proposed project could increase the flow of drainage to the Lotus Drain, affecting the drain's capacity to function properly. In addition, the use of fertilizers and general household pesticides would be included in the runoff, and could impact water quality in local waterways. Though the conversion of agricultural to residential use would result in beneficial impacts on water quality, the impacts to storm drainage capacity and stormwater quality from the new residential use are considered potentially significant. Implementation of Mitigation Measures HYD-7 and HYD-8 would ensure that impacts would be lowered to **less than significant** levels.

**Mitigation Measure HYD-5: Preparation of Drainage Report to City Standards**

The City of El Centro and the IID require that detention basins be designed and constructed with each new development project to reduce peak discharge from proposed projects. To The City of El Centro publishes guidelines for designing detention basins. A Drainage Report has been completed for the Lotus Ranch project and is attached as Appendix A. The Drainage Report assesses projected runoff from the Lotus Ranch project and the required detention basin capacity necessary to accommodate runoff so that existing or future stormwater system capacity is not exceeded.

The Drainage Report includes the following items:

- An accurate description of pre-development runoff conditions.
- An accurate description City of El Centro design guidelines.
- An analysis of post-development runoff scenarios using appropriate engineering methods and specific design criteria.
- Standards for drainage systems to be installed.

**Mitigation Measure HYD-6: Implement Best Management Practices to Maximize Storm Water Quality**

As mentioned previously, existing pollutants in agricultural runoff from the site include nutrients, pesticides and herbicides, sediment, and salts. The proposed project would convert existing agricultural land to residential use. This would reduce the discharge of nutrients, pesticides and herbicides, sediment, and salts due to the decrease in exposed soil and crops. Residential land uses are potential contributors of oil, grease, metals, and trash, as well as contribute some pesticides from lawn and garden maintenance. To reduce or eliminate water quality effects from polluted runoff from the Lotus Ranch development site, the developer or applicant shall implement multiple BMPs in areas with potential to drain into storm drainage systems and/or surface waters.

As required by the City of El Centro and the IID, including requirements of approved TMDLs for the Alamo River, Imperial Valley Agricultural Drains, and Salton Sea, the project will utilize BMPs in the form of detention basins and end-of-pipe stormwater treatment systems to reduce pollutants in stormwater and dry weather runoff to the maximum extent practicable. The City shall inspect following construction to ensure that all identified BMPs have been properly installed. The project shall adopt a regular maintenance and monitoring schedule to ensure that these BMPs function properly during project operations. If necessary, the City shall require that additional BMPs be designed and implemented if those originally constructed do not achieve the identified performance standard.

### Impact HYD-5: Decreased Groundwater Recharge (Less than Significant)

The proposed project will not use groundwater as a water supply source. However, the project would change use of the site from agricultural (permeable surface) to residential (partially impermeable surface) and thereby reduce the amount of direct percolation into the groundwater table. Also, the amount of irrigation water used on the site will be greatly reduced (irrigation for lawns and gardens as opposed to agricultural crops). Although the groundwater recharge would decrease due to the amount of impervious surface on site and reduced amount of irrigation, the groundwater supply in the region would not be substantially depleted from this project due to the fact that a substantial amount of agriculture and open fields would remain. Furthermore, as discussed above, the region surrounding the project site is not a major area for groundwater recharge. Because groundwater is not used as part of this project and groundwater recharge is not significantly affected, impacts considered **less than significant**.

### Impact HYD-6: Flooding Hazards (Less than Significant)

The project would be constructed in an area outside of the 100-year flood zone and in an area unlikely to be subject to inundation in the event of a dam failure. Further, the project would be unlikely to contribute to any existing flooding issues elsewhere. This impact is **less than significant**, and no mitigation is necessary.

### Impact HWQ-7: Seiche, Tsunami, and Mudflow Hazards (Less than Significant)

The program is not located near the Pacific Ocean or any water bodies potentially subject to seiche or tsunami. In addition, the program area is relatively flat, with little risk of mudflow. Impacts are **less than significant**, and no mitigation is necessary.

## Cumulatively Significant Impact

### Impact HYD-8: Water Quality Impacts from Discharge to 303(d) Listed Surface Water Bodies (Cumulatively Less than Signficant)

The Salton Sea has been listed under Section 303(d) of the CWA as impaired by the following 303(d) listed constituents:

- Nutrients
- Salt
- Selenium

Both the Alamo River and Central Main Canal, an Imperial Valley Agricultural Drain, discharge to the Salton Sea and are each listed under Section 303(d) of the CWA as impaired by the following constituents:

- Pesticides
- Sedimentation/Siltation
- Selenium

Contributions of these constituents originate from agricultural or naturally occurring sources. As implied by inclusion on the 303(d) list, the beneficial uses of waters of the Alamo River, Imperial Valley Agricultural Drains, and Salton Sea are impaired such that they have no remaining assimilative capacity or ability to accommodate additional quantities of these contaminants, irrespective of concentration.

The existing agricultural activities at the project site presently contribute to the impaired status of these waters. After construction, the project would cease contributions of agricultural-related constituents, such as sediment, from the site through conversion of the land to residential use. However, some level of pollutants, such as nutrients from fertilizers, may be discharged from residential uses as a result of landscaping and urban runoff. Contributions of residential-related contaminants from the project is anticipated to be relatively low compared to existing conditions, and is considered less than significant at the project-level. Additionally, the project would incorporate detention basins and other water quality treatment BMPs, as required by adopted TMDLs and the City municipal stormwater discharge permit, to ensure that runoff from the project would not further impair the Alamo River, Imperial Valley Agricultural Drains, or the Salton Sea as identified by CWA Section 303(d). Overall, the project would reduce agricultural sources of impairment to the Alamo River, Imperial Valley Agricultural Drains, and the Salton Sea. Thus, the project would have a **less than significant** impact on CWA Section 303(d) listed water bodies.

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# Personal Communication

Hines, Randy. Wastewater Treatment Plant Supervisor. City of El Centro. November 15, 2005. Kathryn Gaffney of Jones & Stokes received a message from Hines's assistant.

# APPENDIX A
Lotus Ranch Drainage Report

# Lotus Ranch Drainage Report

*Prepared for:*

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El Centro, California 92243

*Prepared by:*

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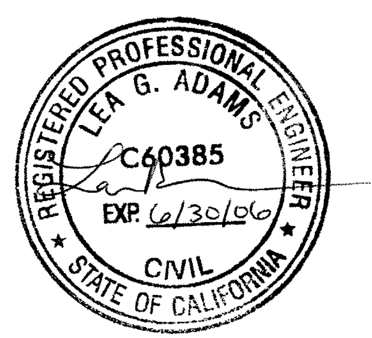


February 2006

## INTRODUCTION

The City of El Centro, California is located in Imperial County, approximately 15 miles north of the U.S.-Mexico border. The City currently encompasses 10.75 square miles and is surrounded by agriculture fields. The Lotus Ranch project occupies a 213-acre tract of land immediately southwest of the existing city limits. The site is bounded by Interstate-8 to the north, La Brucherie Road to the east, agricultural fields to the south, and the Lotus Drain to the west. Surrounding land use is mostly agriculture with some residential development to the northeast and a high school across Interstate-8 to the north. The proposed plan for the site includes 616 single-family residences, a possible elementary school, and three retention basins.

The City of El Centro and the Imperial Irrigation District (IID) require new development projects to incorporate best management practices (BMPs) for reducing peak runoff during storms so that the IID canal and drainage system is not overloaded, causing downstream flooding. New projects must also implement BMPs for improving water quality of runoff.

This Drainage Report reviews the pipe-sizing requirements for sufficiently draining the Lotus Ranch project and the retention basin requirements necessary for capturing and treating runoff from the site.

### Existing Conditions

Land use for the site currently is, and historically has been, agricultural. The general topography of the site is characterized as flat with a gentle slope from the southwest toward the northeast. Runoff from the site travels in a northeasterly direction at an approximate 0.11% slope to the Lotus Drain. Three drainage connection points from the project site to the Lotus Drain are currently in place and utilized to drain the site. Discharges to the Lotus Drain flow approximately 47 miles via the Central Main Drain (8 miles) and Alamo River (39 miles) before entering the Salton Sea. The Lotus Drain is owned and operated by the IID. The Lotus Drain is currently an open channel but will be put into an underground pipe prior to construction of the Lotus Ranch project as required by the City of El Centro and the IID.

Runoff from adjacent rural residential property surrounded to the north, west, and south by the project site flows onto parts of the project site and onto La Brucherie Road. Runoff from the section of La Brucherie Road that is adjacent to the project site will be captured by the storm drain system designed for the project.

### Proposed Conditions

To reduce the effects of converting pervious agricultural land to largely impervious single-family residential, the project will include three retention basins to attenuate runoff from the site. Preliminary site design, including retention basin location and drainage infrastructure has been completed by JBL Associates. The first retention basin is the largest and covers the entire northern edge of the project site as well as the top third of the western edge of the site. The second basin occupies the middle third of the western edge of the site. The third basin occupies the bottom third of the western edge of the site. All three retention basins will be designed to allow public access during non-flood periods.

The retention basins must accommodate all runoff from the site, as well as runoff coming onto the site from two adjacent rural residences. Runoff from the site would be collected through a series of catch basins and curb inlets and conveyed to the retention basin. Runoff from the basins would be slowly released to the underground drain pipes, through a stormwater treatment system, and finally through a riser connected to one of three existing 12-inch concrete pipes that currently connect to the Lotus Drain. Flow would then be conveyed through the IID drain system and would ultimately discharge into the Salton Sea.

The City of El Centro adopted the *City of El Centro Retention Basin Standards* in summer 2005, with key requirements noted here:

- Retention basins shall be limited to five (5) acres or less.
- The volume of the retention basin shall be based on calculating a depth of 3 inches for the entire area of the development.
- Collection system piping shall be based on a 1 inch per hour intensity.
- The retention basin must be drained within 72 hours after the rainfall event, to eliminate and prevent mosquito development.
- Depth of retention basin shall not exceed four feet maximum; depth shall be measured from adjacent street's gutter flow line (used as datum).
- In cases where the depth of the retention basin exceeds four feet, the depth shall be a minimum of five feet above the water table at its highest point during the preceding year.

As outlined in the City of El Centro's *City of El Centro Retention Basin Standards*, the retention basins will be designed to capture three (3) inches of rain across the entire site and have a drawdown time of no more than 72 hours. This period of retention decreases peak flow in the IID's drainage system, reduces the discharge of pollutants such as oil, grease, and metals, and prevents standing water for long periods of time, thus preventing mosquito development. In addition, the collection system will be designed to convey runoff from rainfall event with 1 inch per hour intensity.

The Lotus Ranch project was originally submitted to the City in spring 2005, and the Retention Basin Standards were adopted in summer 2005. Staff from JBL Associates met with Terry Hagen, City of El Centro engineer, in October 2005 to review the preliminary site layout and retention basin design. Mr. Hagen stated that the design of the basins was adequate to meet the newly adopted Retention Basin Standards (Jeff Lyon, pers. comms.). Two of the three retention basins are less than 5 acres in size. The third retention basin is approximately 10 acres in size, and the City stated that a berm could be constructed in this basin to create two smaller ponds, each approximately 5 acres in size (Jeff Lyon, pers. comms.). In addition, the City and JBL Associates agreed that the final retention basin depths would meet either the City's requirement of a maximum depth of 4 feet from the adjacent gutter flow line or that the minimum depth would be 5 feet above the water table (Jeff Lyon, pers. comms.).

Design criteria, assumptions, and calculations are provided in the following sections.

## METHODS

Two sets of calculations were conducted for this Drainage Report: storm drain pipe-sizing and retention basin sizing. These calculations have been preformed at a preliminary level and do not include detailed pipe alignments or retention basin design. The following design criteria and assumptions were used.

**Storm Drain Pipe-Sizing**

Sub-basins were delineated based on the drainage area for each catch basin, or curb inlet, identified on the Lotus Ranch Tentative Map, prepared by JBL Associates. Direction of flow provided on the tentative map and the assumption that all lots drain to the street were used to define the area of each sub-basin; see Figure 1 for sub-basin delineations.

Flows were calculated using the following equation (Rational Method):

$Q=CIA$ where, **Equation 1**

- Q = flow in cubic feet per second (cfs) at time of concentration
- C = runoff coefficient, percent impervious surface
- I = intensity of storm in inches per hour
- A = area of drainage basin

The runoff coefficient, or C-factor, was derived from a range of runoff coefficients published in McCuen's *Hydrologic Analysis and Design* (1998). The range of 0.22-0.35 represents residential land use types on a slope of 0-2 percent. To use a conservative estimate, the high end of this range (0.35) is used in these calculations. Intensities were determined from NOAA precipitation frequency estimates for a 10-year storm and two average times of concentration, 10 minutes and 15 minutes (NOAA 2005). Manning's formula was used to calculate pipe sizes required to meet flow rates of each sub-basin. The following equation was used (Brater and King 1976), and assumes the pipes are circular and flowing full:

$D_i = (1630Qn/s^{1/2})^{3/8}$ where **Equation 2**

- $D_i$ = diameter of pipe in inches
- Q = flow (cfs)
- n = Manning's number
- s = slope

The flow for each sub-basin and minimum required pipe size to receive runoff from a 10-year 10-minute intensity storm and a 10-year 15-minute intensity storm is presented in Table 3 in the Results section below.

In addition to estimating required pipe sizes for each sub-basin in the project site, total flow and corresponding pipe sizes were calculated at ten collection points within the storm drain system (see Figure 1). Only the flow for a 10-year storm for 10-minutes was used for this calculation, as the 10-minute flow is higher than the 15-minute flow. The results of this calculation are shown in Table 4 below.

Table 1 summarizes the hydraulic variables used in calculating flows from project sub-basins and to perform preliminary pipe dimensioning.

**Table 1: Hydraulic Variables for Flow and Pipe Size Calculations**

| **Variable** | **Value** |
|---|---|
| C-factor | 0.35[1] |
| Design storm intensity (I) | 1 inch/hour[2] |
| Manning's number (smooth concrete) | 0.012 |
| Slope of pipes | 0.001 |

[1] Source: Brater and King. 1976.
[2] Source: City of El Centro.

**Retention Basin Sizing**
Required retention basin volumes were calculated using the following equation:

$V = CPA$, where **Equation 3**

$V$ = volume of storage needed (acre feet)
$C$ = runoff coefficient, percent impervious surface
$P$ = depth of precipitation (feet)
$A$ = drainage area (acres)

Drawdown flow rates for the retention basins were initially calculated by dividing the total volume of runoff in each retention basin (as calculated using the equation above) by 72 hours, the maximum drawdown time permitted by City guidelines. The flow rates were then converted from acre-feet per hour to cubic feet per second (cfs). This calculation assumes that the difference in elevations between the retention pond outlets and the Lotus Drain water surface is great enough to allow free surface flow in the connection pipes. The outflow calculated for Retention Basin 1 was greater than the capacity of the 12-inch connection pipe under free surface conditions, however, suggesting that the basin would take longer than 72 hours to drain. An evaluation of design water surface elevations was therefore performed to determine whether the basin would actually drain within 72 hours under design conditions.

Retention Basin 1 will capture approximately 10.2 acre-feet of runoff, and will require a minimum outflow rate of 1.72 cfs to drain within 72 hours. The minimum hydraulic head necessary to generate this flow rate in the 12-inch connection pipe was estimated using standard pipe flow hydraulic analysis procedures, assuming an average drainage pipe length of 600 feet within Retention Basin 1 (estimated from the Lotus Ranch Tentative Map). The resulting minimum head is 1.4 feet.

The Lotus Ranch Tentative Map indicates that the outlet catch basins with Retention Basin 1 are set at elevation 67.0. Retention basin outflows will enter the Lotus Drain, which will be put into a pipe through the entire project site. The minimum elevation of the Lotus Drain in the vicinity of Retention Basin 1 is currently about 60.0 feet. Assuming that a 60-inch diameter pipe is used to enclose the Lotus Drain, maximum water surface elevations in the pipe will be at elevation 65.0 feet and a minimum of 2 feet of hydraulic head will be available to drive outflows from Retention Basin 1. This is greater than the estimate of 1.4 feet required to drain the basin within 72 hours. The basin will therefore meet the City's drainage requirements, provided the assumptions made for this analysis remain valid for final design conditions.

Table 2 summarizes the hydraulic variables used to calculate retention basin volumes and drawdown rates.

**Table 2: Hydraulic Variables for Retention Basin Calculations**

| Variable | Value |
|---|---|
| Runoff coefficient (C) | 0.35[1] |
| Precipitation (P) | 0.25 feet[2] |
| Drainage Basin 1 Area | 117.06 acres |
| Drainage Basin 2 Area | 52.46 acres |
| Drainage Basin 3 Area | 46.51 acres |
| Drawdown time | 3 days (72 hours)[2] |
| Max outlet pipe size | 12 inches (existing Lotus Drain connection) |

[1] Source: McCuen. 1998.
[2] Based on City requirements in the *City of El Centro Retention Basin Standards*.

In addition to performing retention basin sizing, the capacities of the connection pipes from the retention basins to the Lotus Drain were calculated. These capacities were then compared to the estimated drawdown rates to evaluate whether the retention basins could be emptied within the required time period. A normal depth calculation was also used to determine the velocity of the estimated drawdown rates in each of the three 12-inch pipe connections to the Lotus Drain.

## RESULTS

The results of the pipe and retention basin sizing analyses are presented below in Tables 3 through 5.

**Table 3: Storm Drain Pipe-Sizing**

| Sub-Basin ID | Sub-Basin Acres | Design Q (cfs) | Calc Min Pipe Size (inches) | Design Pipe Size (inches) |
|---|---|---|---|---|
| 1 | 0.816 | 0.286 | 6.962 | 12 |
| 2 | 0.580 | 0.203 | 6.125 | 12 |
| 3 | 0.652 | 0.228 | 6.400 | 12 |
| 4 | 0.514 | 0.180 | 5.851 | 12 |
| 5 | 1.634 | 0.572 | 9.032 | 12 |
| 6 | 0.983 | 0.344 | 7.464 | 12 |
| 7 | 0.908 | 0.318 | 7.245 | 12 |
| 8 | 2.323 | 0.813 | 10.304 | 12 |
| 9 | 1.196 | 0.419 | 8.034 | 12 |
| 10 | 2.260 | 0.791 | 10.200 | 12 |
| 11 | 1.189 | 0.416 | 8.015 | 12 |

| Sub-Basin ID | Sub-Basin Acres | Design Q (cfs) | Calc Min Pipe Size (inches) | Design Pipe Size (inches) |
|---|---|---|---|---|
| 12 | 0.981 | 0.344 | 7.460 | 12 |
| 13 | 0.977 | 0.342 | 7.449 | 12 |
| 14 | 1.825 | 0.639 | 9.414 | 12 |
| 15 | 1.864 | 0.652 | 9.489 | 12 |
| 16 | 1.854 | 0.649 | 9.469 | 12 |
| 17 | 1.855 | 0.649 | 9.471 | 12 |
| 18 | 1.623 | 0.568 | 9.010 | 12 |
| 19 | 1.637 | 0.573 | 9.038 | 12 |
| 20 | 1.654 | 0.579 | 9.073 | 12 |
| 21 | 1.634 | 0.572 | 9.031 | 12 |
| 22 | 1.840 | 0.644 | 9.443 | 12 |
| 23 | 1.848 | 0.647 | 9.459 | 12 |
| 24 | 1.866 | 0.653 | 9.492 | 12 |
| 25 | 1.845 | 0.646 | 9.453 | 12 |
| 27 | 1.867 | 0.653 | 9.494 | 12 |
| 28 | 1.869 | 0.654 | 9.499 | 12 |
| 29 | 1.878 | 0.657 | 9.515 | 12 |
| 30 | 1.820 | 0.637 | 9.404 | 12 |
| 31 | 1.601 | 0.560 | 8.963 | 12 |
| 32 | 1.643 | 0.575 | 9.051 | 12 |
| 33 | 1.647 | 0.576 | 9.059 | 12 |
| 34 | 1.644 | 0.576 | 9.053 | 12 |
| 35 | 1.867 | 0.653 | 9.494 | 12 |
| 36 | 1.857 | 0.650 | 9.475 | 12 |
| 37 | 1.858 | 0.650 | 9.477 | 12 |
| 38 | 1.836 | 0.643 | 9.436 | 12 |
| 39 | 1.858 | 0.650 | 9.477 | 12 |
| 40 | 1.881 | 0.658 | 9.522 | 12 |
| 41 | 1.907 | 0.667 | 9.570 | 12 |
| 42 | 1.922 | 0.673 | 9.598 | 12 |
| 43 | 4.571 | 1.600 | 13.283 | 18 |
| 44 | 0.494 | 0.173 | 5.766 | 12 |
| 45 | 0.639 | 0.224 | 6.351 | 12 |
| 46 | 0.573 | 0.200 | 6.096 | 12 |
| 47 | 0.830 | 0.290 | 7.005 | 12 |
| 48 | 0.820 | 0.287 | 6.973 | 12 |
| 49 | 1.852 | 0.648 | 9.466 | 12 |
| 50 | 1.873 | 0.655 | 9.505 | 12 |
| 51 | 1.876 | 0.657 | 9.512 | 12 |
| 52 | 1.880 | 0.658 | 9.518 | 12 |
| 53 | 1.865 | 0.653 | 9.491 | 12 |
| 54 | 1.877 | 0.657 | 9.514 | 12 |
| 55 | 1.857 | 0.650 | 9.476 | 12 |
| 56 | 1.869 | 0.654 | 9.499 | 12 |

| Sub-Basin ID | Sub-Basin Acres | Design Q (cfs) | Calc Min Pipe Size (inches) | Design Pipe Size (inches) |
|---|---|---|---|---|
| 58 | 0.542 | 0.190 | 5.970 | 12 |
| 59 | 0.285 | 0.100 | 4.692 | 12 |
| 60 | 0.586 | 0.205 | 6.146 | 12 |
| 61 | 1.494 | 0.523 | 8.733 | 12 |
| 62 | 1.497 | 0.524 | 8.740 | 12 |
| 63 | 1.522 | 0.533 | 8.795 | 12 |
| 64 | 1.484 | 0.519 | 8.711 | 12 |
| 65 | 2.033 | 0.711 | 9.802 | 12 |
| 66 | 1.986 | 0.695 | 9.717 | 12 |
| 67 | 2.015 | 0.705 | 9.770 | 12 |
| 68 | 2.009 | 0.703 | 9.760 | 12 |
| 69 | 0.574 | 0.201 | 6.102 | 12 |
| 70 | 0.641 | 0.224 | 6.357 | 12 |
| 71 | 1.475 | 0.516 | 8.691 | 12 |
| 72 | 1.491 | 0.522 | 8.727 | 12 |
| 73 | 1.443 | 0.505 | 8.621 | 12 |
| 74 | 1.402 | 0.491 | 8.527 | 12 |
| 75 | 1.721 | 0.602 | 9.208 | 12 |
| 76 | 1.467 | 0.514 | 8.675 | 12 |
| 77 | 1.364 | 0.477 | 8.439 | 12 |
| 78 | 1.295 | 0.453 | 8.276 | 12 |
| 79 | 0.406 | 0.142 | 5.356 | 12 |
| 80 | 0.531 | 0.186 | 5.927 | 12 |
| 81 | 1.288 | 0.451 | 8.259 | 12 |
| 82 | 1.306 | 0.457 | 8.305 | 12 |
| 83 | 1.961 | 0.686 | 9.672 | 12 |
| 84 | 1.802 | 0.631 | 9.369 | 12 |
| 85 | 1.587 | 0.555 | 8.932 | 12 |
| 86 | 1.479 | 0.518 | 8.700 | 12 |
| 87 | 0.875 | 0.306 | 7.146 | 12 |
| 88 | 0.836 | 0.292 | 7.023 | 12 |
| 89 | 0.512 | 0.179 | 5.843 | 12 |
| 90 | 1.570 | 0.549 | 8.897 | 12 |
| 91 | 3.651 | 1.278 | 12.210 | 18 |
| 92 | 2.144 | 0.750 | 9.999 | 12 |
| 93 | 2.400 | 0.840 | 10.433 | 12 |
| 94 | 3.684 | 1.289 | 12.251 | 18 |
| 95 | 1.572 | 0.550 | 8.901 | 12 |
| 97 | 0.254 | 0.089 | 4.493 | 12 |
| 98 | 1.171 | 0.410 | 7.971 | 12 |
| 99 | 1.158 | 0.405 | 7.936 | 12 |
| 100 | 3.075 | 1.076 | 11.447 | 12 |
| 101 | 2.219 | 0.777 | 10.130 | 12 |
| 102 | 2.237 | 0.783 | 10.160 | 12 |

| Sub-Basin ID | Sub-Basin Acres | Design Q (cfs) | Calc Min Pipe Size (inches) | Design Pipe Size (inches) |
|---|---|---|---|---|
| 103 | 2.226 | 0.779 | 10.142 | 12 |
| 104 | 2.207 | 0.772 | 10.109 | 12 |
| 105 | 2.252 | 0.788 | 10.186 | 12 |
| 106 | 0.211 | 0.074 | 4.188 | 12 |
| 107 | 0.719 | 0.251 | 6.637 | 12 |
| 108 | 0.332 | 0.116 | 4.969 | 12 |
| 109 | 2.038 | 0.713 | 9.811 | 12 |
| 110 | 2.062 | 0.722 | 9.855 | 12 |
| 111 | 2.005 | 0.702 | 9.751 | 12 |
| 112 | 2.092 | 0.732 | 9.909 | 12 |
| 113 | 2.028 | 0.710 | 9.794 | 12 |
| 114 | 2.107 | 0.737 | 9.934 | 12 |
| 116 | 0.226 | 0.079 | 4.300 | 12 |
| 117 | 0.246 | 0.086 | 4.437 | 12 |
| 118 | 0.507 | 0.177 | 5.824 | 12 |
| 119 | 1.064 | 0.372 | 7.690 | 12 |
| 120[1] | 16.571 | 5.800 | 21.530 | 24 |

[1] The proposed school site does not have drainage delineated on the tentative map.

**Table 4: Collection Point Calculations and Required Pipe-Sizing**

| Flow Point | Combined Flow (cfs) | Calc Min Pipe Size (inches) | Design Pipe Size (inches) | Retention Basin |
|---|---|---|---|---|
| 1 | 0.49 | 8.5 | 12 | Retention Basin 2 |
| 2 | 15.15 | 30.9 | 36 | Retention Basin 3 |
| 3 | 2.15 | 14.8 | 18 | Retention Basin 3 |
| 4 | 0.40 | 7.9 | 12 | Retention Basin 1 |
| 5 | 16.67 | 32.0 | 36 | Retention Basin 2 |
| 6 | 2.72 | 16.2 | 18 | Retention Basin 2 |
| 7 | 10.70 | 27.1 | 30 | Retention Basin 1 |
| 8 | 12.87 | 29.0 | 30 | Retention Basin 1 |
| 9 | 18.89 | 33.5 | 36 | Retention Basin 1 |
| 10 | 16.85 | 32.1 | 36 | Retention Basin 1 |

**Table 5: Retention Basin Calculations**

| Retention Basin | Drainage Area (acres) | Acre-feet of Runoff | Cubic Feet of Runoff | Average Drainage Flow (cfs) | Drainage Velocity (fps) |
|---|---|---|---|---|---|
| Retention Basin 1 | 117.06 | 10.243 | 446,178 | 1.72 | 2.65[1] |
| Retention Basin 2 | 52.56 | 4.590 | 199,947 | 0.77 | 1.64[2] |
| Retention Basin 3 | 46.51 | 4.070 | 177,275 | 0.68 | 1.60[2] |

[1] Velocity calculated assuming 2 feet of hydraulic head.
[2] Velocity calculated assuming free surface flow conditions.

## CONCLUSION

A review of the estimated pipe sizes for the storm drainage system within the project area indicates that the estimated pipe sizes closely match those of the comparable pipes shown on the Lotus Ranch Tentative Map, produced by JBL Associates.

Average outflow rates were calculated for each retention basin

The volume of runoff currently directed to Retention Basin 1 will not completely drain though the 12-inch connection pipe to the Lotus Drain within 72 hours. The maximum estimated flow rate through a 12-inch pipe with a slope of 0.001 is about 1.2 cfs, assuming the pipe is flowing full but not under pressure, while the estimated discharge rate from Retention Basin 1 is closer to 2 cfs. Given that the estimated discharge rates from Retention Basins 2 and 3 are less than the maximum of 1.2 cfs, one possible solution is to route a portion of the flow currently draining to Retention Basin 1 to either of the other two retention basins.

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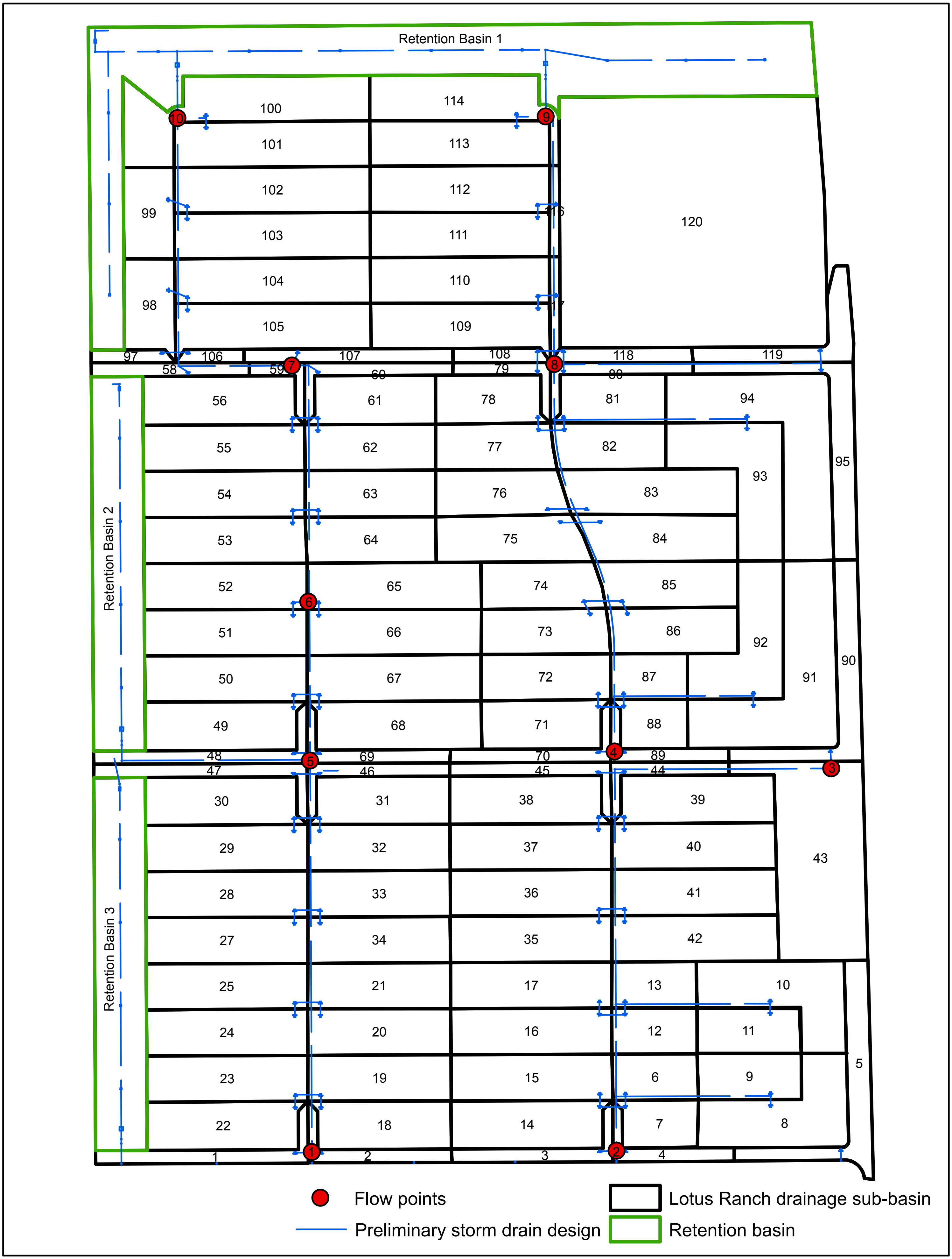


Figure 1
Lotus Ranch Drainage Map