UPDATED
HAZARDOUS MATERIAL TECHNICAL STUDY

Otay Mesa Community Plan Update
San Diego, California

PREPARED FOR:

RECON ENVIRONMENTAL
1927 FIFTH AVENUE
SAN DIEGO, CALIFORNIA 92101

PREPARED BY:

GEOCON INCORPORATED
6960 FLANDERS DRIVE
SAN DIEGO, CALIFORNIA 92121

GEOCON PROJECT NO. 09721-06-02

OCTOBER 2012

GEOCON
CONSULTANTS, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. 09721-06-02
October 11, 2012

DRAFT VIA ELECTRONIC MAIL

Ms. Stephanie Morgan Whitmore
RECON Environmental
1927 Fifth Avenue
San Diego, California 92101

Subject: OTAY MESA COMMUNITY PLAN UPDATE
SAN DIEGO, CALIFORNIA
UPDATED HAZARDOUS MATERIALS TECHNICAL STUDY

Dear Ms. Whitmore:

In accordance with your request, Geocon, Inc. has updated the Hazardous Materials Technical Study (HMTS) of the Otay Mesa community in San Diego, California. The report provides updated information regarding properties/facilities of potential environmental concern identified in our initial HMTS dated July 27, 2007, and additional facilities identified during this update study. We understand that our report will be included in an updated Environmental Impact Report that is currently being developed as part of the April 2011 Otay Mesa Community Plan Update.

We appreciate the opportunity to assist RECON with this project. Please contact us if you have any questions concerning this report or if we may be of further service.

Sincerely,

GEOCON, INC.

Matthew Lesh
Project Geologist

Jim Brake, PG
Senior Geologist/Associate

(1) Addressee

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UPDATED HAZARDOUS MATERIALS TECHNICAL STUDY

1. INTRODUCTION

This report presents the results of an Updated Hazardous Materials Technical Study (Updated HMTS) of an approximate 8,175-acre area of land in the Otay Mesa community of the City of San Diego identified as the Otay Mesa Community Plan project area (the Site). Geocon, Inc. (Geocon) prepared this report in accordance with the request of RECON Environmental (the Client).

We previously conducted an HMTS of the Site in 2007 and presented our findings in a report titled *Hazardous Materials Technical Study, Otay Community Plan Update, San Diego, California*, dated July 27, 2007. We prepared the 2007 HMTS to provide information regarding properties/facilities of potential environmental concern on or within the vicinity of the Site as part of a program-level Environmental Impact Report (EIR). This Updated HMTS was requested to provide current information regarding properties/facilities of potential environmental concern to include in an updated EIR that is being prepared for the Site as part of the April 2011 Otay Mesa Community Plan Update.

The following sections identify the purpose and scope of services including any limitations/exceptions associated with the Updated HMTS.

1.1 Purpose

The purpose of the Updated HMTS was to provide an updated evaluation of existing and potential impacts to the Site (i.e., levels of hazardous materials or petroleum likely to warrant mitigation pursuant to current regulatory guidelines) from the presence of hazardous materials or petroleum on or within the vicinity of the Site and to discuss necessary mitigation measures that can be implemented to reduce or eliminate the potential impact. The scope of services for the Updated HMTS was developed in general accordance with the California Environmental Quality Act (CEQA) and American Society for Testing and Materials (ASTM) *Designation E 1527-05 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.*

1.2 Scope of Services

We performed the following scope of services in general accordance with Proposal No. LG-11143, dated May 12, 2011, and revised June 13, 2011. No exceptions or limitations to the scope of services were identified or encountered during the performance of the Updated HMTS.

- Conducted an updated review of available Federal, State, and local databases for the Site and for properties located within approximately 660 feet (⅛ mile) of the Site.

- Reviewed the State Water Resources Control Board (SWRCB) GeoTracker website (http://geotracker.waterboards.ca.gov) and Department of Toxic Substances Control (DTSC) EnviroStor website (http://www.envirostor.dtsc.ca.gov) for records pertaining to properties/facilities located within or near the boundaries of the Site whose environmental conditions might potentially impact the Site. These properties were identified during our review of regulatory agency databases and/or from information in the 2007 HMTS.

- Contacted representatives of the County of San Diego – Department of Environmental Health (DEH) and San Diego County Solid Waste Local Enforcement Agency (County LEA) for information regarding select properties/facilities of potential environmental concern identified during our review of regulatory agency databases and/or in the 2007 HMTS.

- Performed a limited visual reconnaissance of properties/facilities of potential environmental concern identified within the boundaries of the Site. These properties/facilities were selected based on our review of regulatory agency databases and/or information in the 2007 HMTS. The visual reconnaissance was generally limited to observing the exterior portions of the properties/facilities from nearby public streets.

- Reviewed recent aerial photographs to obtain information regarding land use changes to the Site since completion of our 2007 HMTS.

2. GENERAL SITE CHARACTERISTICS

The following sections describe the location, current and historical uses, and physical setting of the Site.

2.1 Site Location

The Site is roughly bounded by the Otay River to the north, the United States-Mexico international border to the south, Interstate 805 (I-805) to the west, and Highways 125 and 905 to the east. As with our 2007 HMTS, we divided the Site into six areas (Areas 1 through 6) for discussion purposes. The approximate location of the Site is shown on Figure 1, and the approximate boundaries of the six areas are shown on Figure 2 and Figures 3-1 to 3-6.

2.2 Current Land Use

The Site is a mixed-use area within the Otay Mesa community, currently supporting residential, commercial, industrial, agricultural, and municipal uses. The Site also includes areas of undeveloped, naturally vegetated land. Area-specific land use information is provided below. The information was obtained during the limited visual site reconnaissance and from reviews of recent aerial photographs.

2.2.1 Area 1

Area 1 is bounded by the Otay River to the north, Otay Mesa Road and Highway 905 to the south, Johnson Canyon and Piper Ranch Road to the east, and I-805 to the west (Figure 3-1). The majority of Area 1 has been developed and includes industrial developments and Brown Field Municipal Airport (Brown Field) in the eastern portion of the area, automobile sales/recycling and junkyard facilities in the central portion, residential development in the central and western portions of the area, and commercial improvements along the western area boundary. Undeveloped portions of Area 1 exist in the northeastern portion of the area and in Dennery Canyon in the western portion of the area.

2.2.2 Area 2

Area 2 is bounded by Otay Mesa Road and Highway 905 to the north, the US-Mexico international border to the south, Heritage Road to the east, and I-805 to the west (Figure 3-2). Area 2 is largely comprised of undeveloped, naturally vegetated land and is cut by several canyons, including Moody Canyon, Dillon Canyon, Finger Canyon, Spring Canyon, and Wruck Canyon. Residential development is present in the northwestern portion of the area. Single-family residences and San Ysidro High School (5353 Airway Road) are in the northern portion of Area 2 just south of Otay Mesa Road. Commercial/light-industrial developments are located at the northern and eastern boundaries of Area 2. An area used for agricultural purposes is located at the eastern boundary of the area.

2.2.3 Area 3

Area 3 is bounded by Otay Mesa Road to the north, the US-Mexico international border to the south, Britannia Boulevard to the east, and Heritage Road to the west (Figure 3-3). Undeveloped areas of Area 3 include Wruck Canyon and Spring Canyon, traversing the southwestern and western portions of the area, respectively. The area between the two canyons consists of agricultural land. The balance of Area 3 primarily consists of commercial/light-industrial-related development. Commercial establishments are present along the northern perimeter of Area 3, just south of Otay Mesa Road.

2.2.4 Area 4

Area 4 is bounded by Otay Mesa Road to the north, the US-Mexico international border to the south, La Media Road to the east, and Britannia Boulevard to the west (Figure 3-4). The western portion of Area 4 is predominantly developed with commercial/light-industrial properties and the eastern portion consists of agricultural land.

2.2.5 Area 5

Area 5 is bounded by Otay Mesa Road to the north, the US-Mexico international border to the south, Highway 905 to the east, and La Media Road to the west (Figure 3-5). The southern and central portions of Area 5 are predominantly developed with commercial/light-industrial improvements. Commercial developments occupy the western corner of Highway 905 and Siempre Viva Road. The northern portion of Area 5 is predominately undeveloped land.

2.2.6 Area 6

Area 6 is bounded by Otay Mesa Road to the north, the US-Mexico international border to the south, Enrico Fermi Drive the east, and Highway 905 to the west (Figure 3-6). Vacant land is located in the northwestern portion of Area 6. The balance of Area 6 consists of commercial/light-industrial developments, with low-density commercial development located in the western and southwestern portions of the area.

2.3 Historical Land Use

As part of our 2007 HMTS, we reviewed historical aerial photographs for the Site and surrounding properties for selected years from 1953 to 2002. Review of the aerial photographs and our knowledge of the Otay Mesa community indicate that Brown Field was the first major development to occur within the boundaries of the Site. Brown Field was first opened in 1918 and was primarily used for military purposes until 1962. Since 1962, Brown Field has been used as municipal airport and a port-of-entry for private aircrafts entering the U.S. from Mexico. Overall development of the Site appeared to dramatically increase subsequent to the completion of Highway 905 in 1976. The Site primarily consisted of undeveloped land or land used for agricultural purposes from prior to 1953 to sometime between 1980 and 1990, when construction of the current commercial/light-industrial facilities in Areas 3, 4, 5, and 6 commenced. Construction of the current single-family residential communities in Areas 1 and 2 began sometime between 1990 and 2002.

Comparison of site descriptions provided in our 2007 HMTS and of recent aerial photographs indicates that significant additional development has not occurred since our 2007 HMTS. RECON personnel have informed us that several development projects are planned for the Otay Mesa community in the near future, particularly in the western potions of Areas 1 and 2, but construction has not started. The primary change to the Otay Mesa community since 2007 has been the completion of Highway 125 along the eastern site boundary in November 2007 and the nearly completed relocation of Highway 905 to the south of its former alignment that coincided with Otay Mesa Road.

2.4 Physical Setting

We provided a detailed discussion of the topographic, geologic, and hydrogeologic conditions in the vicinity of the Site in our 2007 HMTS. Information sources reviewed and our limited visual reconnaissance as part of this Updated HMTS do not indicate significant changes to these conditions.

3. REGULATORY AGENCY RECORDS

This section describes our review of updated regulatory agency databases to identify properties/facilities of potential environmental concern. In addition, this section includes discussion of SWRCB GeoTracker and DTSC EnviroStor records and regulatory agency correspondence regarding properties/facilities of potential environmental concern identified in the database listings and/or the 2007 HMTS.

3.1 Database Review

EDR performed a search of Federal, State, and local databases for the Site and surrounding areas. Copies of the EDR database executive summary and overview map are in Appendix A. A complete electronic copy (CD) of the report titled EDR DataMap Area Study, dated August 30, 2012, is also in Appendix A (CD pocket).

We reviewed the EDR report to identify properties/facilities within the site boundaries or approximate ⅛-mile of the Site that have had unauthorized releases of hazardous substances or petroleum or other events with potentially adverse environmental effects. In general, our review focused on those databases that report spills and leaks from features such as underground storage tanks (USTs) and waste disposal facilities.

Site Plans depicting the site boundaries and properties/facilities of potential environmental concern with indicated Map Identification Numbers (Map ID Nos.) are presented as Figures 3-1 through 3-6. Information provided in the database report is summarized below.

3.1.1 LUST and CORTESE Listings

The EDR report lists four leaking UST facilities within the Site boundaries on the LUST and/or CORTESE databases. The table below lists the referenced facilities as well as the associated DEH case(s) for each listing.

Facility Name	Address	Map ID	DEH Case No(s).
Brown Field	1424 Continental Street	2	H10618-001 through -024
Former Rohr Engine Facility	1500 Heritage Road	11	H19053-001
Arco Service Station	2510 Otay Center Road	22	H29556-001
Air Liquide Industrial	9955 Via De La Amistad	23	125243-001

Additional information from agency file reviews performed as part of our 2007 HMTS and/or from GeoTracker as part of this Updated HMTS for the four facilities located within the Site boundaries is summarized in Section 3.2.

The following offsite facilities within ⅛-mile of the Site are also referenced on the LUST and/or CORTESE databases:

- **City of San Diego General Services Yard, 4515 Otay Mesa Road (adjacent to the west of the Site)**, is referenced for UST-related diesel release in 1991 that impacted soil only. The case was closed in 1993 following excavation and disposal of the impacted soil. Based upon the offsite location and closed status of the case, it is unlikely operations at this facility have negatively impacted the Site.

- **Former Red Cab, 803 E San Ysidro Boulevard, (approximately 530 feet west of the Site)**, is referenced for UST-related gasoline and diesel release in 2006 that impacted soil only. Additional site investigations were conducted between 2006 and 2009 that indicated the extent of soil impacts was limited to the property boundaries. Based on this information, it is unlikely operations at this facility have negatively impacted the Site.

3.1.2 SLIC Listings

Review of the EDR Report indicates that ten facilities located within the Site boundaries are referenced on the Spills, Leaks, Investigations, and Cleanups (SLIC) database. Offsite properties/facilities within ⅛-mile of the Site were not referenced on the SLIC database. The table below provides a list of the referenced facilities well as the associated DEH case(s) for each listing.

Facility Name	Address	Map ID(s)	DEH Case No(s).
Brown Field	1424 Continental Street	2	H21496-001
Former U.S. Border Patrol Pistol Range	North of Pogo Row	3	H37776-001
Former Rohr Engine Facility	1500 Heritage Road	11	H19053-002
Auto Recycling	980 Otay Valley Road	12	H30802-001
Kaiser Foundation	4650 Palm Avenue	13	H37970-001
OLA Imports and Exports	935 Heritage Road	14	H39789-001
Tripp Salvage Landfill (Sesi Property and Barnhart and Dantzler Property)	West of northern termination of Cactus Road	16,17	H32115-001
Martinez Ranch	2160 Cactus Road	18	H99064-001
Former Martinez Outdoor Storage	2770 Martinez Ranch Road	20	H39743-001

Additional information from agency file reviews performed as part of our 2007 HMTS and/or obtained from GeoTracker as part of this Updated HMTS for the above facilities is summarized in Section 3.2.

3.1.3 ERNS and HMIRS Listings

We reviewed the Emergency Response Notification System (ERNS) and the Hazardous Material Incident Report System (HMIRS) databases for facilities with reported hazardous substance release incidents. Fifteen facilities located within the boundaries of the Site are listed on one or both of these databases. Offsite facilities within ⅛-mile of the Site were not referenced on either database.

Information in the database listings for the 15 onsite facilities indicates that the releases generally consisted of surficial spills of fuel or temporary exposure of workers or personnel to noxious fumes that were mitigated by or under the oversight of the local fire department or office of emergency services. In addition, these 15 facilities do not appear on any other database that reports unauthorized releases of hazardous substances. Based on this information and the nature of the releases, there is low likelihood that these facilities present an environmental concern to the Site at this time.

3.1.4 SWF/LF Listings

The Solid Waste Facilities/Landfill Sites (SWF/LF) database is maintained by the California Integrated Waste Management Board (CIWMB) and lists solid waste facilities, operations, and disposal facilities throughout the State of California. One waste facility within the boundaries of the Site is listed on this database, Tripp Salvage Landfill. Agency records reviewed at the County LEA as part of our 2007 HMTS indicate that this landfill is comprised of two adjacent properties located west of the northern termination of Cactus Road, the Barnhart and Dantzler Property (Map ID 16) and the Sesi Property (Map ID 17). One offsite waste facility was also identified on this database, the Shinohara II Burn Site (Map ID 9). Agency records reviewed at the County LEA as part of our 2007 HMTS indicate that this property is adjacent to the north of Area 1 on the south side of the Otay River. Additional information regarding these facilities in our 2007 HMTS and a summary of our recent discussions with representatives of the County LEA as part of this Updated HMTS is in Section 3.2.

The following facilities were identified in our 2007 HMTS as solid waste disposal sites, but were not referenced in the EDR Report on the SWF/LF listings or on databases that report releases of hazardous materials:

- **Former INS Shooting Range (Map ID 4)**. According to our 2007 HMTS, this facility was located at the north end of Brown Field and was a former disposal site for burn ash and sand blast grit. Additional information from regulatory agency files reviewed as part of our 2007 HMTS and GeoTracker website as part of this Updated HMTS is in Section 3.2.

- **Organic Recycling West, 1202 La Media Road (Map ID 5).** As discussed in our 2007 HMTS, this facility was classified as a composting facility. Additional information from regulatory agency files reviewed as part of our 2007 HMTS and GeoTracker website as part of this Updated HMTS is in Section 3.2.

- **Dillons Trail Site (Map ID 15).** According to our 2007 HMTS, the Dillons Trail Site was located in Area 2 southwest of the southern termination of Caliente Avenue. This property reportedly consisted of several parcels where illegal disposal activities were initially discovered in 1987. Additional information from regulatory agency files reviewed as part of our 2007 HMTS is in Section 3.2.

- **Martinez Ranch Canyon Fill (Map ID 19).** According to our 2007 HMTS, this property was located to the southwest of the Martinez Ranch Compound (Map ID 18). Previous assessment activities revealed that fill containing debris was present at this property. Additional information from regulatory agency files reviewed as part of our 2007 HMTS agency correspondence as part of this Updated HMTS is in Section 3.2.

- **San Ysidro Burn Site.** According to our 2007 HMTS, this property was located in Area 2 approximately ⅛-mile southwest of the intersection of Otay Mesa Road and Hawken Drive. Reportedly, approximately 12,000 to 15,000 cubic yards of burn ash were placed at this property from 1947 to 1957. Discussions with a representative of the County LEA indicated that the property was issued a "clean closed" status in 2000 following the excavation of the impacted soils. As previously concluded in our 2007 HMTS, the "clean closed" status of the case and cleanup under County LEA oversight indicates that this property is unlikely to require additional mitigation prior to future redevelopment and does not represent an environmental concern for the Site at this time.

3.1.5 Underground Storage Tank Listings

The EDR Report indicates that 18 onsite facilities and one offsite facility are referenced as containing either registered USTs (UST database), active or inactive USTs (SWEEPS database), or historical USTs (HIST UST database).

Five of the 19 listings are associated with onsite facilities that are also listed on the LUST database. These listings are identified as:

- Brown Field, 1424 Continental Street, Map ID 2.
- Piper Ranch, Map ID 6.
- Former Rohr Engine Facility, 1500 Heritage Road, Map ID 11.
- Arco Service Station, 2510 Otay Center Drive, Map ID 22.
- Air Liquide Industrial, 9955 Via De La Amistad, Map ID 23.

The referenced offsite facility is Former Red Cab, 803 E San Ysidro Boulevard, which is also listed on the LUST database. However, based on information provided in the LUST database, it is unlikely that operations at this facility have negatively impacted the Site.

The remaining 13 listings are not on databases that report unauthorized releases of hazardous substances. As such, there is a low likelihood that these 13 listings present an environmental concern to the Site at this time.

3.1.6 No Further Remedial Action Planned (NFRAP) Listings

The NFRAP list is maintained by the United States Environmental Protection Agency (EPA) and includes archived facilities where assessment has reportedly been completed, and it has been determined that no further steps will be taken to include the site on the National Priority List (NPL).

One property was identified on the NFRAP database, identified as the Brown Field Hazardous Waste Site. Review of EPA case files for this facility as part of our 2007 HMTS indicates that this property was located in Area 1, approximately one mile west of Brown Field Airport in an industrial/commercial area adjacent to Otay Valley Road. Reportedly, the EPA provided oversight of the cleanup of approximately 300 deteriorated drums containing hazardous substances deposited at the property by a trucker enroute to Tijuana, Mexico. Cleanup activities were conducted in 1983 and included proper disposal of the drums and excavation and disposal of approximately 40 cubic yards of contaminated soil. Following completion of the cleanup, the EPA reportedly stated that no further action was required. As previously concluded in our 2007 HMTS, the closed status of the case and cleanup under EPA oversight indicates that this property is unlikely to require additional mitigation prior to future redevelopment and does not represent environmental concern for the Site at this time.

3.1.7 EnviroStor Listings

One facility was identified on the DTSC EnviroStor database: Honeywell, Inc, 2055 Dublin Drive, which is located in Area 4. This facility is reportedly under DTSC oversight for permitted hazardous waste disposal. References regarding unauthorized releases of hazardous substances were not noted in EnviroStor. In addition, this facility is not listed on databases that report unauthorized releases of hazardous substances or petroleum. As such, there is a low likelihood that this facility presents an environmental concern to the Site at this time.

3.1.8 Orphan Summary

The EDR *Orphan Summary* identifies properties/facilities that have incomplete address information and could not be specifically plotted. A total of 290 properties/facilities were listed in the *Orphan Summary*; however in some cases, multiple records were listed for the same property/facility. Based on the distances of these properties/facilities from the Site and the nature of the databases on which the listings appear, 283 of the 290 records do not appear to present an environmental concern to the Site at the present time.

The remaining seven listings are associated with properties/facilities interpreted to be located within or in proximity to the boundaries of the Site and referenced on databases that report unauthorized releases of hazardous substances, petroleum, or waste disposal facilities. Information regarding these properties/facilities is provided below.

- **Otay Mesa Road Widening Project, Map ID 1,** is referenced on the LUST database. According to our 2007 HMTS, this project included several properties immediately north and south of Otay Mesa Road (former Highway 905). Additional information from regulatory agency files reviewed as part of our 2007 HMTS and from GeoTracker as part of this Updated HMTS is in Section 3.2.

- **Piper Ranch, Map ID 6**, is referenced on the LUST database. Additional information from regulatory agency files reviewed as part of our 2007 HMTS and from GeoTracker as part of this Updated HMTS is in Section 3.2.

- **Former Dennery Ranch, Map ID 7,** is referenced on the EnviroStor database. Additional information from regulatory agency files reviewed as part of our 2007 HMTS and from EnviroStor as part of this Updated HMTS is in Section 3.2.

- **Shinohara I Burn Site, Map ID 9,** is referenced on the SWF/LF database. According to our 2007 HMTS, this property is approximately ⅛-mile north of Area 1 on the north side of the Otay River. Reportedly, approximately 850,000 cubic yards of burn ash material were placed at this property and the Shinohara Burn Site II (Map ID 9) in 1978. Additional information from regulatory agency files reviewed as part of our 2007 HMTS is in Section 3.2.

- **Southbay Operations Center, Map ID 10,** is referenced on the LUST database. Information regarding this facility from review of GeoTracker is in Section 3.2.

- **Britannia Boulevard Property, 2133 Britannia Boulevard, Map ID 21,** is referenced on the EnviroStor database. Information regarding this property from review of the EnviroStor website is in Section 3.2.

- **South Bay Burn Site,** is referenced on the SWF/LF database. According to our 2007 HMTS, this facility consists of a 50-acre parcel in Area 1 southeast of the intersection of Palm Avenue and I-805, which was used as a trash incineration facility from approximately 1950 to 1963. Approximately 850,000 cubic yards of material were reportedly exported from this facility in 1978 and used as fill material on the Shinohara I Burn Site (Map ID 8) and Shinohara II Burn Site (Map ID 9). Approximately 73,000 cubic yards of additional material found at this facility were hauled to a landfill in 1993 and 1994 as part of mitigation activities. Following completion of the excavation activities, the County LEA issued a "clean closed" status for this facility, and the property was redeveloped with a shopping center. As previously concluded in our 2007 HMTS, the "clean closed" status of the case from the County LEA and redevelopment of the property indicates that it is unlikely to require additional mitigation prior to future redevelopment and does not represent environmental concern for the Site at this time.

3.2 Regulatory Case Document Review

This section summarizes additional information obtained from agency file reviews conducted as part of our 2007 HMTS and from GeoTracker and EnviroStor as part of this Updated HMTS for

properties/facilities of potential environmental concern identified in Section 3.1. Copies of GeoTracker and EnviroStor records are in Appendix B.

3.2.1 Area 1

Fourteen properties/facilities of potential environmental concern were identified in Area 1 or within ⅛-mile of the boundaries of Area 1. The approximate locations of these properties/facilities (Map IDs 1 through 14) are depicted on Figure 3-1, and additional information for each property/facility from the sources listed in Section 3.2 follows below.

Otay Mesa Widening Project (Map ID 1)

As discussed in our 2007 HMTS, the Otay Mesa Widening Project (OMWP) included the areas immediately north and south of the former alignment of Highway 905, which is currently Otay Mesa Road. The project reportedly involved the expansion of former Highway 905 from four to six lanes. Assessment conducted in 1996 indicated that the pesticides dieldrin, endrin, DDT, and DDD were detected in soil in the eastern and western portions of the OMWP. Information on GeoTracker indicates that DEH Case H36821-001 was opened in May 1997 to further evaluate the pesticide-impacted soil initially reported in 1996. Reportedly, a letter from the City of San Diego dated August 8, 1998, was sent to DEH stating that the soil generated from the project was not contaminated. DEH administratively closed the case on August 15, 2012.

Based on the information above, a site reconnaissance of the OMWP site did not appear warranted and was not performed for this assessment.

Brown Field Municipal Airport, 1424 Continental Street (Map ID 2)

Information available in regulatory databases (Section 3.1) indicates 24 LUST cases and 1 SLIC case are associated with Brown Field that were historically or are currently under the oversight of the DEH. At the time of the 2007 HMTS, 14 of the LUST cases and the SLIC case were closed and involved contamination of soil only or a failed tank integrity test. Based on this information, it was concluded that there was a low likelihood that these 15 cases presented an environmental concern to the Site.

The remaining 10 cases were open and/or reportedly involved contamination of groundwater. The 10 cases pertain to UST fuel releases in the western portion of the Brown Field operations area, predominately in the area of the former fuel farm (Figure 3-1). Depth to groundwater in this area of Brown Field is estimated to be 200 feet; however, areas of perched groundwater have been encountered at shallower depths. A detailed summary of the nature and status of each of these cases was included in our 2007 HMTS. An updated summary of each case from review of information on GeoTracker is summarized in the following table.

DEH Case No.	Location in Operations Area	Updated Information
H10618-002	Northern Portion	The DEH indicated that "no further action related to the petroleum release at the site [was] required" in a letter dated May 23, 2011. Reportedly, the release associated with this case affected soil only and did not extend vertically to groundwater. At the time of case closure, residual hydrocarbon-impacted soil was reported to be left in place at an approximate depth of 15 feet in the area of a former waste oil UST.
H10618-015	Central Portion	The DEH indicated that "no further action related to the petroleum release at the site [was] required" in a letter dated August 19, 2003. Reportedly, the release associated with this case affected soil only and did not extend vertically to groundwater. At the time of case closure, residual hydrocarbon-impacted soil was reported to be left in place at an approximate depth of 32 feet in the area of a former heating oil tank.
H10618-016	Enclosed area in northwestern portion, known as the "fuel farm"	In January 2010, DEH consolidated Case Nos. H10618-016, -017, -018, -019, -022, and -023 into DEH Case No. H10618-016. In October 2011, additional site assessment of soil and groundwater was conducted by Ninyo and Moore downgradient of the former USTs associated with the cases above. Three soil borings were advanced to depths ranging from 205 to 210 feet, and soil samples were collected at 5- to 10-foot intervals. Groundwater was encountered in the borings at depths ranging from 176 to 185 feet. Following soil sampling activities, the borings were converted to monitoring wells MW9, MW10, and MW11, and groundwater samples were collected. Analysis of soil samples from boring MW11 detected oil-range hydrocarbons at depths ranging from 58 to 193 feet. Benzene was detected in one soil sample from boring MW10 at a depth of 63 feet. Petroleum hydrocarbons and volatile organic compounds (VOCs) were not detected in the remaining soil samples analyzed. Petroleum hydrocarbons and VOCs were not detected in groundwater samples collected from wells MW9, MW10, and MW11. Analysis of groundwater samples collected from existing monitoring wells MW4, MW5, MW6, and MW8 detected gasoline-range organics and VOCs, but at decreased concentrations compared to results from previous monitoring events. Approximately 1.85 feet of liquid phase hydrocarbons (LPH) were present in well MW7, located in the southwest portion of the former fuel farm. Based on the results of the October 2011 assessment and previous assessments related to former USTs, Ninyo and Moore estimates 111,500 cubic yards of hydrocarbon-impacted soil remain in the former fuel farm at variable depths ranging from existing ground surface to approximately 200 feet. Following review of the October 2011 assessment results, the DEH requested further delineation of soil and groundwater impacts downgradient (east) of well MW7. Ninyo and Moore submitted a workplan for this work in September 2012 that is currently in review by DEH.
H10618-017	Fuel Farm	In January 2010, DEH consolidated Case Nos. H10618-016, -017, -018, -019, -022, and -023 into DEH Case No. H10618-016.
H10618-018	Fuel Farm	In January 2010, DEH consolidated Case Nos. H10618-016, -017, -018, -019, -022, and -023 into DEH Case No. H10618-016.
H10618-019	Fuel Farm	In January 2010, DEH consolidated Case Nos. H10618-016, -017, -018, -019, -022, and -023 into DEH Case No. H10618-016.

DEH Case No.	Location in Operations Area	Updated Information
H10618-020	Northeastern Portion	The DEH indicated that "no further action related to the petroleum release at the site [was] required" in a letter dated August 19, 2003. Reportedly, the release associated with this case affected soil only and did not extend vertically to groundwater. At the time of case closure, residual hydrocarbon-impacted soil was reported to be left in place at an approximate depths ranging from 11.5 to at least 20 feet in the area of a former heating oil tank.
H10618-022	Fuel Farm	In January 2010, DEH consolidated Case Nos. H10618-016, -017, -018, -019, -022, and -023 into DEH Case No. H10618-016.
H10618-023	Fuel Farm	In January 2010, DEH consolidated Case Nos. H10618-016, -017, -018, -019, -022, and -023 into DEH Case No. H10618-016.
H10618-024	Northwestern Portion	The DEH indicated that "no further action related to the petroleum release at the site [was] required" in a letter dated July 2, 2012. Reportedly, the release associated with this case affected soil only and did not extend vertically to groundwater. At the time of case closure, residual hydrocarbon-impacted soil was reported to be left in place at an approximate depth of 15 feet in the area of a former aviation fuel tank.

Section 4.1 summarizes our limited visual reconnaissance of Brown Field.

Former U.S. Border Patrol Pistol Range (Map ID 3)

As discussed in our 2007 HMTS, the former U.S. Border Patrol Pistol Range (historically known as Brown Field Firing Range) was formerly located on the north side of Brown Field, north of Pogo Row. The facility consisted of three adjacent firing ranges that were previously used by the Immigration and Naturalization Service (INS) from 1989 to approximately 2002.

DEH records reviewed for our 2007 HMTS regarding Case No. H37776-001 indicated that an assessment conducted in 1998 identified 3,000 cubic yards of lead-containing soil at this facility. Additional assessment in 2000 found that at least 3,500 cubic meters of soil at the three firing ranges contained high concentrations of lead, antimony, arsenic, copper, molybdenum, and zinc. Excavation, characterization, and disposal of the impacted soil were recommended to mitigate the former facility.

Information available on GeoTracker indicates that this case is open as of November 1998. However, recent aerial photographs of the facility show that the western portion of the former pistol range has been redeveloped with a large concrete building and maintenance yard.

Information available on EnviroStor indicates that the eastern portion of this facility is currently occupied by the San Diego Space Surveillance Station (SDSSS) and that assessment is ongoing to evaluate former munitions installations that were operated by the U.S. Navy, prior to use of the facility by the U.S. Border Patrol. A Remedial Investigation/Feasibility Study (RI/FS) Workplan was prepared

by the U.S. Army Corps of Engineers and Sky Research in February 2012. The workplan details a comprehensive investigation of soil and debris in the area of a former small arms range and skeet range located in the northeastern and southwestern portions of the SDSSS facility, respectively. In addition, the workplan proposes an interim removal action (IRA) that includes excavation and disposal of lead and polycyclic aromatic hydrocarbon (PAH) impacted soil previously identified at both of these former ranges. Reportedly, the IRA will be completed in 2013 and the RI/FS in 2014.

Section 4.1 summarizes our limited visual reconnaissance of the former U.S. Border Patrol Pistol Range.

Former INS Shooting Range (Map ID 4)

As described in our 2007 HMTS, the former INS Shooting Range was located on the north side of Brown Field north of the eastern termination of Pogo Row. City of San Diego Local Enforcement Agency (City LEA) records indicate that the facility was used by the INS for firearms training in the 1980s. The INS reportedly vacated the property in 1989 and relocated to a new facility approximately ¼ mile west of the original location, to the site of the former U.S. Border Patrol Shooting Range (Map ID 3). In 1987, fill material reportedly containing burn ash and sand blast grit was excavated from a solid waste disposal site and deposited at the INS Shooting Range. The materials were used to create safety berms at the property, approximately 4 to 7 feet high. Remedial excavation activities were conducted in 2001 at the facility followed by grading and revegetaiton. In 2002, the City LEA issued a "no further action" designation for the facility.

Information available on GeoTracker indicates that San Diego Regional Water Quality Control Board Case No. 2093900 was historically associated with this facility. Information regarding the remedial excavation in 2001 indicates that soil containing concentrations of lead less than 350 milligrams per kilogram (mg/kg) was left in place at the facility and capped with concrete. Soil containing concentrations of lead that exceeded 350 mg/kg was disposed of at a landfill. The case is noted as closed as of May 2004.

Section 4.1 summarizes our limited visual reconnaissance attempted for the former INS Shooting Range.

Former Organic Recycling West, 1202 La Media Road (Map ID 5)

Documents at the County LEA that we reviewed as part of our 2007 HMTS indicate that this facility began operating 1994, is approximately 26 acres in size, and was classified as a composting facility. The facility is not located on an existing or closed landfill and, reportedly, only "green" and "woody" materials (i.e., materials which are derived from plant material) were accepted at the facility. During a routine inspection conducted on July 26, 2006, by City LEA staff, the following observation was noted: "Vehicular fluids and leaking batteries were spilled onto soil west of vehicular maintenance area and

shall be properly cleaned up during site restoration activities or in accordance with applicable regulations from other agencies." According to the City LEA, the responsibility of overseeing the cleanup of this spill was referred to the DEH.

This facility does not appear on any database that reports unauthorized releases of hazardous substances and is not referenced on GeoTracker. This suggests that the unauthorized hazardous waste release incident was minor and did not warrant the opening of a DEH case.

Section 4.1 summarizes our limited visual reconnaissance of former Organic Recycling West.

Piper Ranch (Map ID 6)

As described in our 2007 HMTS, the Piper Ranch property includes 27 parcels adjacent to the west of Piper Ranch Road. Air Wing Road bisects the 27 parcels in a north-south direction. The property is currently improved with several commercial/light-industrial developments, collectively known as the Piper Ranch Business Park. Records reviewed as part of our 2007 HMTS and from GeoTracker for three DEH cases associated with this property are summarized below.

- DEH Case No. H25621-001. Surficial soil in the southeastern portion of the property impacted with waste oil and pesticides was excavated and disposed of in 1988. A 500-gallon gasoline UST was encountered beneath the waste oil contamination which was addressed under DEH Case No. H25621-002 (discussed below). The case involving pesticide contamination in soil on the property was subsequently transferred to SAM Case No. H26521-003 (discussed below). DEH Case No. H25621-001 was closed in 1996.

- DEH Case No. H25621-002. Due to the observed presence of hydrocarbon-impacted soil beneath the 500-gallon UST, excavation and soil sampling activities were conducted in 1988. Analysis of soil samples indicated that approximately 2 cubic yards or less of contaminated soil was present in soil beneath the former UST location. The vertical extent of impacts did not appear to extend to groundwater. Based on this information, the DEH determined that no further action was required regarding DEH Case #H26521-002 in 1995.

- DEH Case No. H25621-003. Additional soil sampling was conducted in 1988 and 1989 to assess the extent of residual pesticides in soil initially identified as part of DEH Case No. H25621-001. Analyses of the soil samples indicated that approximately 10 to 15 cubic yards of soil was impacted with pesticides with concentrations that exceeded regulatory screening levels. This soil was subsequently excavated and disposed of at a landfill. In 1994, additional soil samples were collected from 24 locations throughout the property and analyzed. Various pesticides were detected but concentrations were less than regulatory screening levels. Information available on GeoTracker indicates Case No. H25621-003 was closed by DEH in 1996.

Section 4.1 summarizes our limited visual reconnaissance of the Piper Ranch Business Park.

Former Dennery Ranch (Map ID 7)

Documents that we reviewed at the County LEA as part of our 2007 HMTS indicate that this property is located north of the intersection of Dennery Road and Red Fin Lane. Reportedly, approximately 5,000 cubic yards of burn ash deposits, originating from the Shinohara II Burn Site (Map ID 9 and adjacent to the north of this property), are present over an approximately 0.5-acre area in the northwestern portion of this property. In a letter dated October 25, 2006, the County LEA approved a plan to construct a 2-foot-thick vegetative soil cap over the areal extent of the burn ash deposits.

Information available on EnviroStor indicates that Pardee Homes entered into a Voluntary Cleanup Agreement (VCA) with the DTSC in 2005 for review and opinion on potential health risks to future occupants of a proposed residential community due to the proximity of the Shinohara II Burn Site. Based on a health risk assessment prepared in 2005, the DTSC indicated that the Shinohara II Burn Site does not pose a significant health threat to future residents of the proposed residential community provided the following conditions are met:

1) The Shinohara II Burn Site will continue to remain undisturbed and covered with vegetation.

2) The DEH or other appropriate regulatory agency will provide oversight of any future disturbance to the burn site soils to ensure that potential dust migration will be controlled to protect the health of residents in the adjacent residential community.

Information available on EnviroStor indicates that the VCA case was closed in January 2006. At the time of our 2007 HMTS, grading was being conducted at the property as part of redevelopment.

Section 4.1 summarizes our limited visual reconnaissance of the former Dennery Ranch.

Shinohara I Burn Site (Map ID 8)

Information reviewed at the County LEA as part of our 2007 HMTS indicates the Shinohara I Burn Site is located approximately ⅛-mile north of Area 1 on the north side of the Otay River. Reportedly, approximately 850,000 cubic yards of burn ash material was placed at this property and the Shinohara II Burn Site (Map ID 9) in 1978. The majority of the burn ash material reportedly was subsequently excavated and removed from this property during mitigation activities in 1993 and 2001. Approximately 1,500 cubic yards of burn ash was left in place at the property. In a letter dated July 19, 2001, the County LEA stated that "it is the position of the LEA that no further action is required at this time." Based on this information and the offsite location of this property, a site reconnaissance of the Shinohara I Burn Site did not appear warranted and was not performed for this assessment.

Shinohara II Burn Site (Map ID 9)

Information reviewed at the County LEA as part of our 2007 HMTS indicates the Shinohara II Burn Site is located adjacent to the north of Area 1 on the south side of the Otay River. Reportedly, approximately 850,000 cubic yards of burn ash material was placed at this property and the Shinohara Burn Site I in 1978. Up to a 40-foot-thick layer of burn ash is believed to exist at the Shinohara II Burn Site. Ms. Melissa Porter with the County LEA indicated that burn ash material has migrated from the Shinohara II Burn Site onto the adjacent property to the south, the former Dennery Ranch (Map ID 7).

We contacted Ms. Porter on August 31, 2012, regarding the status of this property. Ms. Porter indicated the property is currently in litigation and the property owner has recently passed away. She also indicated that the owner's family is not interested in assuming responsibility for the property and it may become an orphan site. Ms. Porter also indicated that this property is privately owned and access is limited. Due to this information and the offsite location of this property, a site reconnaissance of the Shinohara II Burn Site did not appear warranted and was not performed for this assessment.

Southbay Operations Center (Map ID 10)

Information available on GeoTracker indicates a 1,500-gallon diesel UST was encountered northwest of the northern termination of Air Wing Road in 2007 during construction of the Southbay Expressway Operations Center at 1129 La Media Road. Due to the presence of hydrocarbon-impacted soil beneath the UST, the DEH opened Case No. 207903-001. Subsequent assessment activities were conducted including the collection of soil samples from borings advanced in the area of the former UST to depths of 30 feet. Analysis of the soil samples showed that that hydrocarbon-impacted soil extended vertically to a depth of 15 feet, laterally to 5 feet beyond the limits of the former UST pit, and that VOCs were not detected. Based on this information, the DEH closed the case in a letter dated May 4, 2011. In their closure letter, the DEH noted that an estimated 200 cubic yards of hydrocarbon-impacted soil remain at this property in the area of the former UST.

Section 4.1 summarizes our limited visual reconnaissance of the Southbay Operations Center.

Former Rohr Engine Facility, 1500 Heritage Road (Map ID 11)

Information available in regulatory databases (Section 3.1) and on GeoTracker indicate two DEH cases are associated with this facility, H19053-001 and H19053-002. Each case is summarized as follows:

- DEH Case No. H19053-001. This case was opened due to an unauthorized release of aviation fuel that was identified during removal of a UST from this facility 1987. Reportedly, the release affected soil only and the case was closed by DEH in 1988. Additional details regarding this case were not available on GeoTracker.

- DEH Case No. H19053-002. This case was opened due to an unauthorized release of aviation fuel at this facility from an unreported source. Reportedly, the release affected soil only and the case was closed by DEH in 1992. Additional details regarding this case were not available on GeoTracker.

Section 4.1 summarizes our limited visual reconnaissance of the former Rohr Engine Test Facility.

Auto Recycling, 980 Otay Valley Road (Map ID 12)

Information available in regulatory databases (Section 3.1) and on GeoTracker indicates that DEH Case No. H30802-001 is associated with this facility for an unauthorized release of diesel from an unreported source. Reportedly, the release affected soil only, and the case was closed by DEH in 2007. Additional details regarding this case were not available on GeoTracker.

Section 4.1 summarizes our limited visual reconnaissance of the Auto Recycling facility.

Kaiser Foundation, 4650 Palm Avenue (Map ID 13)

Information available in regulatory databases (Section 3.1) and on GeoTracker indicate that DEH Case No. H37970-001 is associated with this facility for a spill of gasoline from an overturned tanker in June 2010. Gasoline reportedly entered a storm drain below the sidewalk adjacent to this facility and impacted sediment in the storm drain and soil and groundwater in the vicinity of the storm drain outfall at the Otay River. Approximately 130 cubic yards of impacted soil/sediment were removed from the storm drain and outfall area and disposed of at a landfill in July 2010. DEH noted that residual concentrations of gasoline and VOCs in soil do not threaten public health or the environment. Following the removal of impacted soil/sediment, groundwater samples were collected from twelve monitoring wells installed along the storm drain alignment and in the outfall area. Analysis of the samples showed that gasoline was not detected and concentrations of VOCs were well below public health standards. The DEH closed the case on June 7, 2011. Based on this information, a site reconnaissance of the Kaiser Foundation facility did not appear warranted and was not performed for this assessment.

OLA Imports and Exports, 935 Heritage Road (Map ID 14)

Information available in regulatory databases (Section 3.1) and on GeoTracker indicates that DEH Case No. H39789-001 is associated with this facility. This case was opened in April 2012 as a result of submittal of a Phase I Environmental Site Assessment (ESA) prepared in 1995 by Geocon and a compliance letter prepared in April 2012 by Brash Industries to the DEH for review through the Voluntary Assistance Program. During the 1995 Phase I ESA, stained concrete and soil was observed in various areas of the facility, and batteries and engines were observed on the ground. It was

recommended that the areas of staining be further investigated to determine the extent of potential impacts to underlying soils.

The April 2012 compliance letter describes best management practices (BMPs) that were implemented at the facility to minimize current and future discharges to soil and surface waters, including storing engines off the ground, use of concrete pads with berms for auto dismantling, and storing hazardous waste in a covered space with an impervious floor. The letter also describes the observations from a site reconnaissance conducted in March 2012 by Brash Industries during which no oil spills of significance were noted and no hydrocarbon sheen was observed in puddles of standing water from recent rainfall. Based on this information, Brash Industries concluded that the concerns of petroleum hydrocarbon contamination of the soil have no basis and that no significant damage to the environment has occurred from the staining observed during the 1995 Phase I ESA.

Representatives of DEH inspected the facility on May 16, 2012, and noted that asphalt was observed under the work areas, engines were located on pallets staged on concrete, and the facility was clean and organized. Based on their inspection, the DEH concurred that the BMPs implemented decreased the likelihood of an illegal discharge to the environment. However, DEH review of their inspection records for the facility revealed multiple violations between 1996 and 2007 where oil/fuel spills/stains were noted. In combination with the observations noted in the 1995 Phase I ESA, the DEH concluded that petroleum-impacted soil likely remains at shallow depths (up to of depths 5 feet) in various locations at the facility. As such, the DEH noted they are unable to provide a closure letter without assessment of the extent of petroleum impacts. The DEH did note that they have no objection to the continued use of the facility as an auto recycler provided that they are notified prior to surface grading or proposed changes in land use.

Section 4.1 summarizes our limited visual reconnaissance of OLA Imports and Exports.

3.2.2 Area 2

One property of potential environmental concern was identified in Area 2 or within ⅛-mile of the boundaries of Area 2. The approximate location of this property (Map ID 15) is depicted on Figure 3-2. This section summarizes additional information for this property from the sources described in Section 3.2.

Dillons Trail Site (Map ID 15)

Documents reviewed at the City LEA as part of our 2007 HMTS indicate that the Dillons Trail Site is located southwest of the southern termination of Caliente Avenue and reportedly consists of several parcels where illegal disposal activities were initially discovered in 1987. The discarded materials primarily consisted of demolition debris with minor amounts of solid waste. Representatives of the

City LEA conducted periodic inspections of the site from 1999 through 2001 and observed "evidence of historical surface dumping that had been largely cleaned up." Subsequently, the City LEA recommended a "zero inspection frequency" for the site in a letter dated January 3, 2002. Reportedly, City LEA representatives no longer conduct inspections of this property.

Section 4.2 summarizes our limited visual reconnaissance of the Dillons Trail property.

3.2.3 Area 3

Five properties/facilities of potential environmental concern were identified in Area 3. The approximate locations of these properties/facilities (Map IDs 16 through 20) are depicted on Figure 3-3, and additional information for each property/facility from the sources listed in Section 3.2 follows below.

Tripp Salvage Landfill (Map IDs 16 and Map ID 17)

As discussed in our 2007 HMTS, the Tripp Salvage Landfill is located in Area 3 adjacent to the west of Cactus Road. Information available in regulatory agency databases (Section 3.1) and on GeoTracker indicates that Case No. H32115-001 was historically associated with this facility for discovery of hazardous debris in 1991. This case was transferred to the County LEA in 1996 for oversight and administratively closed by DEH in June 2012.

Records reviewed at the County LEA as part of our 2007 HMTS indicated that the Tripp Salvage Landfill consists of one property divided into two properties (due to different property owners) for remediation purposes. The two properties are identified as the Barnhart and Dantzler Property (Map ID 16), located west of the northern termination of Cactus Road, and the Sesi Property (Map ID 17), located adjacent to the south of the Barnhart and Dantzler Property. Reportedly, the Barnhart and Dantzler Property includes 4.07 acres of land where automobile dismantling waste was accepted from approximately 1968 to 1977. The Sesi Property includes 33.25 acres of land where automobile dismantling waste was reportedly placed from approximately 1968 to 1977 and burn ash-contaminated soil was placed in 1987. It is estimated that the waste extends to a depth of approximately 65 feet below both properties.

Groundwater monitoring activities conducted at the Barnhart and Dantzler Property in 1998 indicated that detectable concentrations of VOCs, semi-volatile organic compounds (SVOCs), and metals were present in groundwater samples collected from this property. Following additional assessment activities at the Barnhart and Dantzler Property, an asphalt cap was reportedly constructed over the areal extent of the waste, estimated to encompass 1.1 acres, in 2001. In a letter dated February 3, 2003, the County LEA indicated that "no further action" was required for the Barnhart and Dantzler Property and that the City LEA would assume future oversight responsibilities for this property.

Groundwater monitoring activities conducted at the Sesi Property in 2005 indicated that detectable concentrations of VOCs, SVOCs, and metals were present in the groundwater samples collected from this property. Following additional assessment, a revegetation plan was submitted to the County LEA in 2006 that proposed an engineered soil cap to facilitate in-place closure of the waste at the Sesi Property. We contacted Ms. Melissa Porter of the County LEA on August 31, 2012, regarding the status of the Sesi Property. Ms. Porter indicated the soil cap design and associated grading plans have been submitted to City of San Diego for review but the cap has not yet been constructed.

Section 4.3 summarizes our limited visual reconnaissance of the Barnhart and Dantzler Property and Sesi Property.

Martinez Ranch, 2160 Cactus Road (Map IDs 18 and 19)

Information reviewed at the DEH as part of our 2007 HMTS indicates that Martinez Ranch is located in Area 3 immediately west-southwest of the intersection of Airway Road and Cactus Road. The property is roughly divided into two portions, equal in size, consisting of the operations compound in the northeastern portion of the property (Map ID 18) and agricultural fields and a canyon fill area in the southwestern portion of the property (Map ID 19). A Phase I and Phase II ESA was performed at the property by Rincon in 2004. The Phase I ESA identified the following concerns:

- Potential for pesticides in soil due to historic and current agricultural land use.
- Observations of stained soil in the operations compound in proximity to an aboveground storage tank (AST) used to store motor oil and drums containing oil additive.
- The presence of two septic systems at the operations compound.
- Observations of "burn" areas and areas of minor soil staining observed at the compound.
- Canyon fill from an unknown source observed in the southwestern corner of the property.

Rincon conducted the Phase II ESA to address the environmental concerns identified by the Phase I ESA. Based on the findings of the Phase II ESA, Rincon concluded that the burn areas, soil stained areas, septic system leach field areas, did not appear to contain soil impacted with the various constituents analyzed for at concentrations exceeding their respective soil screening levels for residential land use. Rincon estimated that approximately 17,300 to 26,100 cubic yards of soil in the northeastern portion of Martinez Ranch were impacted with elevated concentrations of the pesticides DDE, DDT, and/or toxaphene. In addition, analysis of soil samples collected from the canyon fill in the southwestern corner of the property showed elevated concentrations of petroleum hydrocarbons and lead.

Information available in regulatory agency databases (Section 3.1) and on GeoTracker indicates that DEH Case No. H99064-001 is associated with Martinez Ranch. This case was opened in 2004 when Centex Homes submitted an application to DEH for oversight of mitigation activities under the

Voluntary Assistance Program, prior to redevelopment of the property with a residential community. In a letter dated July 23, 2007, Centex Homes indicated that they were not moving forward with redevelopment of the property due to changes in market conditions and requested to be withdrawn from the VAP. We contacted Mr. Scott Weldon at the DEH on September 2, 2012, regarding the status of this property. Mr. Weldon indicated that no progress has been made on property following the withdrawal of Centex Homes from the VAP. According to Mr. Weldon, the pesticide, hydrocarbon and lead-impacted soil identified in the Rincon 2004 Phase II ESA has not been mitigated.

Section 4.3 summarizes our limited visual reconnaissance of the Martinez Ranch Compound and attempted visual reconnaissance of the Martinez Canyon Fill.

Former Martinez Outdoor Storage, 2770 Martinez Ranch Road (Map ID 20)

Information from regulatory database review (Section 3.1) and GeoTracker indicates that DEH Case No. H39743-001 is associated with this property for review of an assessment of pesticides in shallow soil and a former AST. The property was formerly used by Martinez Ranch (Map ID 18) for agricultural purposes and assessment activities were conducted in 2009 prior to redevelopment of the property with a storage facility. The assessment reportedly included collection of shallow soil samples from the area of the former AST and from the central portion of the property within the area of historical agricultural use. Analysis of the samples showed detections of petroleum hydrocarbons and several pesticides, but at concentrations below health screening levels for commercial/industrial land use. Based on this information, the DEH closed the case in a letter dated March 8, 2011.

Section 4.3 summarizes our limited visual reconnaissance of the former Martinez Outdoor Storage property.

3.2.4 Area 4

One property of potential environmental concern was identified in Area 4. The approximate location of this property (Map ID 21) is depicted on Figure 3-4. This section summarizes additional information for this property from the sources listed in Section 3.2.

Britannia Boulevard Property, 2133 Britannia Boulevard (Map ID 21)

Information available on EnviroStor indicates that this site was formerly used for agricultural purposes and was redeveloped with a commercial/industrial business park in 2005. Prior to redevelopment, a Preliminary Endangerment Assessment (PEA) was conducted at the property in 2003 under the oversight of the DTSC. Analysis of soil samples collected from shallow soil on the property as part of the PEA detected elevated concentrations of pesticides.

To mitigate the potential health risk to future occupants due to potential exposure to impacted soil, a concrete cap was constructed over the entire property. In addition, a deed restriction was recorded for the property on March 26, 2004, that stated "The following restrictions apply to the property: it is not to be used as: a residence, including any mobile home or factory home built housing, constructed or installed for use as residential human habitation; a hospital for humans; a public school for person under 21 years of age; a day care center for children; convalescent homes; or any use that included full-time human habitation". The DTSC conducts annual inspections of the property to observe the condition of the concrete cap. According to information on EnviroStor, the most recent inspection was conducted on September 22, 2011. The inspection report notes that the concrete cap was observed to be in good condition.

Section 4.4 summarizes our limited visual reconnaissance of the Britannia Boulevard property.

3.2.5 Area 5

One property of potential environmental concern was identified in Area 5 or offsite within ⅛-mile of the boundaries of Area 5. The approximate location of this property (Map ID 22) is depicted on Figure 3-5. This section summarizes additional information for this property from the sources described in Section 3.2.

Arco Service Station, 2510 Otay Center Road (Map ID 22)

Information from regulatory database review (Section 3.1) and GeoTracker indicates that DEH Case No. H29556-001 is associated with this facility for an unauthorized release of gasoline from the eastern dispenser island in 2003. Assessments and remediation were conducted from 2003 to 2005 that included excavation and disposal of approximately 138 cubic yards of petroleum hydrocarbon-impacted soil and installation of three groundwater monitoring wells. Analysis of groundwater samples collected from the monitoring wells did not detect gasoline or VOCs. Based on this information, the DEH closed the case in a letter dated October 27, 2005. At the time of case closure, an estimated 38 cubic yards of petroleum hydrocarbon-impacted soil remained at this facility in the area of the eastern dispensers.

Section 4.5 summarizes our limited visual reconnaissance of the Arco service station.

3.2.6 Area 6

One property of potential environmental concern was identified in Area 6 or offsite within ⅛-mile of Area 6. The approximate location of this property (Map ID 23) is depicted on Figure 3-6. This section summarizes additional information for this property from the sources described in Section 3.2.

Air Liquide Industrial, 9955 Via De La Amistad (Map ID 23)

Information from regulatory databases (Section 3.1) and GeoTracker indicates that DEH Case No. H29556-001 is associated with this facility for an unauthorized release of diesel that impacted soil in the area of a former dispenser island. The release was discovered in 2004 during the removal of the dispenser island and two diesel USTs. Assessment and remediation were conducted in 2005 that included excavation and disposal of approximately 15 cubic yards of diesel-impacted soil. Analysis of confirmation soil samples collected following the excavation activities indicated that approximately 6 cubic yards of diesel-impacted soil remain in the area of the former dispenser island at a depth of 7 feet. Based on this information, the DEH noted that the residual impacted soil is unlikely to affect groundwater and closed the case in a letter dated April 28, 2006.

Section 4.6 summarizes our limited visual reconnaissance of Air Liquide Industrial.

4. SITE RECONNAISSANCE

On September 11 and 12, 2012, we conducted a limited visual reconnaissance of selected properties of potential environmental concern based on our review of the environmental database report, the 2007 HMTS, agency records available on GeoTracker and EnviroStor, and correspondence with regulatory agencies (Section 3). During the limited visual reconnaissance, we were not accompanied by site representatives. The visual reconnaissance was generally limited to observing the exterior portions of the properties from nearby public streets or adjacent properties that were publicly accessible.

Observations noted during the site reconnaissance are summarized below by area, along with any limitations encountered during the reconnaissance activities. Photographs of the properties observed are appended.

4.1 Area 1

Observations made during our limited visual reconnaissance of select properties of potential environmental concern identified in Area 1 are summarized below.

4.1.1 Brown Field Municipal Airport (Map ID 2)

With the exception of the Brown Field operations area, located at 1424 Continental Street and accessible to the public from Otay Mesa Road, our observations of Brown Field were limited to portions of the property visible from nearby streets, including La Media Road and Heritage Road. Exterior portions of the Brown Field operations area were observed from onsite streets, including Sikorsky Street, Fairchild Way, Boeing Street, and Curran Street.

Observations of the Brown Field operations area were similar to that observed during our 2007 HMTS. An administration and control tower building was observed in the central portion of the Brown Field operations area, and private plane hangars were observed in the northwestern and northern portions. ASTs containing jet fuel were observed to the south of the hangars and north of the administration and control tower building. Staining was not observed in the area of the ASTs.

Property adjacent to east and north of the Brown Field operations area consists of runways, a control tower, and vacant land. A circular unpaved area, enclosed by a chain-link fence, was observed adjacent to the west of the Brown Field operations area. Information sources reviewed in Section 3.2 suggest this area is the former "fuel farm" where numerous LUST-related investigations have been conducted. Several groundwater monitoring wells were observed within and in proximity to the fuel farm enclosure. The 55-gallon drums and soil stockpiles noted in the eastern portion of the former fuel farm in our 2007 HMTS appear to longer be present. No other direct evidence of environmental concerns was observed at Brown Field Municipal Airport during our limited visual reconnaissance.

4.1.2 Former U.S. Border Patrol Pistol Range (Map ID 3) and INS Shooting Range (Map ID 4)

Observations of the former U.S. Border Patrol Pistol Range were made from Pogo Row to the south of this property. The western portion of this property is currently occupied by a U.S. Border Patrol Maintenance facility and the eastern portion is occupied by the San Diego Space Surveillance Station. Access to the maintenance facilty and surveillance station was restricted, but we did not observe evidence of environmental concerns during our limited visual reconnaissance.

We attempted a visual reconnaissance of the former INS Shooting Range, but were unsuccessful as this former facility is located in the northern portion of Brown Field which is not accessible to the public or in proximity to public roads.

4.1.3 Former Organic Recycling West (Map ID 5)

Observations of the property formerly occupied by the Organic Recycling West facility were limited to portions visible from La Media Road, which is adjacent to the east of the property. The property appeared to be vacant and evidence of the composting operations described in our 2007 HMTS was not observed. The property is currently surrounded with a chain-link fence, and direct evidence of environmental concerns was not observed during our limited visual reconnaissance.

4.1.4 Piper Ranch (Map ID 6) and Former Dennery Ranch (Map ID 7)

Observations of Piper Ranch were limited to portions visible from Piper Ranch Road and interior driveways between the warehouses and businesses that currently occupy the property, known as the

Piper Ranch Business Park. The warehouses appeared to be leased by various tenants including a furniture distributor, sporting goods supplier, and tire distributor. Observations of the former Dennery Ranch property were limited to portions visible from Ocean View Hills Parkway and interior driveways between the multi-family homes that currently occupy the property. Direct evidence of environmental concerns was not observed at the Piper Ranch Business Park or former Dennery Ranch property during our limited visual reconnaissance.

4.1.5 Southbay Operations Center (Map ID 10)

Observations of the property where a former UST was encountered and removed during construction activities for the Southbay Expressway Operations Center in 2007 were limited to the portion visible from the northern boundary of the Piper Ranch Business Park. The property appeared to be vacant and covered in light vegetation. The property is currently surrounded with a chain-link fence, and evidence of environmental concerns was not observed during our limited visual reconnaissance.

4.1.6 Former Rohr Engine Test Facility (Map ID 11)

Observations of the property formerly occupied by the Rohr Engine Test Facility were limited to the portion visible from Heritage Road. The property appeared to be vacant and covered in light vegetation. A concrete slab and two steel piers were observed along the western property boundary. The auto sales lots that were observed to occupy this property in our 2007 HMTS were no longer present. The property is currently surrounded with a chain-link fence, and evidence of environmental concerns was not observed during our limited visual reconnaissance.

4.1.7 Auto Recycling (Map ID 12) and OLA Imports and Exports (Map ID 14)

Observations of the Auto Recycling facility and OLA Imports and Exports were limited to the portions visible from Otay Valley Road and Heritage Road, respectively. Both facilities are surrounded with fencing, but it appears they are active as several automobiles in various stages of dismantling were observed at both facilities. Evidence of environmental concerns was not observed during our limited visual reconnaissance at either facility.

4.2 Area 2

Observations of the only property of concern in Area 2, the Dillons Trail Site (Map ID 15) were limited to portions visible from the main trail that is accessed at the southern termination of Caliente Avenue. This property appeared similar to that observed during our 2007 HMTS and primarily consists of undeveloped and naturally vegetated land traversed by unpaved pathways. We observed several

apparently vacant and dilapidated residential structures to the southeast and southwest of the main trail. We also observed trash/debris piles consisting of construction debris, such as concrete fragments and lumber, discarded furniture, full trash bags, tires, general refuse, and stockpiles of soil adjacent to the main trail. The drums observed in the southern portion of the site in our 2007 HMTS appear to have been removed. With the exception of the observance of illegal dumping, no other evidence of environmental concerns was observed at the Dillon Trail site during our limited visual reconnaissance.

4.3 Area 3

Observations made during our limited visual reconnaissance of properties of potential environmental concern identified in Area 3 are summarized below.

4.3.1 Barnhart and Dantzler Property (Map ID 16) and Sesi Property (Map ID 17)

Observations of the Barnhart and Dantzler Property and Sesi Property were limited to portions of the properties that were visible from Cactus Road. The conditions at both properties appeared similar to that observed during our 2007 HMTS. The asphalt cap at the Barnhart and Dantzler Property described in Section 3.2.2 was observed to be in good condition. A mobile home continues to occupy the western portion of this property, but the trash/debris observed adjacent to the mobile home during our 2007 HMTS appears to have been removed. Evidence of environmental concerns was not observed at the Barnhart and Dantzler Property during our limited visual reconnaissance.

We observed several groundwater monitoring wells in the eastern portion of the Sesi Property. Signage observed in the northeastern portion of the property indicated that accessing the property was dangerous due to existing hazardous waste. An abandoned AST was visible in the northern portion of the property, approximately 500 feet west of Cactus Road. No other evidence of environmental concerns was observed at the Sesi Property during our limited visual reconnaissance.

4.3.2 Martinez Ranch (Map IDs 18)

Observations of Martinez Ranch were limited to the portions of the compound area, which occupies the northeastern portion of the Martinez Ranch property, visible from Cactus Road. Due to access limitations, we were unable to observe the southwestern portion of the Martinez Ranch property reportedly containing canyon fill impacted with petroleum hydrocarbons and lead (Section 3.2.3).

The conditions of the compound area were generally similar to that observed during our 2007 HMTS. A packing and distribution area was observed in the central portion of the compound with agricultural fields adjacent to the north and south. We observed four ASTs in the packing and distribution area

containing calcium nitrate (i.e., fertilizer). The ASTs were stored on wooden pallets and appeared to be in good condition with no evidence of spillage or leakage. Five diesel ASTs and additional fertilizer ASTs were observed in the agricultural field to the north of the packing and distribution area. Evidence of staining was not apparent in the area of these ASTs. With the exception of the presence of ASTs at Martinez Ranch, no other direct evidence of environmental concerns was observed during our limited visual reconnaissance.

4.3.3 Former Martinez Outdoor Storage (Map ID 20)

Observations of the former Martinez Outdoor Storage property were limited to portions visible from Martinez Ranch Road. The property is currently occupied by a large distribution warehouse operated by Innovative Cold Storage Enterprises. Evidence of environmental concerns was not observed during our limited visual reconnaissance at this property.

4.4 Area 4

Observations of the only property of concern in Area 4, the Britannia Boulevard Property (Map ID 21), were limited to portions visible from Airway Road and Britannia Boulevard. The condition of the property was consistent with the descriptions noted in Section 3.2.4 as it is currently occupied by a business park and capped with concrete. The majority of the business park appears to be occupied by Marquez Brothers International, a food distributor. Evidence of environmental concerns was not observed during our limited visual reconnaissance at this property.

4.5 Area 5

Observations of the only property of concern in Area 5, the Arco Service Station at 2510 Otay Mesa Road (Map ID 22), were limited to exterior portions of the facility. Four USTs were observed that appear to contain regular, midgrade, and premium gasoline that is dispensed at two islands on the eastern portion of the facility. Significant surficial staining was not observed in the area of the USTs or dispenser islands. The remainder of the facilty is occupied by a parking lot and convenience store. With the exception of the active fueling operations at this facility, no other evidence of environmental concerns was observed during our limited visual reconnaissance.

4.6 Area 6

Observations of the only facility of concern in Area 6, the Air Liquide Industrial facility (Map ID 23) were limited to portions visible from Via De La Amistad. The facilty appears to be currently used for storing metal shipping containers, and evidence of the former fueling operations described in Section

3.2.6 was not apparent. The facility is currently surrounded with a chain-link fence, and direct evidence of environmental concerns was not observed during our limited visual reconnaissance.

5. SIGNIFICANCE OF IMPACTS

In determining the significance of properties of potential environmental concern in a particular project area, the criteria to consider, as they relate to hazardous materials and public safety, are presented in a document titled "Appendix G: Environmental Checklist Form" of the CEQA Guidelines. The following is a list of situations that may be encountered during the construction or operation of a proposed project that would require consideration of potential hazardous materials/public safety impacts. These criteria were compared with each of the findings of this Updated HMTS to determine their impact significance to the proposed project.

1. Projects that would create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials.

2. Projects that would create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.

3. Projects that would emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within ¼ mile of an existing or proposed school.

4. Projects that would be located on a site, which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would create a significant hazard to the public or the environment.

5. Projects located within an airport land use plan, or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, that would result in a safety hazard for people residing or working in the project area.

6. For projects within the vicinity of a private airstrip, projects resulting in a safety hazard for people residing or working in the project area.

7. Projects that would impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.

8. Projects that would expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

In accordance with CEQA, with regard to the above criteria, a determination must be made as to whether the criteria apply to the proposed project. Each of the above criteria must be classified into one of the following four categories in terms of potential environmental impact: (1) potentially significant impact, (2) less than significant impact with mitigation incorporation, (3) less than significant impact,

or (4) no impact. Because this Updated HMTS is part of a Community Plan Update, and specific improvement projects are not associated with the Community Plan Update at the current time, it is not possible to determine which of the above criteria may apply to a proposed improvement project located within the boundaries of the Site until the details of the project to be performed are known. However, based on our knowledge of the Site, Item 6 does not apply to properties located within the Site boundaries because no private airstrips are located within the boundaries of the Site. For this reason, this criterion is not further addressed in this Updated HMTS. Items 1, 2, 5 and 7 also have been determined not to apply to properties located within the boundaries of the Site based on the following rationale:

- **Item 1** – In general, projects that involve the routine transport, use, or disposal of hazardous materials would not create a significant hazard to the public or the environment.

- **Item 2** – Based on the nature of the properties of potential environmental concern identified within and near the Site boundaries, reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment are not anticipated.

- **Item 5** – The properties of potential environmental concern identified within and near the Site boundaries are located within 2 miles of a public use airport (e.g., Brown Field); however, there is a low likelihood that proximity of these properties to the airport would result in a safety hazard for people residing or working in the vicinity of the properties.

- **Item 7** – With the exception of the Otay Mesa Widening Project (Map ID 1), the properties of potential environmental concern identified within and near the Site boundaries would not impair the implementation or physically interfere with an adopted emergency response plan or emergency evacuation plan because they do not involve transportation routes associated with such plans.

Items 3, 4, and 8 are addressed in Table 1 as they relate to properties of potential environmental concern currently located within or near the boundaries of the Site identified in the research conducted for this Updated HMTS. In addition, Table 1 includes the level of impact associated with each property, the associated rationale for the selected impact level, and recommended mitigation measures.

6. LIMITATIONS

The conclusions presented in this report are based upon reasonable visual observations made at the Site and research of available materials within the scope and budget of the contract. The information presented is relevant to the dates of our site visits and should not be relied upon to represent conditions at later dates. The opinions expressed herein are based on our experience with similar studies and information obtained during our effort. If additional information becomes available, we request the opportunity to review the information and modify our opinions, if necessary.

The visual observations made by Geocon were limited to accessed portions of the Site and contiguous sites. In addition, this study did not include a 50-year chain-of-title review or a review of fire insurance

maps. The Updated HMTS at the Site was conducted by Geocon expressly and solely for RECON Environmental. Any reliance upon the information, conclusions, or recommendations contained in this report for purposes other than the transfer of the Site shall be at the sole liability of the party undertaking such use.

Our services have been conducted using the degree of care and skill ordinarily exercised, under similar circumstances, by environmental sciences consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional opinions presented in this report. Geocon is not responsible for the conclusions, opinions, or recommendations made by others based on this information.

This report was compiled based partially on information supplied to Geocon from outside sources, other information that is in the public domain, and visual observations made at the property. The preliminary conclusions and recommendations herein are based solely on the information Geocon obtained in compiling the report. Geocon makes no warranty as to the accuracy of statements made by others which may be contained in the report, nor are any other warranties or guarantees, express or implied, included or intended by the report except that it has been prepared in accordance with the current generally accepted practices and standards consistent with the level of care and skill exercised under similar circumstances by other professional consultants or firms performing the same or similar services. This report is intended to be used by the party authorizing the audit for the transfer of the property audited. None of the work performed hereunder shall constitute or be represented as a legal opinion of any kind or nature, but shall be a representation of findings of fact from records examined.

This evaluation does not address the presence of the following conditions unless specifically stated otherwise:

- radon, electromagnetic fields, asbestos, lead-containing paint, mold, burn ash, lead in drinking water, methane gas, and wetlands;
- chemical compounds which naturally occur in the environment;
- commonly used household cleaning products, building materials, and consumables that may be hazardous; and
- contaminants or contaminant concentrations that are not currently a concern but may be under future regulatory standards.

7. REFERENCES

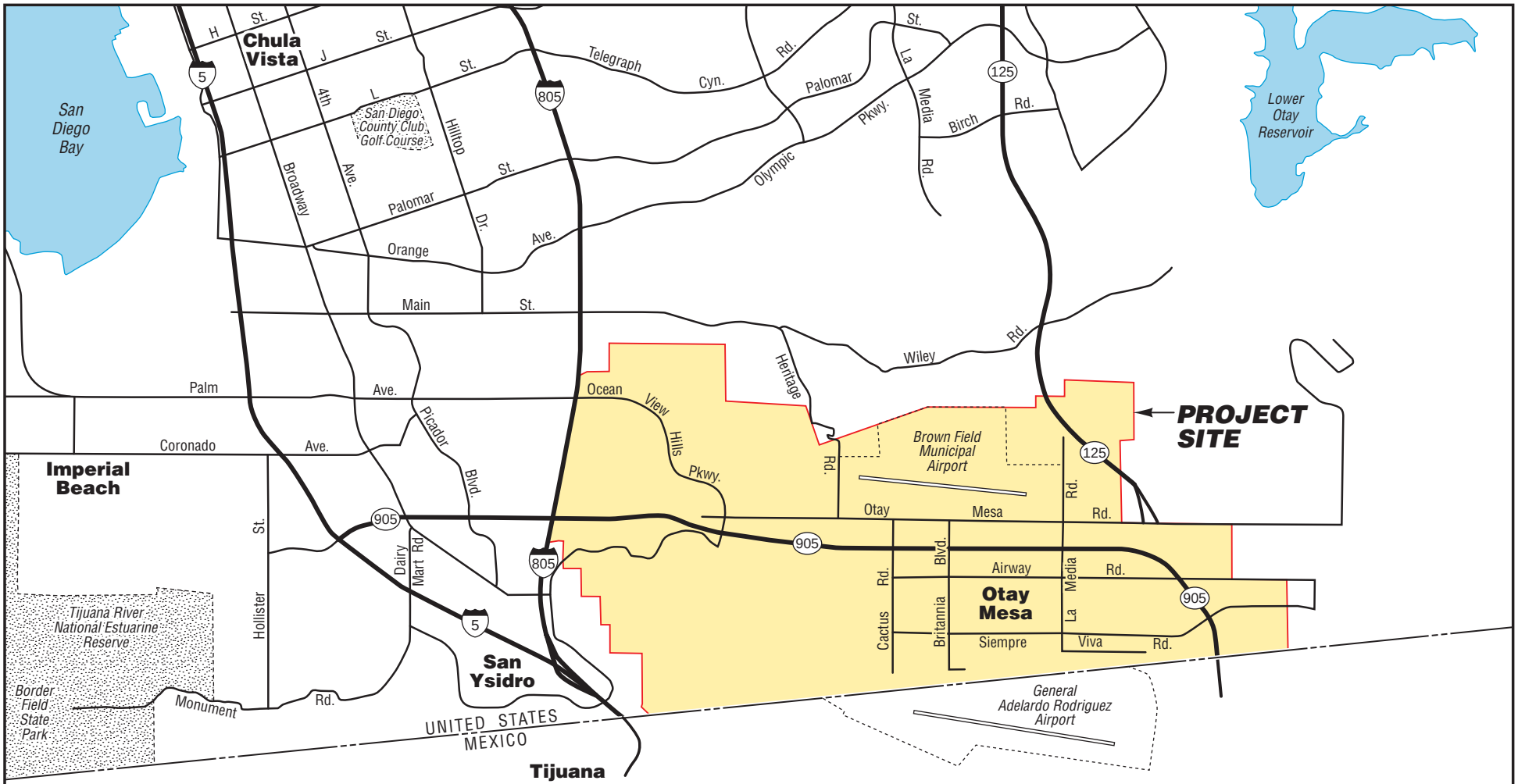
American Society for Testing and Materials, *Designation E 1527-05 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*, 2005.

California State Water Resources Board. GeoTracker Website, <http://geotracker.swrcb.ca.gov/>.

Department of Toxic Substance Control. EnviroStor Website , http://www.envirostor.dtsc.ca.gov.

Porter, Melissa, County of San Diego – Solid Waste Local Enforcement Agency. Telephone interview, 2012.

Weldon, Scott, County of San Diego – Department of Environmental Health. Telephone interview, 2012.



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Otay Mesa Community Plan Update

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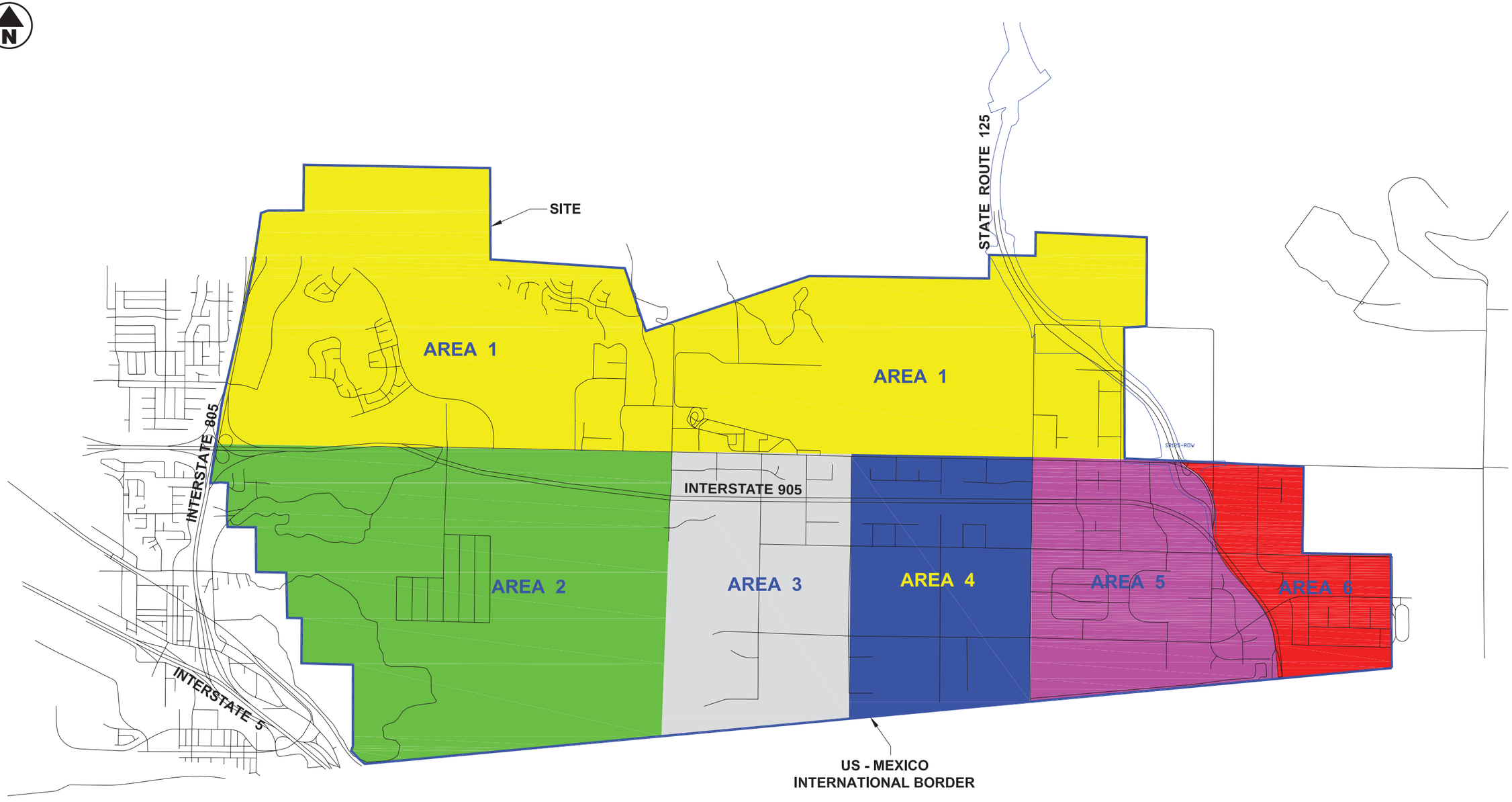
VICINITY MAP

09721-06-02	October 2012	Figure 1



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Scale in Feet

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PROJECT LOCATION MAP

09721-06-02	October 2012	Figure 2

Aerial Photo: Bing Maps

LEGEND:

Site Boundary

Properties/Facilities of Potential Environmental Concern:

1. Otay Mesa Widening Project
2. Brown Field Operations Area – 1424 Continental St.
3. U.S. Border Patrol Maintenance Facility and San Diego Space Surveillance Station (Former U.S. Border Patrol Pistol Range)
4. Former INS Shooting Range – Brown Field
5. Former Organic Recycling West – 1202 La Media Rd.
6. Former Piper Ranch
7. Former Dennery Ranch
8. Shihohara I Burn Site
9. Shihohara II Burn Site
10. Southbay Expressway Operations Center
11. Former Rohr Engine Test Facility – 1500 Heritage Rd.
12. Auto Recycling – 980 Otay Valley Rd.
13. Kaiser Foundation – 4650 Palm Ave.
14. OLA Imports & Exports – 935 Heritage Rd.

N

0 1800

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SITE PLAN – AREA 1

09721-06-02	October 2012	Figure 3-1

Aerial Photo: Bing Maps

LEGEND:

Site Boundary

Properties/Facilities of Potential Environmental Concern:

15 Dillons Trail Site

N

0 1200

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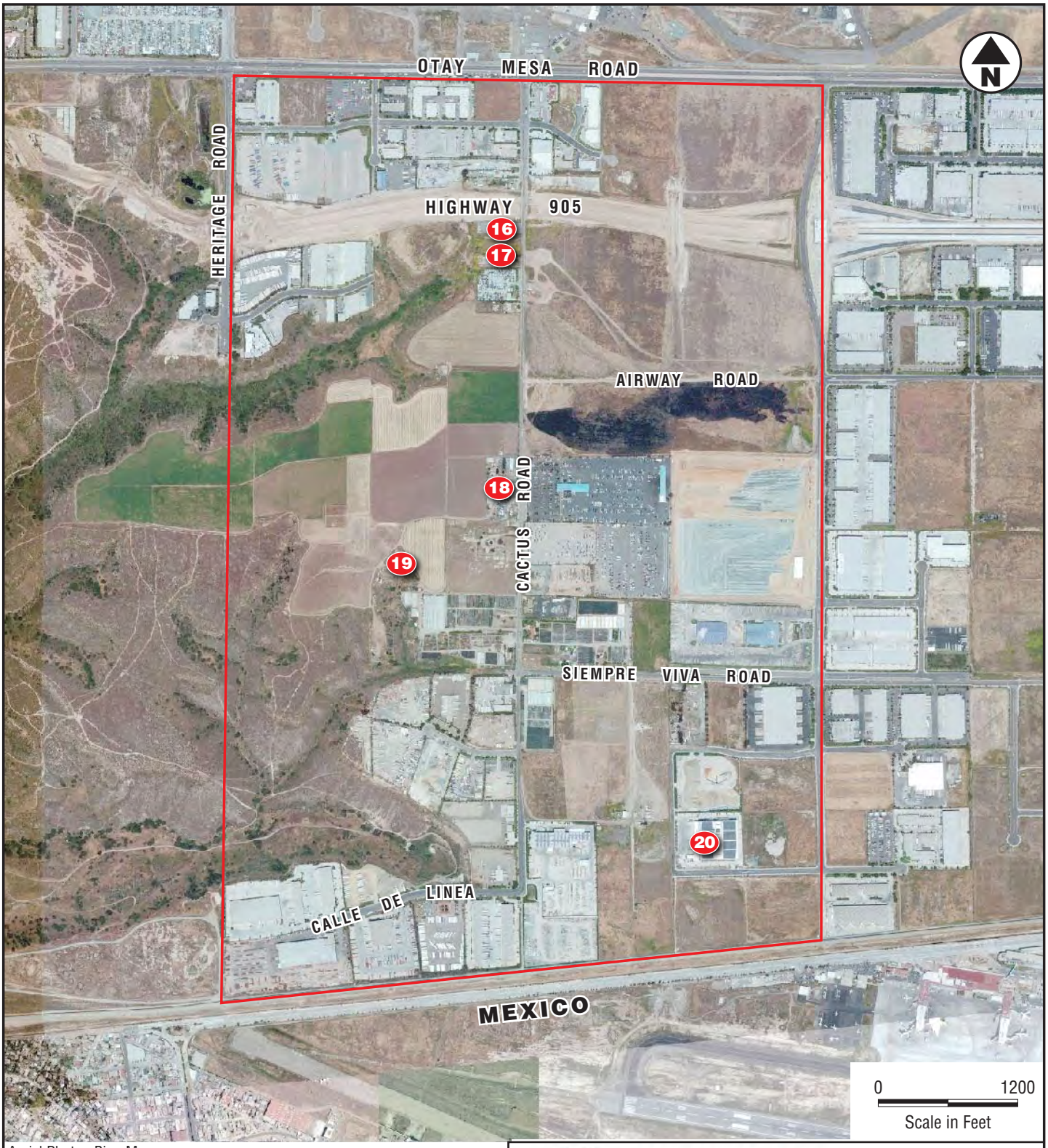
SITE PLAN – AREA 2

09721-06-02	October 2012	Figure 3-2



Aerial Photo: Bing Maps

LEGEND:

Site Boundary

Properties/Facilities of Potential Environmental Concern:

16 Barnhart & Dantzler Property
17 Sesi Property
18 Martinez Ranch Compound – 2160 Cactus Rd.
19 Martinez Ranch Canyon Fill
20 Former Martinez Outdoor Storage – 2770 Martinez Ranch Rd.

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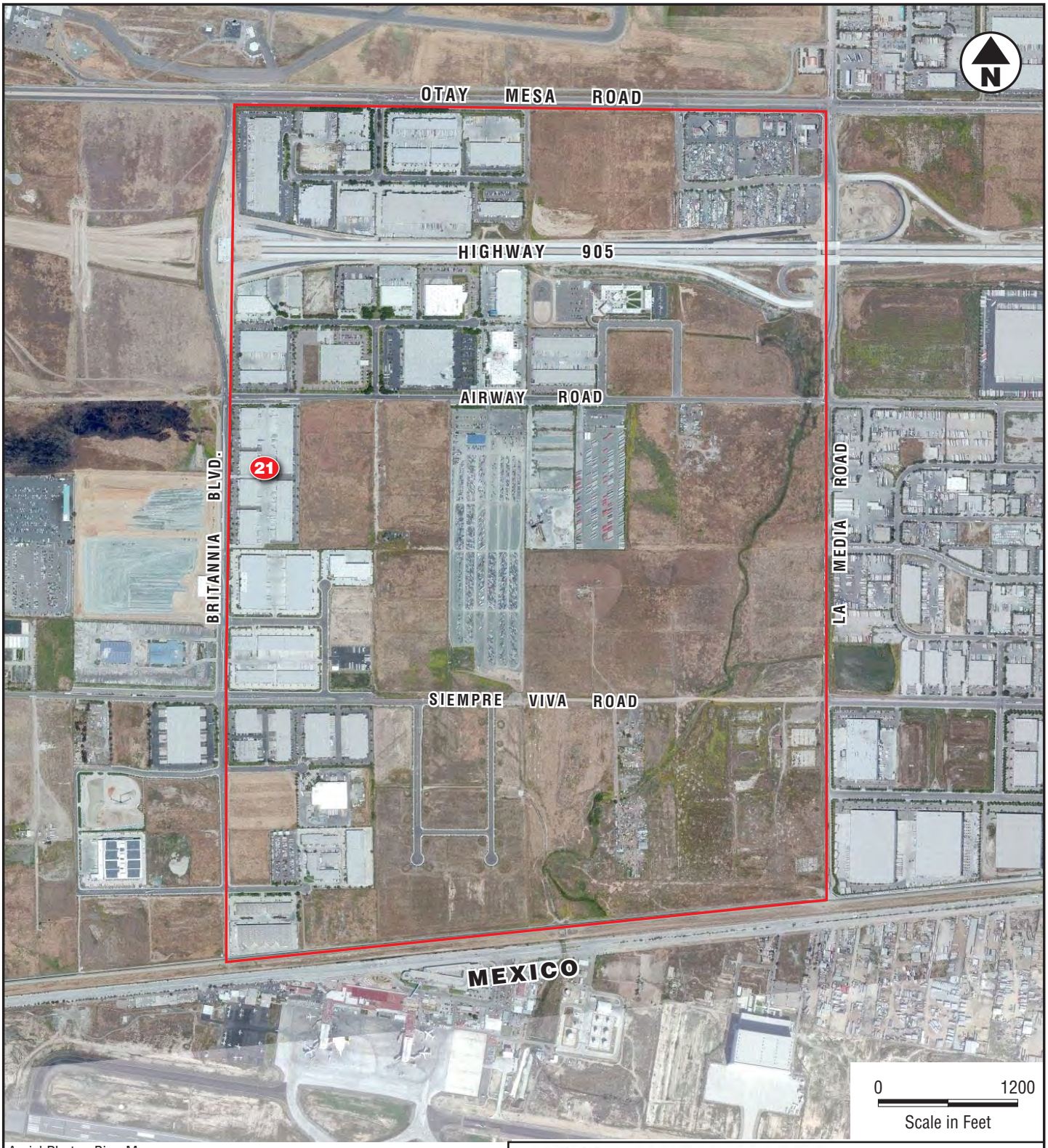
SITE PLAN – AREA 3

09721-06-02	October 2012	Figure 3-3



Aerial Photo: Bing Maps

LEGEND:

Site Boundary

Properties/Facilities of Potential Environmental Concern:

21 Britannia Blvd. Property – 2133 Britannia Blvd.

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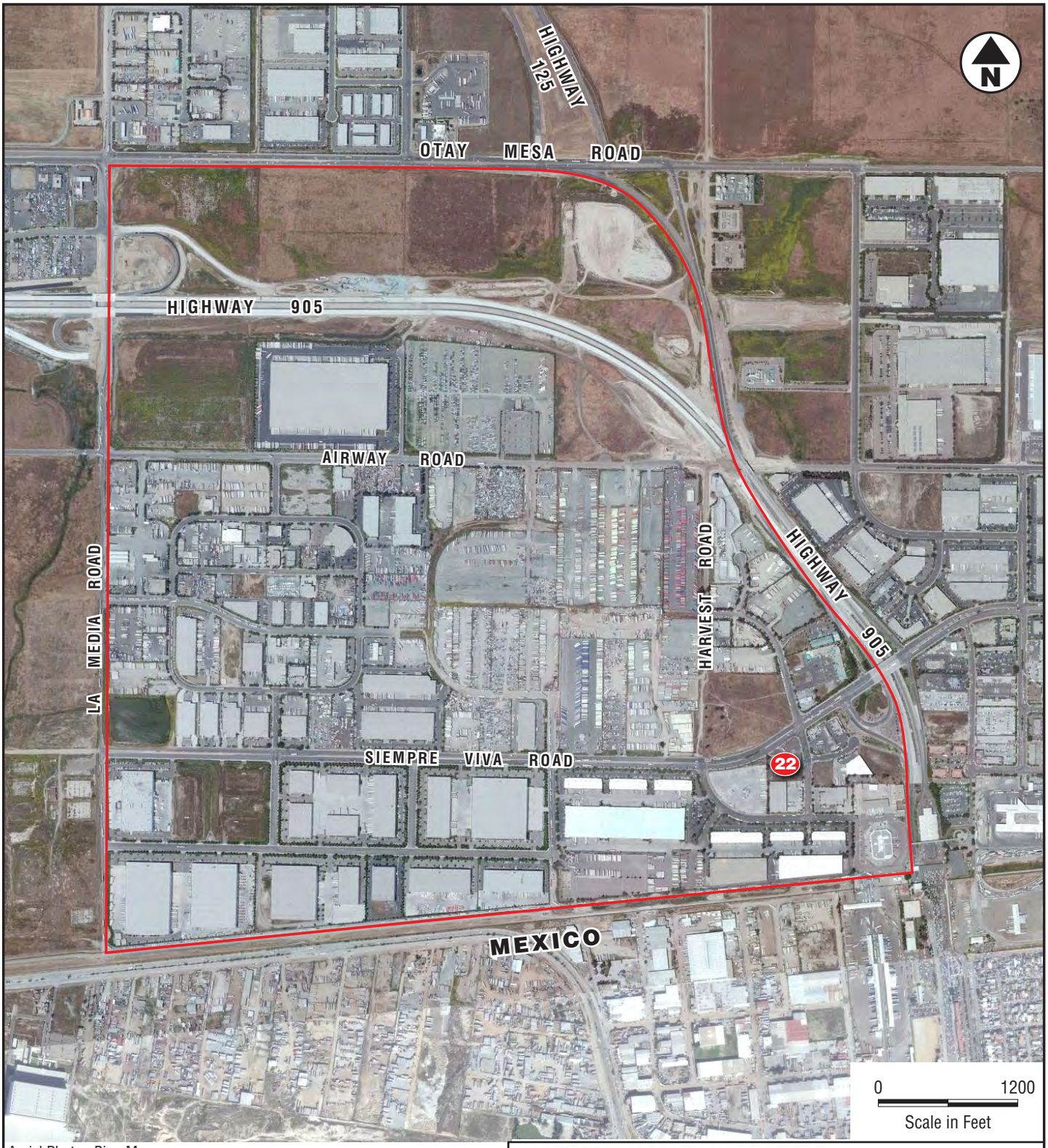
SITE PLAN – AREA 4

09721-06-02	October 2012	Figure 3-4



Aerial Photo: Bing Maps

LEGEND:

Site Boundary

Properties/Facilities of Potential Environmental Concern:

22 Arco Service Station – 2510 Otay Center Rd.

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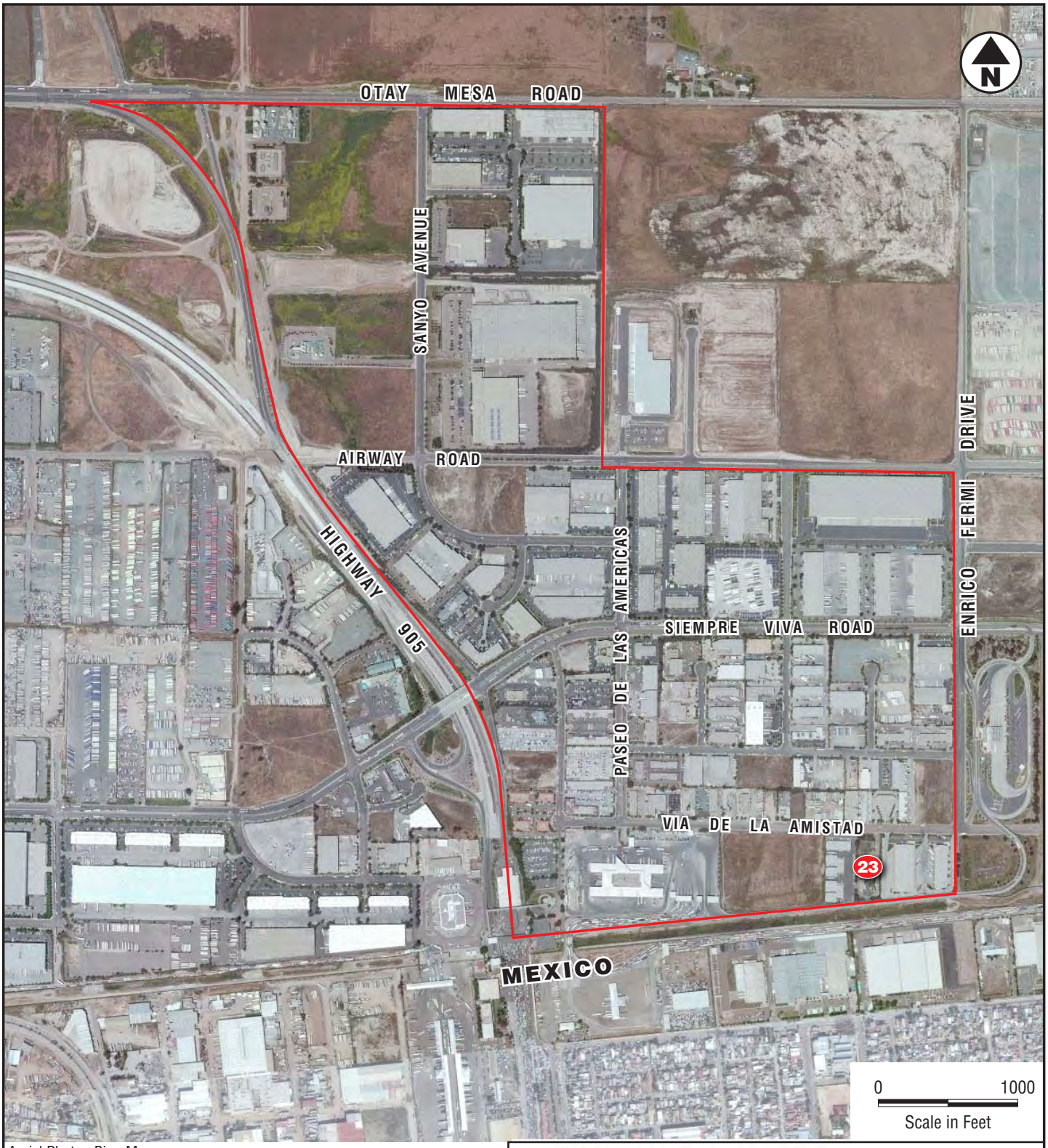
SITE PLAN – AREA 5

09721-06-02	October 2012	Figure 3-5



Aerial Photo: Bing Maps

LEGEND:

Site Boundary

Properties/Facilities of Potential Environmental Concern:

23 Air Liquide Industrial – 9955 Via De La Amistad Dr.

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SITE PLAN – AREA 6

09721-06-02	October 2012	Figure 3-6

Photo No. 1 Area 1 - Administration and control tower building at 1424 Continental Street in the central portion of the Brown Field operations area (Map ID 2)

Photo No. 2 Area 1 - Hangars and private planes in northwestern portion of the Brown Field operations area (Map ID 2)

Photo No. 3 Area 1 - Hangar in northern portion of the Brown Field operations area (Map ID 2)

Photo No. 4 Area 1 - ASTs containing jet fuel north of the administration and control tower building in the Brown Field operations area (Map ID 2)

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PHOTOS NO. 1 – 4

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Photo No. 5 Area 1- ASTs containing jet fuel south of the hangars in the Brown Field operations area (Map ID 2)

Photo No. 6 Area 1 - Former fuel farm west of the Brown Field operations area (Map ID 2)

Photo No. 7 Area 1 - Runways and control tower east of the Brown Field operations area (Map ID 2)

Photo No. 8 Area 1 - U.S. Border Patrol Maintenance Facility north of Pogo Row that currently occupies the western portion of the former U.S. Border Patrol Pistol Range (Map ID 3)

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PHOTOS NO. 5 – 8

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Photo No. 9 Area 1 – San Diego Space Surveillance Station north of Pogo Row that currently occupies the eastern portion of the former U.S. Border Patrol Pistol Range (Map ID 3)

Photo No. 10 Area 1 – Former Organic Recycling West property at 1202 La Media Road (Map ID 5)

Photo No. 11 Area 1 – Former Piper Ranch property west of Piper Ranch Road that has been redeveloped as a business park (Map ID 6)

Photo No. 12 Area 1 – Former Dennery Ranch property north of the intersection of Dennery Road and Red Fin Lane that has been redeveloped with single-family homes (Map ID 7)

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PHOTOS NO. 9 – 12

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Photo No. 13 Area 1 – Vacant property southeast of the Southbay Expressway Operations Center at 1129 La Media Road (Map ID 10). An abandoned underground storage tank was encountered and removed during grading of this property in 2007

Photo No. 14 Area 1 - Vacant land west of the former fuel farm at Brown Field previously occupied by auto sales lots and Rohr Engine Test Facility (Map ID 11)

Photo No. 15 Area 1 – Auto Recycling facility at 980 Otay Valley Road (Map ID 12)

Photo No. 16 OLA Imports and Exports at 935 Heritage Road (Map ID 14)

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PHOTOS NO. 13 – 16

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Photo No. 17 Area 2 – Various debris observed at the northern entrance to the Dillons Trail Site (Map ID 15) at the southern termination of Caliente Avenue

Photo No. 18 Area 2 – Concrete debris observed in the central portion of the Dillons Trail Site (Map ID 15)

Photo No. 19 Area 2 – Abandoned structures and debris observed southwest of the main trail through the Dillons Trail Site (Map ID 15)

Photo No. 20 Area 2 – Abandoned structures and debris observed southeast of the main trail through the Dillons Trail Site (Map ID 15)

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PHOTOS NO. 17 – 20

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Photo No. 21 Area 3 – Barnhart and Dantzler Property (Map ID 16) located west of the northern termination of Cactus Road

Photo No. 22 Area 3 – Sesi Property (Map ID 17) located adjacent to the south of the Barnhart and Dantzler Property

Photo No. 23 Area 3 – Abandoned aboveground storage tank observed in the western portion of the Sesi Property (Map ID 17)

Photo No. 24 Area 3 – Packing and distribution area in the central portion of the Martinez Ranch Compound at 2160 Cactus Road (Map ID 18).

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PHOTOS NO. 21 – 24

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Photo No. 25 Area 3 – Fertilizer storage tanks observed in the packing and distribution area in the central portion of the Martinez Ranch Compound (Map ID 18)

Photo No. 26 Area 3 – Diesel aboveground storage tanks observed in the northern portion of the Martinez Ranch Compound (Map ID 18)

Photo No. 27 Area 3 – Fertilizer aboveground storage tanks observed in the northeastern portion of the Martinez Ranch Compound (Map ID 18)

Photo No. 28 Area 3 – Former Martinez Outdoor Storage at 2770 Martinez Ranch Road currently occupied by Innovative Cold Storage Enterprises (Map ID 20)

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PHOTOS NO. 25 – 28

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Photo No. 29 Area 4 – Northern portion of Britannia Boulevard Property at 2133 Britannia Boulevard, currently occupied by a business park (Map ID 21)

Photo No. 30 Area 4 – Southern portion of Britannia Boulevard Property at 2133 Britannia Boulevard, currently occupied by a business park (Map ID 21)

Photo No. 31 Area 5 – Arco Service Station at 2510 Otay Center Road (Map ID 22)

Photo No. 32 Area 6 – Air Liquide Industrial at 9955 Via De La Amistad (Map 23)

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PHOTOS NO. 29 – 32

Otay Mesa Community Plan Update

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TABLE 1
SUMMARY OF PROPERTIES/FACILITIES OF POTENTIAL ENVIRONMENTAL CONCERN
OTAY COMMUNITY PLAN UPDATE

Map ID No.	Property/Facility	Address/Location	Area	Pertinent Impact Criteria [1]	Impact Level [2]	Rationale	Mitigation Measures
1	Otay Mesa Widening Project	Adjacent to north and south of Otay Mesa Road	1	3, 4, 7, and 8	3	A 1996 site assessment identified petroleum hydrocarbon and pesticide impacted soil adjacent to Otay Mesa Road in the area of the widening project. Although the soil generated during the widening project was determined not to contain detectable concentrations of these compounds, the potential exists for impacted soil to remain in-place.	No mitigation measures are anticipated to be required. However, if additional grading is conducted adjacent to Otay Mesa Road in the area of the former widening project, observations should be made for the presence of impacted soil. If encountered, the impacted soil should be segregated and characterized for potential reuse or disposal options.
2	Brown Field Operations Area	1424 Continental Street	1	4	1	An active LUST case is associated with this facility for petroleum hydrocarbon impacts to soil and groundwater. Releases associated with an additional 24 LUST or spill cases have reportedly resulted in an estimated 111,500 cubic yards of hydrocarbon-impacted soil remaining in-place at the facility.	High likelihood that additional mitigation measures will be required. Soil and/or groundwater sampling would be required to assess the extent of the existing contamination prior to redevelopment of this area. Remediation, consisting of excavation and disposal of contaminated soil or in-situ treatment of contaminated soil, may be required to mitigate potential health risks.
3	San Diego Space Surveillance Station (Former U.S. Border Patrol Pistol Range)	North of Pogo Row	1	4 and 8	1	Assessment in 2000 found that at least 3,500 cubic meters of soil at this former facility contained high concentrations of lead, and other metals. The western portion of this former facility was subsequently redeveloped with a U.S. Border Patrol maintenance station and the eastern portion is currently occupied by the San Diego Space Surveillance Station (SDSSS). A workplan was prepared in 2012 to conduct an investigation of soil and debris in the area of a former small arms range and skeet range located on the SDSSS facility. In addition, the workplan proposes the excavation and disposal of lead and polycyclic aromatic hydrocarbon impacted soil previously identified at both of these former ranges	High likelihood that additional mitigation measures will be required including assessment, excavation, and disposal of impacted soil and debris.
4	Former INS Shooting Range (Currently Vacant)	Northeast of eastern termination of Pogo Row	1	4 and 8	2	In 1987, fill material containing burn ash and sand blast grit was deposited at the INS Shooting Range to create safety berms. Upon discovery of the contaminated material, remediation activities were conducted, including excavation of contaminated soil. Residual lead-impacted soil remains onsite that capped with concrete. Facility was issued a no further action designation in 2002.	Low likelihood that additional mitigation measures will be required provided the concrete cap remains in-place. Should future redevelopment include removal or disturbance of the cap, an environmental consultant should be retained and the City LEA contacted.
5	Former Organic Recycling West (Currently Vacant)	1202 La Media Road	1	4 and 8	3	This facility is a composting facility that only accepts “green” and “woody” materials. During a July 2006 LEA inspection, spills were noted in the vicinity of vehicles and batteries west of vehicular maintenance area. A DEH release case was not opened as a result of the spills, indicating the spills were considered minor.	No mitigation measures are anticipated to be required. Impacted soil, if encountered during future redevelopment, should be segregated and characterized for potential reuse or disposal options.
6	Piper Ranch (Currently a Business Park)	West of Piper Ranch Road	1	4	3	Waste oil and pesticide-contaminated soil excavated and removed in 1988. Gasoline release from a UST removed in 1988 resulted in contamination of two cubic yards of soil. DEH closed the UST case due to limited extent of contamination. Subsequent sampling of the property in 1988, 1989, and 1994 indicated various pesticides were detected but concentrations were below less than regulatory screening levels. The property is currently improved with several commercial/light-industrial developments	Low likelihood that additional mitigation measures will be required. However, if residual impacted soil is encountered during future redevelopment, it should be segregated and characterized for potential reuse or disposal options.
7	Former Dennery Ranch (Currently an Apartment Complex)	North of Intersection of Dennery Road and Red Fin Lane	1	4	2	Approximately 5,000 cubic yards of burn ash deposits, originating from the Shinohara II Burn Site, are present over an approximately 0.5-acre area in the northwestern portion of this property. In 2006, the City LEA approved a plan to construct a 2-foot-thick vegetative soil cap over the burn ash deposits. Property was redeveloped with single-family homes in 2007-2008.	Low likelihood that additional mitigation measures will be required provided the vegetative soil cap remains in-place. Should future redevelopment include removal or disturbance of the cap, an environmental consultant should be retained and the City LEA contacted.
8	Shinohara I Burn Site	N of Otay River	1	4 and 8	2	Approx. 850,000 cubic yards of burn ash material were placed at the Shinohara I and II Burn Sites in 1978. Majority of the burn ash material subsequently was excavated and removed from Shinohara I site in 1993 and 2001. Approx. 1,500 cubic yards of burn ash left in place. County LEA issued closure letter in 2001.	Moderate likelihood that additional mitigation measures will be required. During future excavation activities, an environmental consultant should be retained to observe the property for evidence of contaminated soil (e.g., discoloration, odors). If evidence of contamination is found, the soil should be segregated and characterized for potential reuse or disposal options.
9	Shinohara II Burn Site	Adjacent to the north of former Dennery Ranch	1	4 and 8	1	Approx. 850,000 cubic yards of burn ash material were placed at the Shinohara I and II Burn Sites in 1978. Up to a 40-foot-thick layer of burn ash is believed to exist at the property. Reportedly, additional assessment or mitigation activities have not been performed at the Shinohara II Burn Site to date.	High likelihood that additional mitigation measures will be required under the oversight of the County LEA. Mitigation measures would likely include soil excavation and disposal and /or construction of a cap over the burn ash material. A health risk assessment may also be required depending on future land use.
10	Southbay Operations Center	Northwest of northern termination of Air Wing Road.	1	4	3	Petroleum hydrocarbon release from a UST removed in 2007. DEH closed the UST case in 2011 due to limited extent of contamination. An estimated 200 cubic yards of impacted soil remain in-place in the area of the former UST.	Low likelihood that additional mitigation measures will be required. However, if residual impacted soil is encountered during future redevelopment, it should be segregated and characterized for potential reuse or disposal options.
11	Former Rohr Engine Test Facility (Currently Vacant)	1500 Heritage Road	1	4	3	Two cases associated with this former facility for releases of aviation fuel in 1987 and 1992 that impacted soil. Both cases have been closed by DEH; however, residual impacted soils may remain at this property.	Low likelihood that additional mitigation measures will be required. However, if residual impacted soil is encountered during future redevelopment, it should be segregated and characterized for potential reuse or disposal options.

TABLE 1
SUMMARY OF PROPERTIES/FACILITIES OF POTENTIAL ENVIRONMENTAL CONCERN
OTAY COMMUNITY PLAN UPDATE

Map ID No.	Property/Facility	Address/Location	Area	Pertinent Impact Criteria [1]	Impact Level [2]	Rationale	Mitigation Measures
12	Auto Recycling	980 Otay Valley Road	1	4	3	Release of diesel from an unreported source affected soil at this facility. Associated DEH case was closed in 2007; however, residual impacted soils may remain at this property.	Low likelihood that additional mitigation measures will be required. However, if residual impacted soil is encountered during future redevelopment, it should be segregated and characterized for potential reuse or disposal options.
13	Kaiser Foundation	4650 Palm Avenue	1	4	4	Gasoline from an overturned tanker reportedly entered a storm drain below the sidewalk adjacent to this facility. Sediment in the storm drain and soil and groundwater in the vicinity of the storm drain outfall at the Otay River were determined to be impacted. Following soil remediation activities and cleanup of groundwater to well below public health standards, DEH closed the case in 2011.	The release appears to have been limited to areas outside the boundaries of this facility. As such, no mitigation measures are anticipated to be required for this facility.
14	OLA Imports and Exports	935 Heritage Road	1	4	3	Staining observed during assessment activities in 1995 and numerous DEH violations from 1996 to 2007 at this facility indicate that petroleum-impacted soil likely remains at shallow depths (up to of depths of 5 feet) in various locations at the facility. The DEH noted that they have no objection to the continued use of the facility as an auto recycler provided that they are notified prior to surface grading or proposed changes in land use.	DEH records reviewed indicate that the case associated with this facility will not be closed until assessment of the extent of petroleum impacts has been performed. Likely mitigation measures would include segregation and characterization of impacted soils for potential reuse or disposal options.
15	Dillons Trail Site	Southwest of southern termination of Caliente Avenue	2	3 and 8	2	The Dillons Trail Site consists of several parcels where illegal disposal activities were initially discovered by the City LEA in 1987. The discarded material primarily consisted of demolition debris with minor amounts of solid waste. According to the City LEA, the majority of the waste from the illegal disposal activities at the property has been removed, and the City LEA no longer conducts inspections at this location. During the site reconnaissance, we observed evidence of illegal disposal of trash and debris throughout the interpreted location of the property.	High likelihood that additional mitigation measures, including trash/debris removal and disposal, will be required prior to redevelopment of this area. Chemical containers encountered during the trash/debris removal activities should be properly characterized and disposed of. If evidence of contaminated soil (e.g., discoloration, odors) is encountered during future redevelopment activities, it should be segregated and characterized for potential reuse or disposal options.
16	Barnhart and Dantzler Property	West of northern termination of Cactus Road	3	4 and 8	2	Part of the Tripp Salvage Landfill. Automobile dismantling waste was placed on the Barnhart and Dantzler Property from approximately 1968 to 1977. This material was covered with fill from other landfills in the area. It is estimated that the waste extends to a depth of approximately 65 feet. Groundwater samples collected from this property in 1998 reportedly contained VOCs, SVOCs, and metals. Total area containing waste is approximately 1.1 acres, and an asphalt cap was constructed over the areal extent of the waste in 2001. The County LEA issued “no further action” letter in 2003 for this property.	Low likelihood that additional mitigation measures will be required provided the asphalt cap remains in-place. Should future redevelopment include removal or disturbance of the cap, an environmental consultant should be retained and the County LEA contacted.
17	Sesi Property	Adjacent to the south of Barnhart and Danzler Property	3	4 and 8	1	Part of Tripp Salvage Landfill. Automobile dismantling waste was placed on the Sesi Property from approximately 1968 to 1977, and burn ash-contaminated soil was placed in on the property in 1987. This material was covered with fill from other landfills in the area. It is estimated that the waste extends to a depth of approximately 65 feet. Groundwater samples collected from this property in 1998 reportedly contained VOCs, SVOCs, and metals. A Revegetation Plan prepared 2006 proposed excavation of a portion of the waste and placement of a soil cap over the remaining waste. According to the County LEA, soil cap design and associated grading plans have been submitted to City of San Diego for review but the cap has not yet been constructed.	High likelihood that mitigation measures, as generally described in the 2006 Revegetation Plan, will be required prior to redevelopment of this area (see Section 3.2.3 for details).
18	Martinez Ranch Compound	2160 Cactus Road	3	4 and 8	1	Soil sampling conducted in 2004 indicated approximately 17,300 to 26,100 cubic yards of soil in the northeastern portion of Martinez Ranch were impacted with elevated concentrations of the pesticides DDE, DDT, and/or toxaphene. According to the DEH, the pesticide-impacted has not been mitigated.	High likelihood that mitigation of the pesticide-impacted will be required prior to redevelopment of this area.
19	Martinez Ranch Canyon Fill	Southwest of Martinez Ranch Compound	3	4 and 8	1	Analysis of soil samples collected in 2004 from the canyon fill showed elevated concentrations of petroleum hydrocarbons and lead. According to the DEH, the hydrocarbon and lead-impacted has not been mitigated.	High likelihood that mitigation of the hydrocarbon and lead-impacted will be required prior to redevelopment of this area.
20	Former Martinez Outdoor Storage (Currently Innovative Cold Storage Enterprises)	2770 Martinez Ranch Road	3	4 and 8	3	Analysis of soil samples collected in 2009 showed detections of petroleum hydrocarbons related to a former AST and several pesticides related to historical agricultural use, but at concentrations below health screening levels for commercial/industrial land use.	Low likelihood that mitigation measures will be required provided the property continues to be zoned for commercial /industrial land use. If future plans for this property include residential development, further assessment of pesticides and petroleum hydrocarbons in soil would likely be required.
21	Britannia Boulevard Property (Currently occupied by a Business Park)	2133 Britannia Boulevard	4	4 and 8	3	Soil samples analyzed in 2003 showed elevated concentrations of pesticides in shallow soil at this property. To mitigate the potential health risks, a concrete cap was constructed over the entire property. In addition, a deed restriction was recorded for the property on March 26, 2004, that stated the property was not suitable for uses that include “full-time human habitation”.	Low likelihood that mitigation measures will be required provided the concrete cap continues to be maintained and the deed restriction remains in-place for the property. If land uses excluded in the deed restriction are planned for the property, the DTSC should be contacted.

APPENDIX G-1

Drainage Report

Drainage Study for the Otay Mesa Community Plan Update

April, 2007

Prepared for:
MNA Consulting
427 C Street, Suite 308
San Diego CA 92101

Prepared by:
Kimley-Horn and Associates, Inc.
517 Fourth Avenue, Suite 301
San Diego CA 92101

Drainage Study For The Otay Mesa Community Plan Update

April, 2007

Chuck Spinks Exp. Date 03/31/08

R.C.E. 30894

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LIST OF EXHIBITS

APPENDICES

I. BACKGROUND

This report has been prepared as an appendix to the Otay Mesa Community Plan update EIR. Its purpose is to provide a summary of the existing drainage situation and facilities and proposed future facilities, including alternatives for draining the large central watershed. In addition, this report presents recommendations for drainage design criteria and storm water quality requirements for each of the watersheds on the Mesa. A detailed pre-design report to be approved by the City of San Diego will be required before initiating the design.

For most of its early history, Otay Mesa was used for agriculture and farming was the primary land use. As industrial and commercial development started taking place in the 1960s, the City of San Diego recognized the need for a comprehensive drainage Master Plan for the Mesa. Because most of the Mesa drains to the South into Mexico, there was concern that the new development would increase the runoff crossing the border. The City needed to establish criteria for the new development such that there was no increase in runoff as a result of the new construction.

In May of 1987, the City Council approved a contract to prepare the Otay Mesa Drainage Master Plan. In August of 1987, the City published a Notice to "All Private Engineers" that established "Drainage Requirements for Development in Otay Mesa" (attached). The Master Plan was published in January, 1988, and included a proposed concrete Channel from Airway Road to Siempre Viva Road that followed the existing drainage channel.

The Master Plan was updated with the "Otay Mesa Drainage Study" published in August, 1999. The most significant recommendation change was moving the proposed new channel from the creek alignment to a new location directly adjacent to La Media Road and Siempre Viva Road. This report utilizes the hydrologic models and analyses prepared for the 1999 Master Plan.

Reproduction of 1987 NOTICE from Engineering and Development Department

NOTICE

Date: August 7, 1987

To: All Private Engineers

From: Subdivision Engineer

Subject: Drainage requirements for development in Otay Mesa

In order to minimize the effects of increased storm water runoff in Mexico, due to development of property in Otay Mesa, all property in Otay Mesa that is within the water shed that drains into Mexico, shall be developed with the following requirements:

1. Each property owner shall provide storm water detention facilities so that there will be no increase in the rate of runoff due to development of the property.

2. The detention facilities shall be designed so that the rate of runoff from the property will not be greater after development than it was before development for a 5 year, 10 year, 25 year and 50 year storm.

3. All drainage facilities crossing four-lane major or higher classification streets shall be designed for a Q100 (existing). Other facilities, except the major channel referred to in paragraph 5, may be designed for Q50 (existing).

4. The Drainage Design Manual shall be used as guidelines for design of drainage facilities and computing design discharges.

5. The City Engineer's Office, Flood Control Section, is preparing a preliminary plan for the main north-south channel from Otay Mesa Road near La Media to the Mexican Border. The preliminary design will include the design "Q" (Q100 existing), the invert grade, and the water surface elevation at the major road crossings.

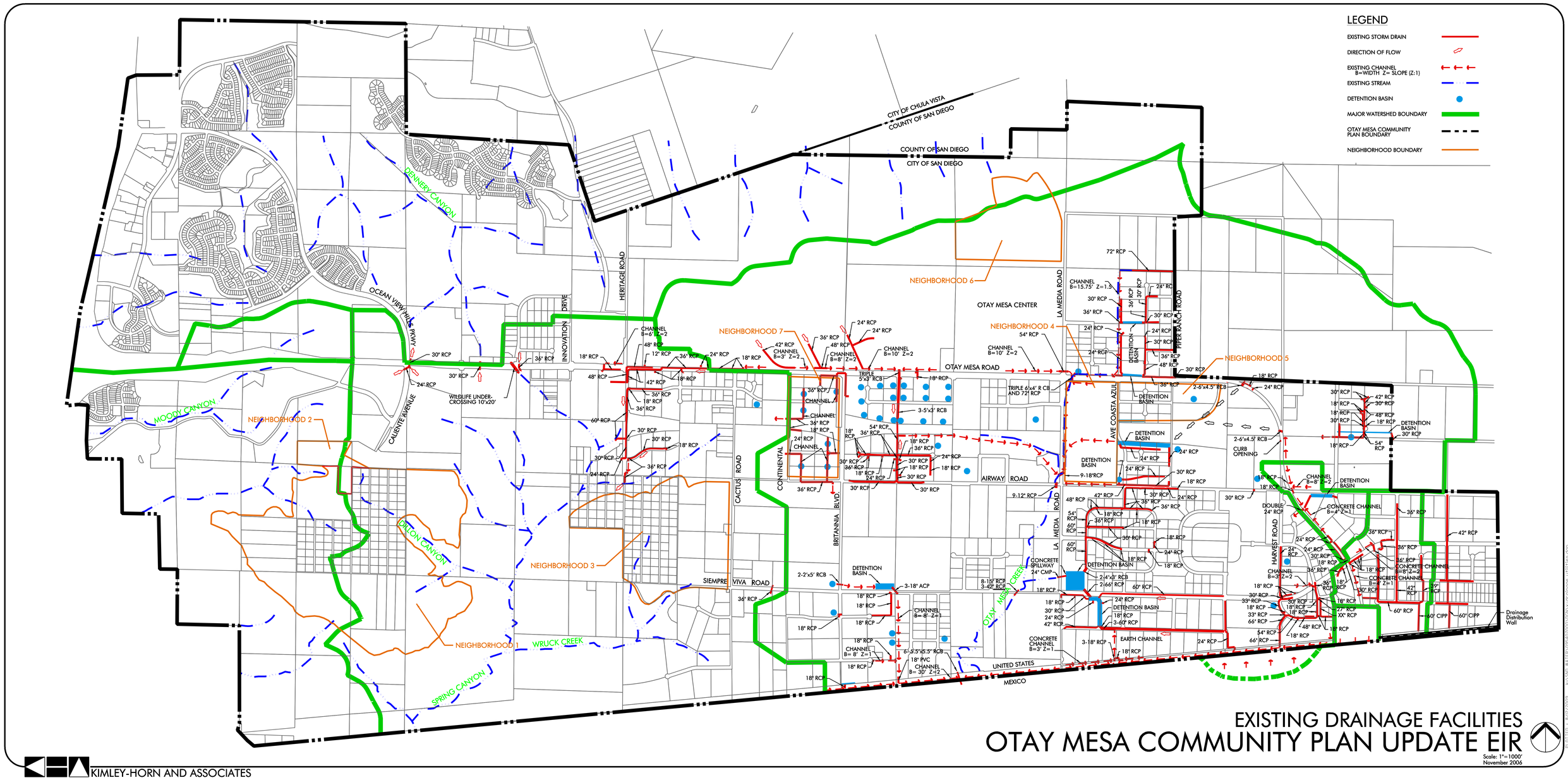
C.R. Lockhead
Subdivision Engineer

II. EXISTING DRAINAGE FACILITIES

Information was collected for existing drainage and flood control facilities on Otay Mesa through as-built plans, SanGIS maps, and site visits. Most of the existing drainage facilities were constructed as part of the private development that is taking place on the Mesa. Many of these facilities are not continuous because of the piecemeal nature of the development. This creates challenges for the subsequent developers that need to tie into the existing facilities. Many of the existing facilities are temporary. We were not able to obtain details on the drainage facilities in Mexico that receive most of the runoff.

Most of the development to-date has occurred in the East Watershed, which therefore includes most of the existing drainage facilities on the Mesa. The existing system is a combination of storm drains, improved channels, and detention basins, which in many areas discharge to natural drainage paths that do not have adequate hydraulic capacity.

The "Existing Drainage Facilities" drawing shows the facilities as-of the date of this report. The area is developing rapidly, and therefore new facilities are continuously being constructed. There are currently no dedicated drainage rights-of-way on the Mesa. Many of the projects, as they were mapped and constructed, dedicated portions of the properties to the city as drainage easements or flood water storage easements. Eventually, the systems and their easements will be continuous.



EXISTING DRAINAGE FACILITIES
OTAY MESA COMMUNITY PLAN UPDATE EIR

Scale: 1"=1000'
November 2006

KIMLEY-HORN AND ASSOCIATES

III. HYDROLOGIC ANALYSIS

The Otay Mesa Study area is shown on the Watershed Map, and includes all of the Mesa area within the City of San Diego divided into five watersheds (with the exception of the far northwest arm of the Mesa, which is fully developed).

Watersheds	Acres	mi^2
West Perimeter Watershed	258	0.40
West Watershed	2,190	3.42
North Perimeter Watershed	590	0.92
East Watershed	3,864	6.04
Border Crossing Watershed	223	0.35
TOTAL	7,125	11.13

Most of the Mesa slopes from North to South, with the flow entering Mexico at several points. The northern and western perimeters of the Mesa flow into the adjacent Canyons. These perimeter watersheds are divided into several independent smaller watersheds. The watershed boundaries on the Mesa are not well defined because the Mesa is so flat. There are very few defined natural drainage paths, with much of the runoff sheet-flowing across the Mesa. The watershed boundaries shown are based on field investigations and best available mapping, but the actual drainage boundaries may be very different.

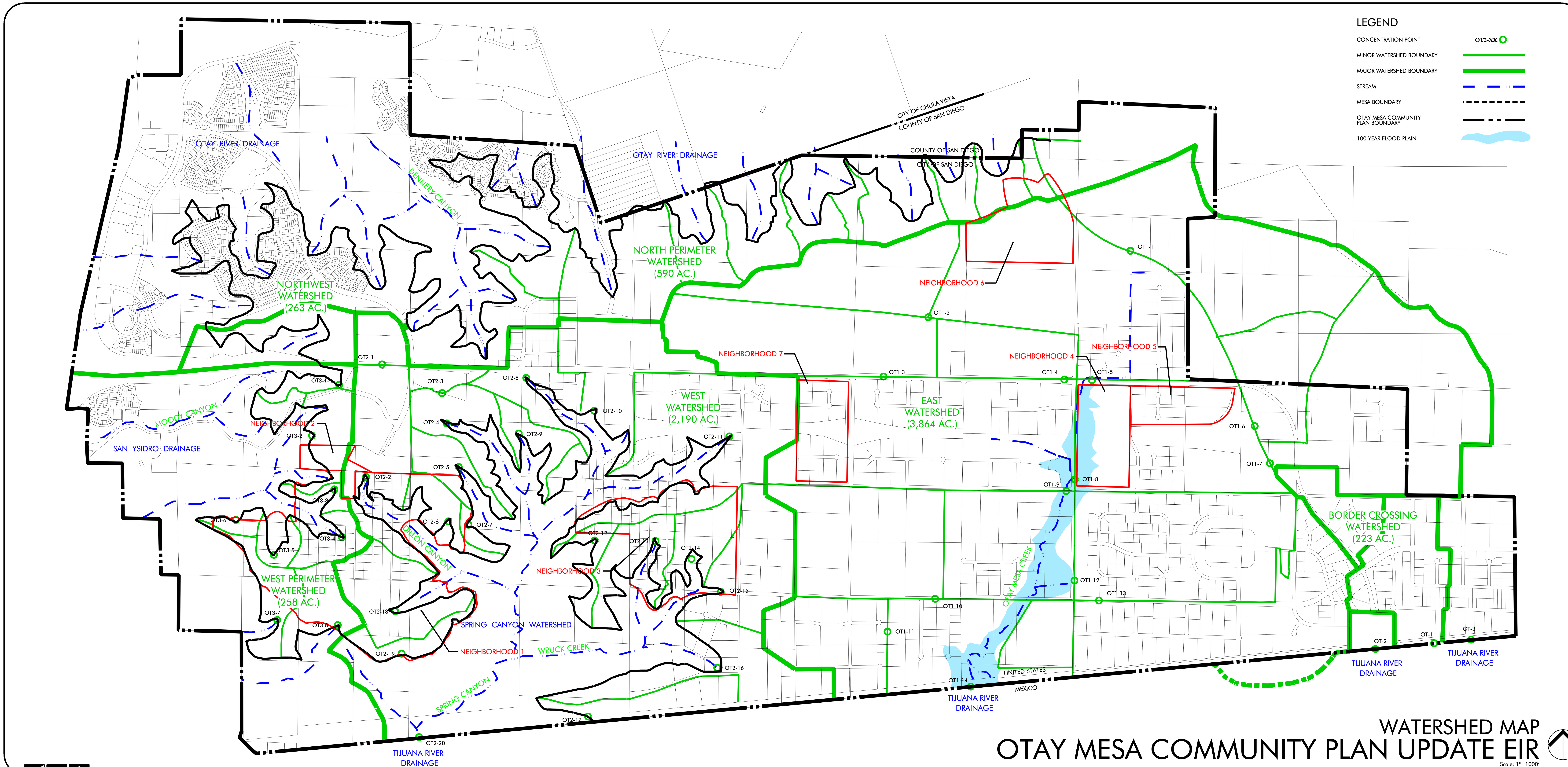
The only watershed that has been studied significantly from a drainage perspective is the East Watershed. Hydrologic models have been prepared for both of the previous drainage studies. The peak flows calculated in the two studies are different, primarily because of different assumptions relative to developed area, proposed drainage facilities, and watershed areas. The East Watershed includes a large area of unincorporated County property. The hydrologic model assumed the same industrial development for the unincorporated area. If land uses change in the County area, it may change the runoff rates. The differences for the concentration point at the border are shown below.

Q100 at Border East Watershed		
	Area (mi^2)	Q100(cfs)
1988 Study	5.72	5,050
1999 Study	6.63	3,529
2004 CPU	6.78	3,673

As part of this study, new hydrologic models have been prepared for the main watersheds which flow into the Tijuana River. For the East Watershed, HEC-1 has been used, since both previous studies used this model. For the other watersheds, the standard City of San Diego Modified Rational Method (AES) has been used. The results of these analyses are shown in the table below.

Hydrologic Analysis Summary			
	Area (mi^2)	Q50(cfs)	Q100(cfs)
West Perimeter Watershed	0.40	170	444
West Watershed	3.42	672	1,676
East Watershed	6.78	1,280	3,673
	10.60	2,122	5,793

In addition to the above flows, the Spring Canyon open space area contributes 109 cfs (Q50) and 257 cfs (Q100) from 1.2 mi^2. Since the Tijuana River Watershed is a water-quality impacted watershed, the quality and quantity of flow will need to be addressed before additional development takes place.



KIMLEY-HORN AND ASSOCIATES

WATERSHED	CONCENTRATION POINT	AREA (ACRES)	Q_{50}	Q_{100}
WEST PERIMITER	OT3-1	19.4	18.3	51.4
	OT3-1A	14.8	12.0	32.1
	OT3-2	47.1	26.7	67.3
	OT3-3	11.8	10.6	29.3
	OT3-4	35.0	22.4	57.5
	OT3-5	16.5	13.3	35.8
	OT3-6	12.2	10.9	30.3
	OT3-7	46.1	27.7	70.4
	OT3-8	51.4	27.7	69.4
		254.3	**169.5**	**443.5**
WEST	OT2-1	33.3	17.1	42.6
	OT2-2	126.2	41.4	99.5
	OT2-18	97.1	47.7	118.2
	OT2-19	27.7	22.3	60.1
	OT2-3	20.1	14.6	38.4
	OT2-4	67.8	38.5	96.9
	OT2-5	40.8	20.1	49.7
	OT2-6	34.8	17.1	42.4
	OT2-7	14.9	17.9	43.2
	OT2-8	81.3	43.0	108.7
	OT2-9	36.9	23.6	60.6
	OT2-9A	12.9	11.5	31.8
	OT2-10	128.4	43.1	103.8
	OT2-11	275.6	112.2	279.9
	OT2-12	23.6	17.5	46.0
	OT2-13	61.5	42.1	109.3
	OT2-14	48.4	26.1	65.3
	OT2-15	153.8	57.2	138.8
	OT2-16	121.7	40.8	98.4
	OT2-17	60.3	17.8	42.5
		1467.1	**671.6**	**1676.1**
MEXICO	Canyon Area	**774.8**	**109.3**	**257.0**

May 23, 2005

IV. HYDRAULIC ANALYSIS

Most of the Mesa is very flat, resulting in local flooding during storms at the low points and along some drainage ditches. The only significant creek on the Mesa is the main channel in the East Watershed, Otay Mesa Creek, which flows from North to South along La Media Road and crosses the border into Mexico just north of the Tijuana Airport.

A HEC-RAS hydraulic model was prepared for this channel from the border north to Otay Mesa Road. The purpose of this model was to identify the 100-year floodplain for this reach for present conditions. The proposed future drainage project along this alignment will be designed to contain the 100-year flow, reducing or eliminating flooding impacts to adjacent properties.

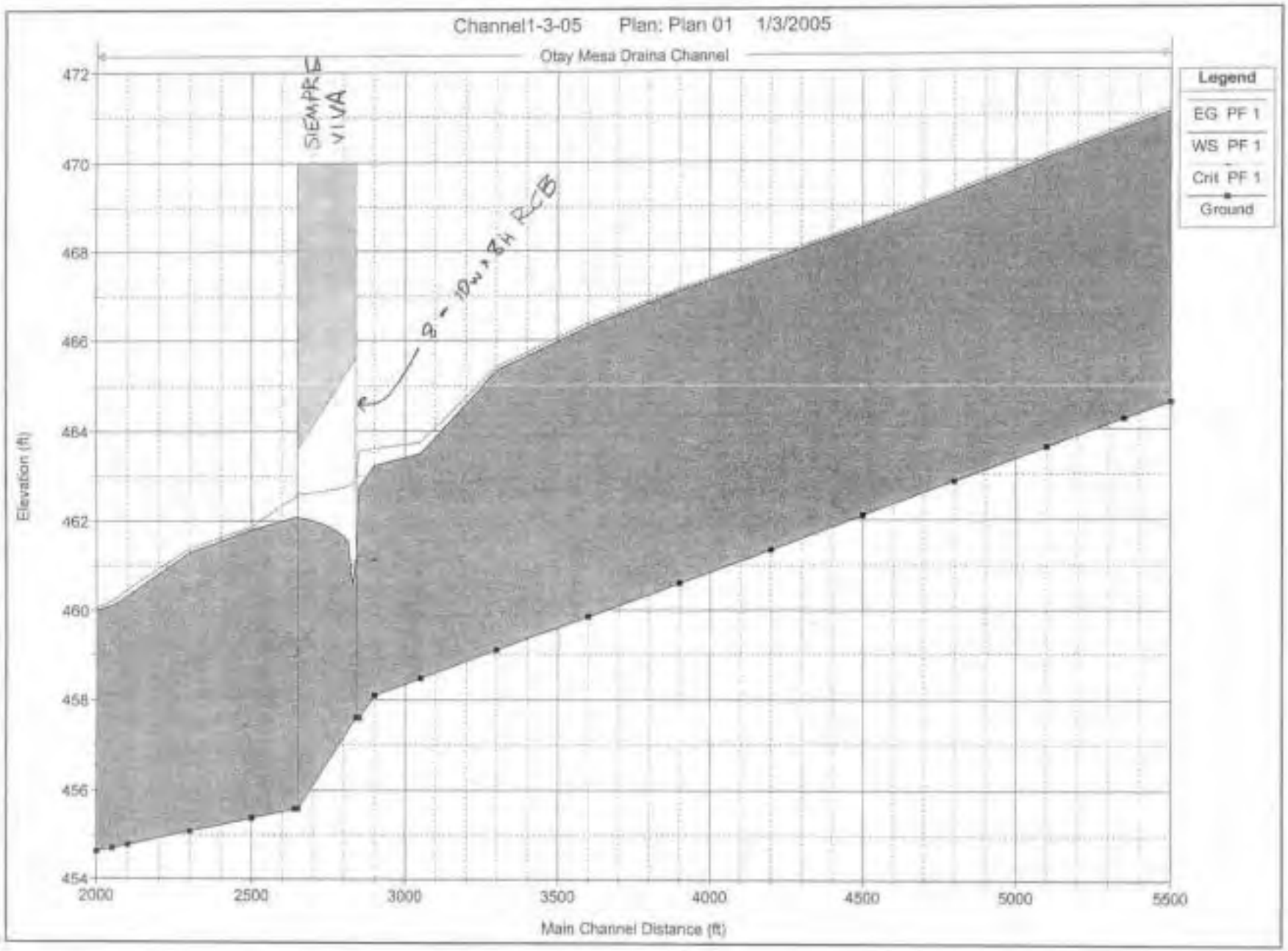
The HEC-RAS model was also used to size the proposed new channel from Airway Road to just south of Siempre Viva Road. Several alternative cross-sections were modeled to reflect input on the environmental aspects of the channel.

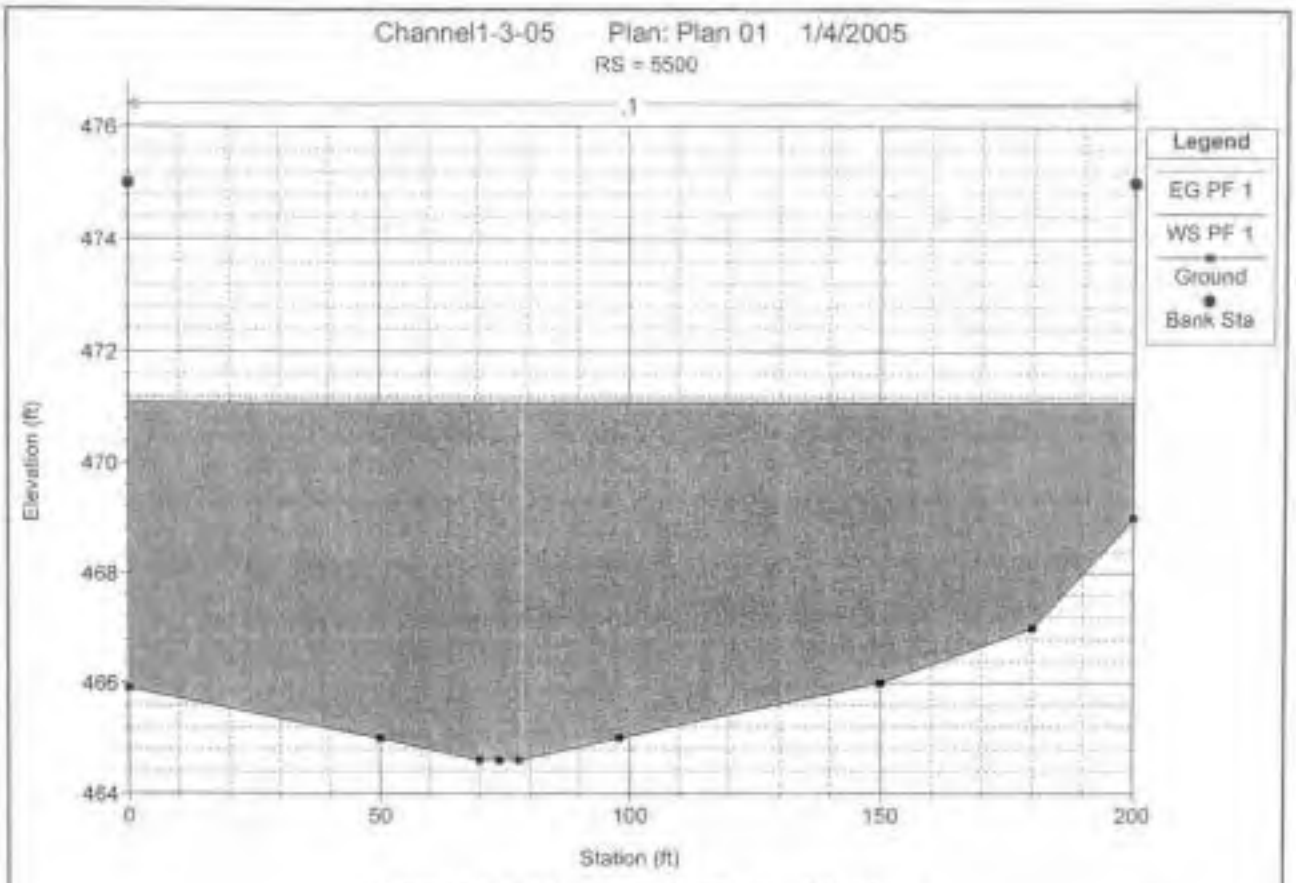
A significant tributary to the main channel enters just upstream of the Siempre Viva Road crossing. This tributary conveys flow from the De La Fuente Business Park and the Siempre Viva Business Park. The existing channel from La Media Road to the proposed main channel is approximately 15 feet wide and 4 feet deep, with a hydraulic capacity of approximately 120 cfs. The 100 year flow in this channel is 1116 cfs. A proposed new channel has a 50 ft bottom width with 1.5:1.0 side slopes and will convey the 100 year flow. A double 10' x 4.5' RCB will also be required for the flow under La Media Road. The cost estimate does not include these facilities.

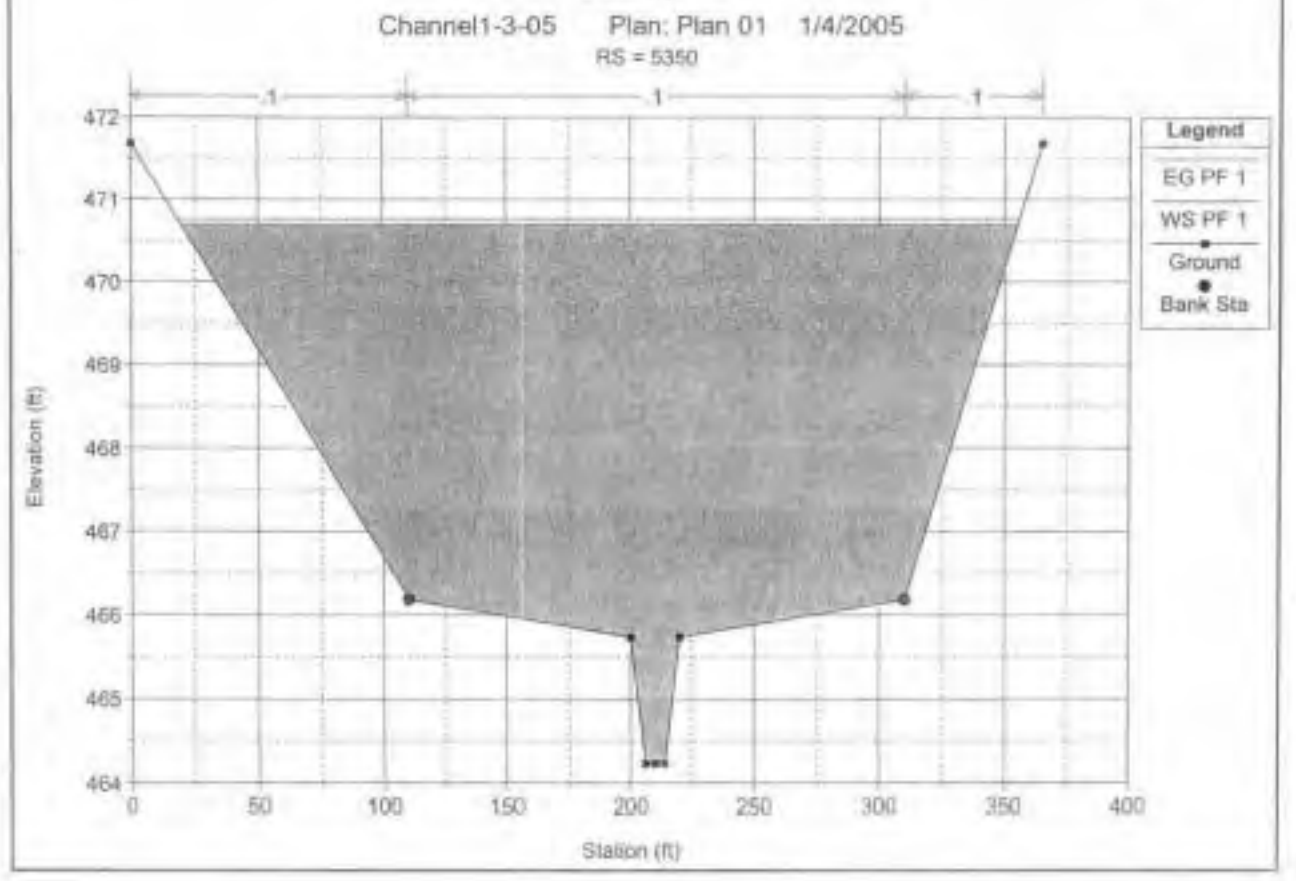
MTAY MESA CPU I-405

HEC-RAS Plan: Plan 01 River: Clay Mesa Drains Reach: Channel Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Channel	5500	PF 1	2500.00	464.60	471.08		471.16	0.002743	2.33	1073.59	200.00	0.18
Channel	5360	PF 1	2500.00	464.23	470.69		470.76	0.002572	2.16	1279.19	335.44	0.17
Channel	5100	PF 1	2500.00	463.80	470.08		470.12	0.002591	2.17	1275.99	335.16	0.17
Channel	4800	PF 1	2500.00	462.85	469.27		469.33	0.002666	2.19	1263.56	334.04	0.18
Channel	4500	PF 1	2500.00	462.10	468.51		468.56	0.002430	2.06	1358.64	379.24	0.17
Channel	4200	PF 1	2500.00	461.35	467.79		467.85	0.002365	2.07	1371.79	379.61	0.17
Channel	3900	PF 1	2500.00	460.60	467.09		467.15	0.002266	2.04	1392.50	381.79	0.16
Channel	3600	PF 1	2500.00	459.85	466.30		466.37	0.002968	2.32	1153.04	281.59	0.19
Channel	3300	PF 1	2500.00	459.10	465.33		465.42	0.003423	2.41	1106.99	285.62	0.20
Channel	3050	PF 1	3000.00	458.48	463.50		463.74	0.014532	4.06	777.90	261.33	0.39
Channel	2900	PF 1	3000.00	458.10	463.23	461.14	463.61	0.000245	4.97	603.31	222.92	0.41
Channel	2850	PF 1	3000.00	457.60	462.74	461.24	463.56	0.000521	7.22	415.32	168.05	0.58
Channel	2750		Culvert									
Channel	2640	PF 1	3000.00	456.59	462.07	458.96	462.52	0.011957	5.38	557.48	183.61	0.37
Channel	2500	PF 1	3000.00	455.38	461.81		461.87	0.001846	2.07	1452.22	277.64	0.15
Channel	2300	PF 1	3000.00	455.08	461.31		461.40	0.003272	2.45	1261.91	277.98	0.19
Channel	2100	PF 1	3000.00	454.78	460.34		460.48	0.006864	3.05	1006.38	276.49	0.27
Channel	2050	PF 1	3000.00	454.70	460.11		460.21	0.003638	2.56	1191.75	275.37	0.21
Channel	2000	PF 1	3000.00	454.63	460.00	456.55	460.06	0.002196	2.06	1582.39	378.00	0.16


Channel1-3-05 Plan: Plan 01 1/3/2005
Otay Mesa Draina Channel
SIEMPRE VIVA
Q = 10w x 8H RCB
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
472
470
468
466
464
462
460
458
456
454
2000
2500
3000
3500
4000
4500
5000
5500
Main Channel Distance (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 5500
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
476
474
472
470
468
466
464
0
50
100
150
200
Station (ft)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RS = 5350
.1
1
1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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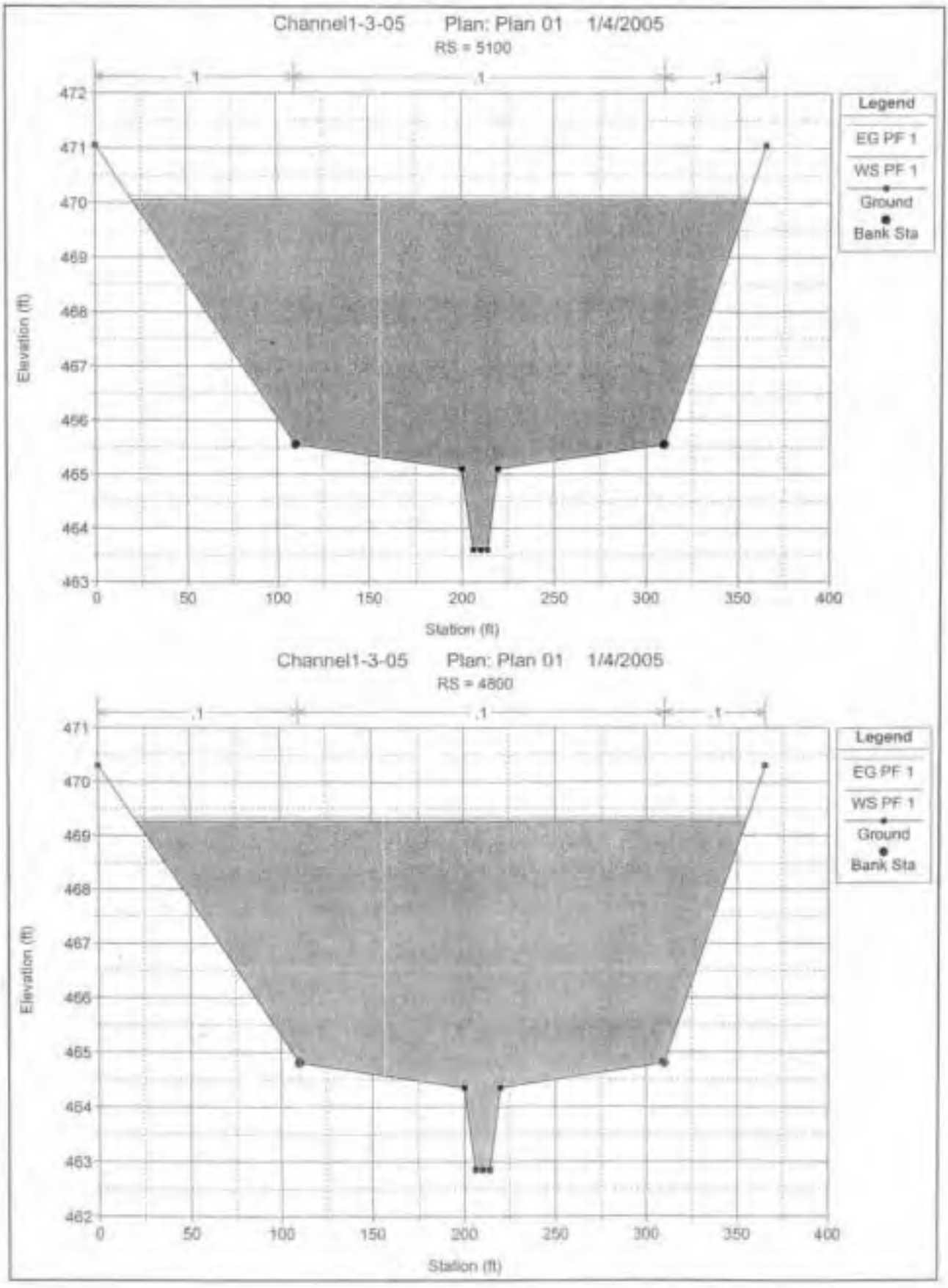
471
470
469
468
467
466
465
464
0
50
100
150
200
250
300
350
400
Station (ft)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.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
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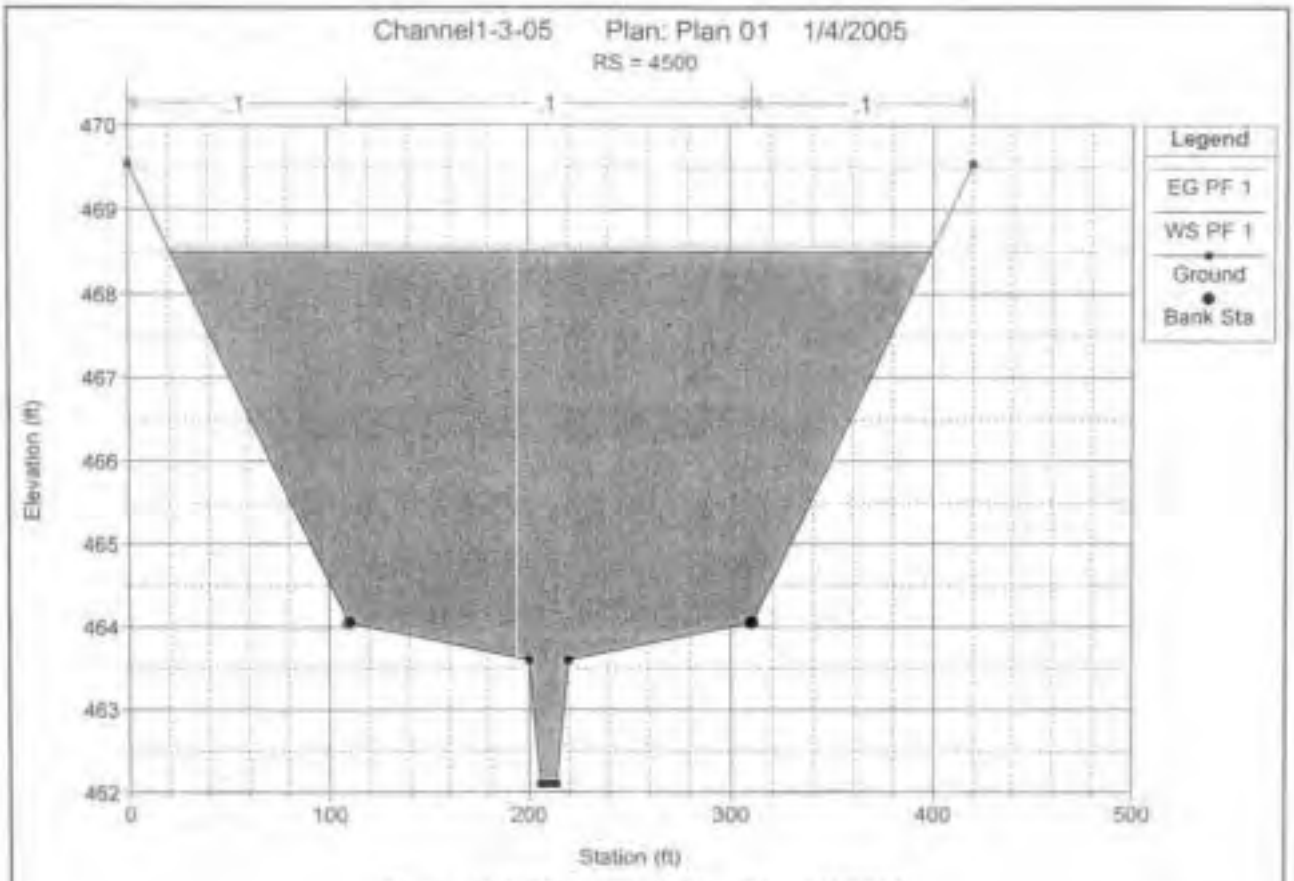
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 4500
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.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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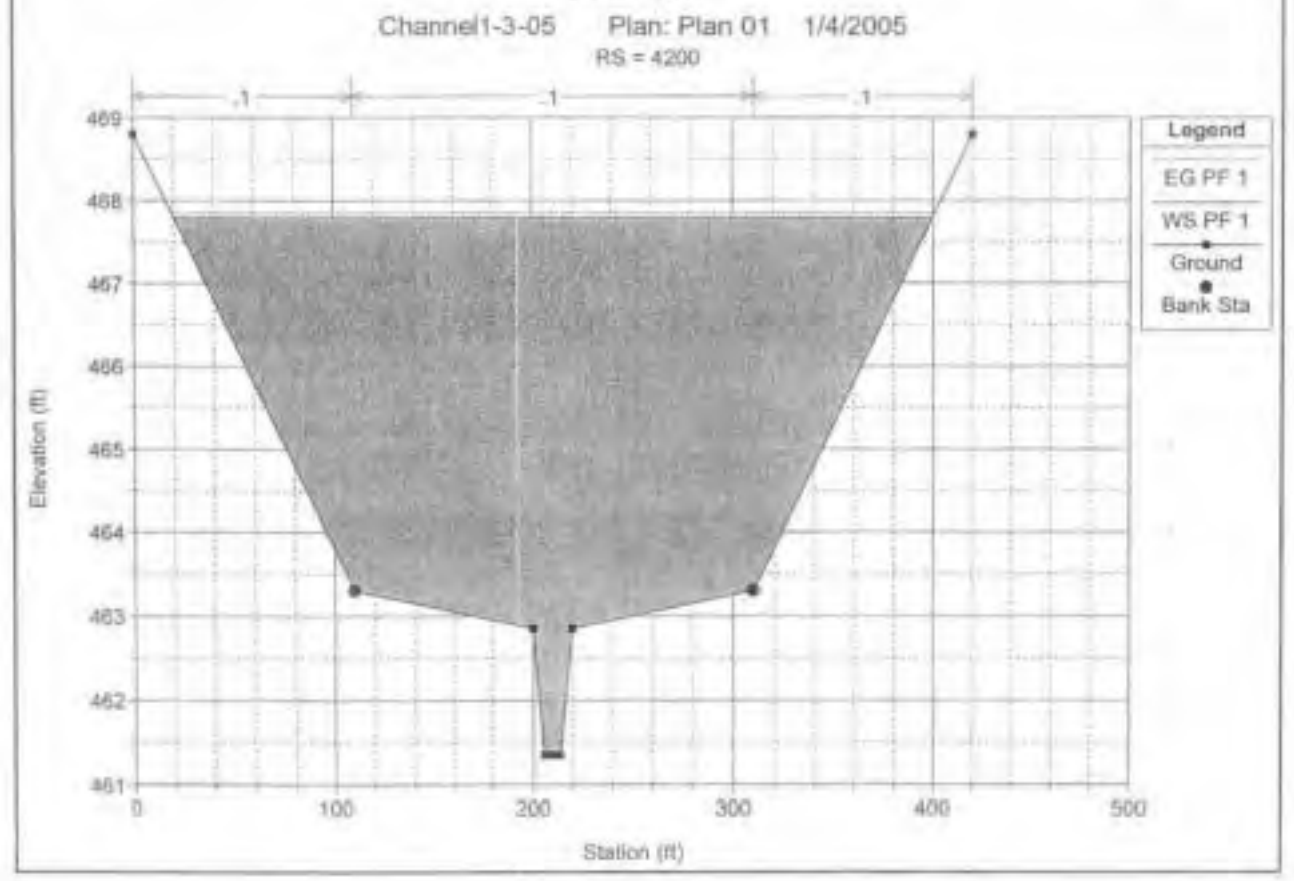
469
468
467
466
465
464
463
462
0
100
200
300
400
500
Station (ft)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RS = 4200
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.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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465
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463
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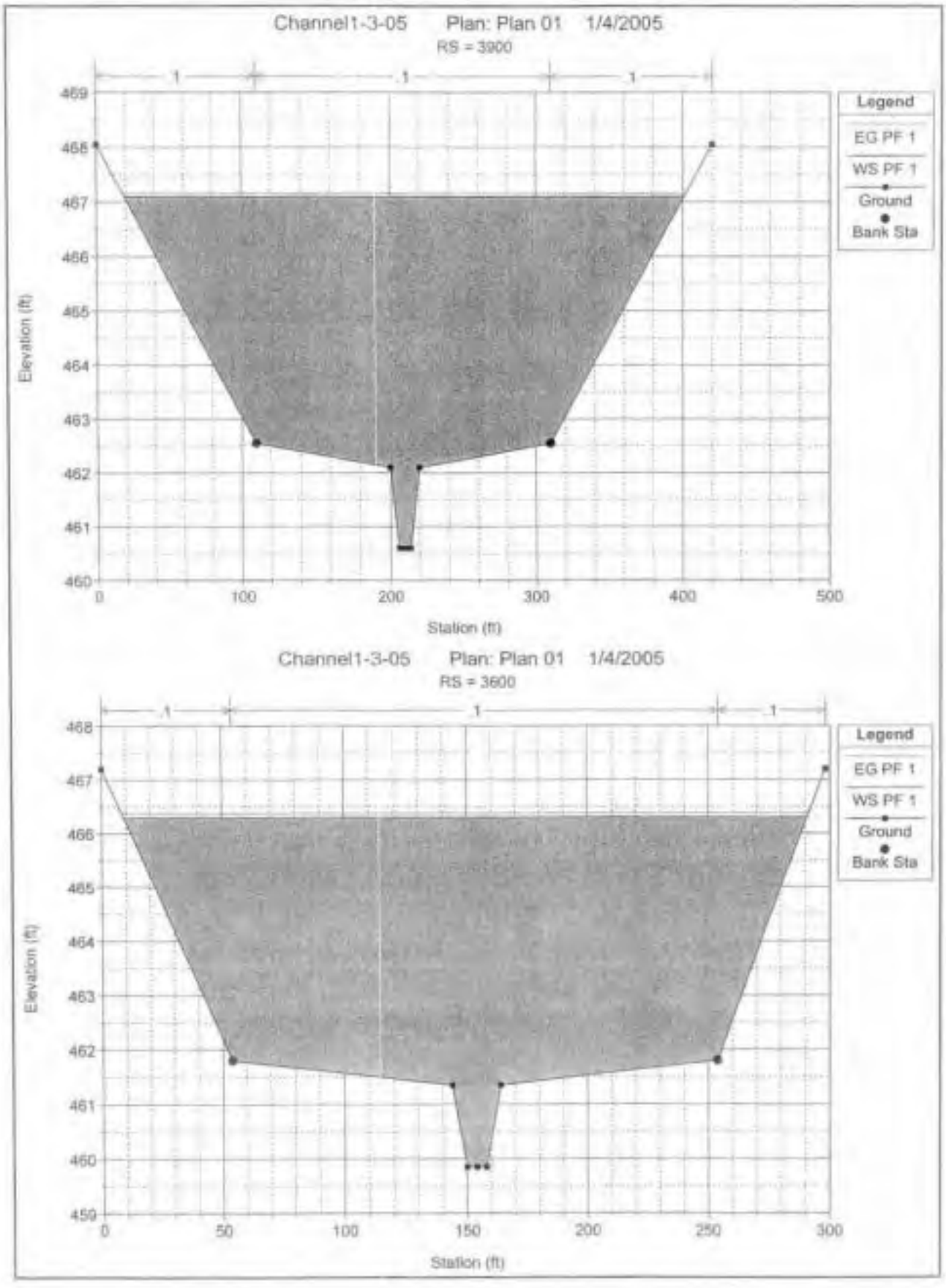
0
100
200
300
400
500
Station (ft)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.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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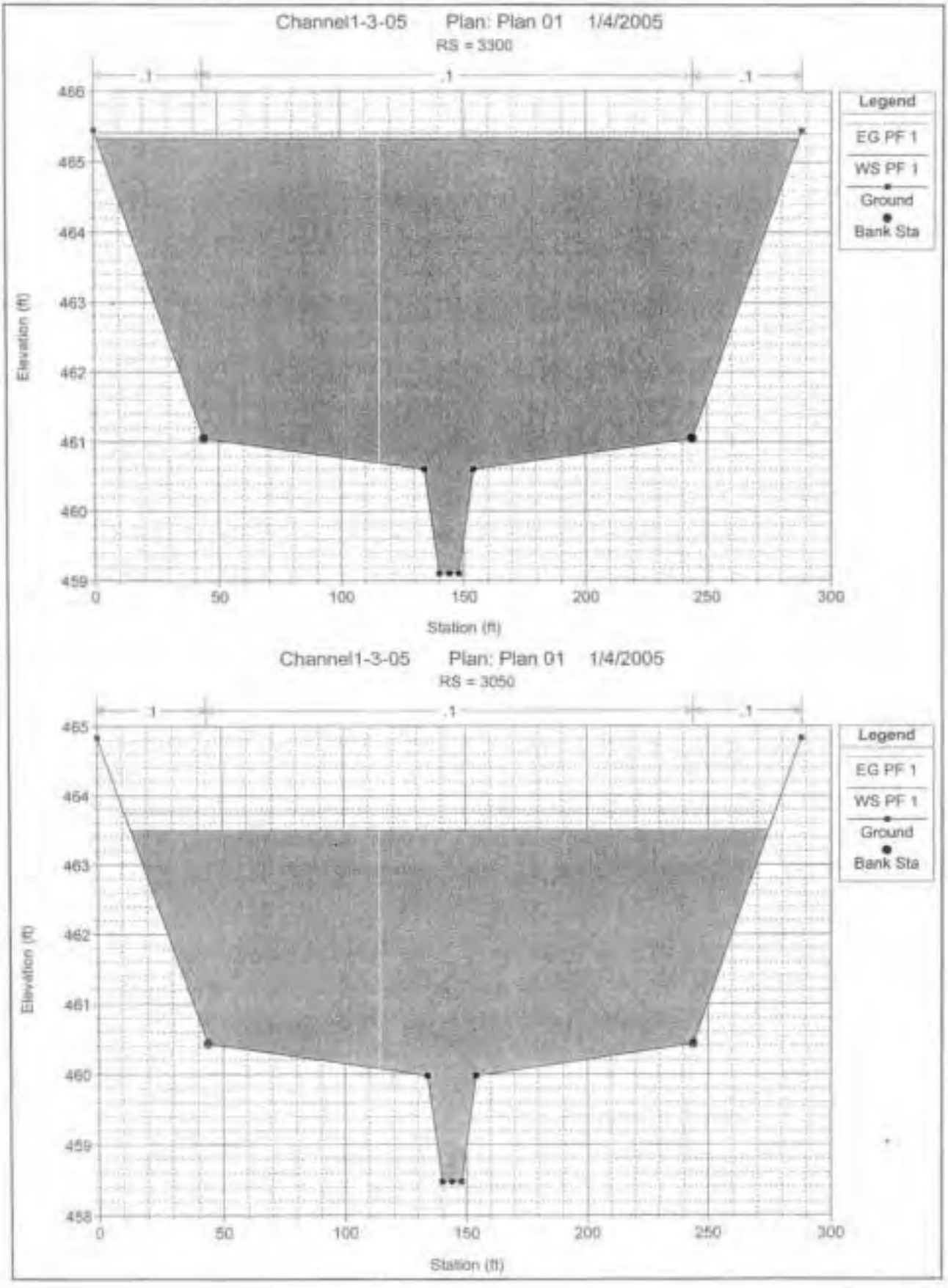
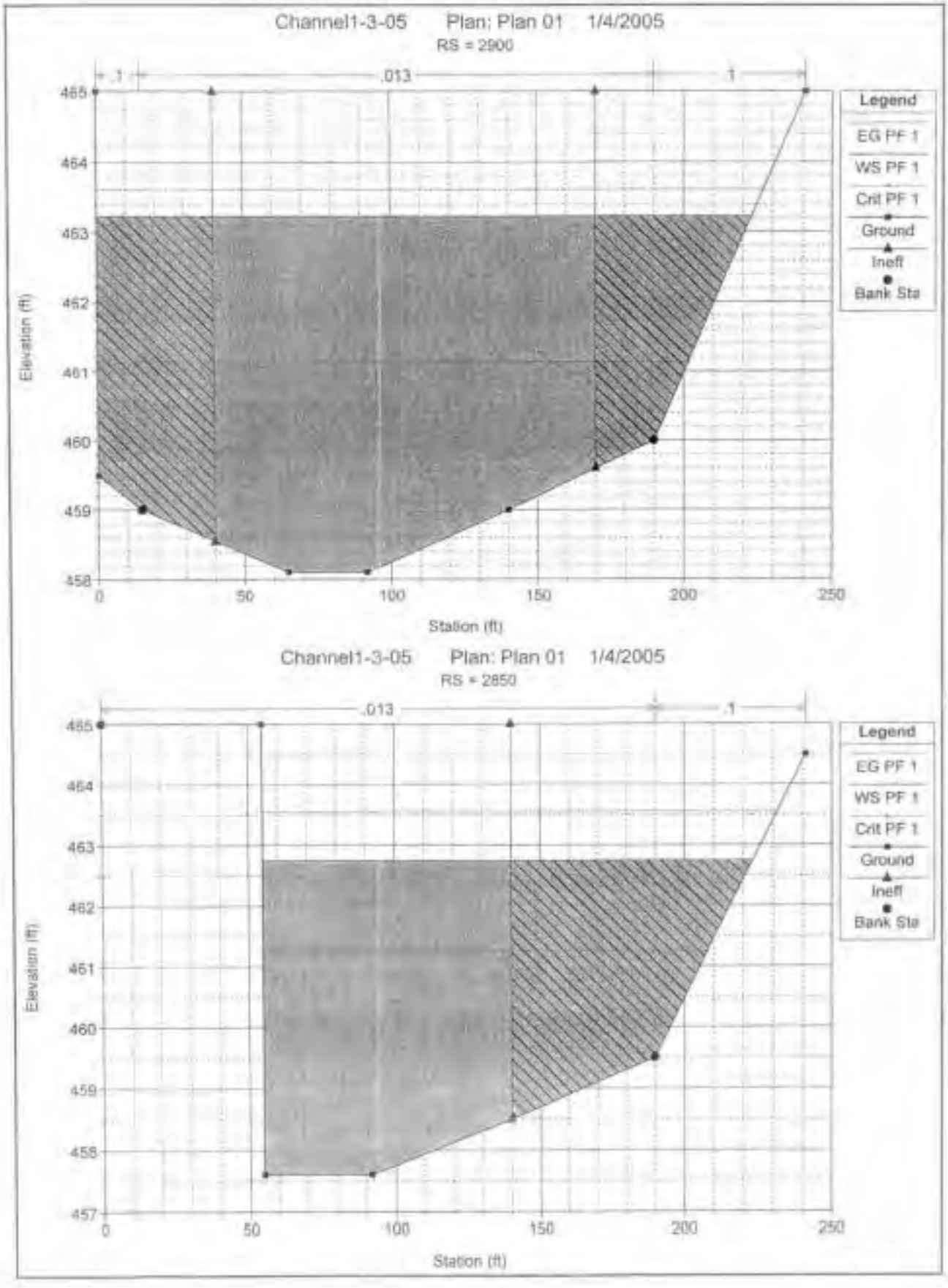
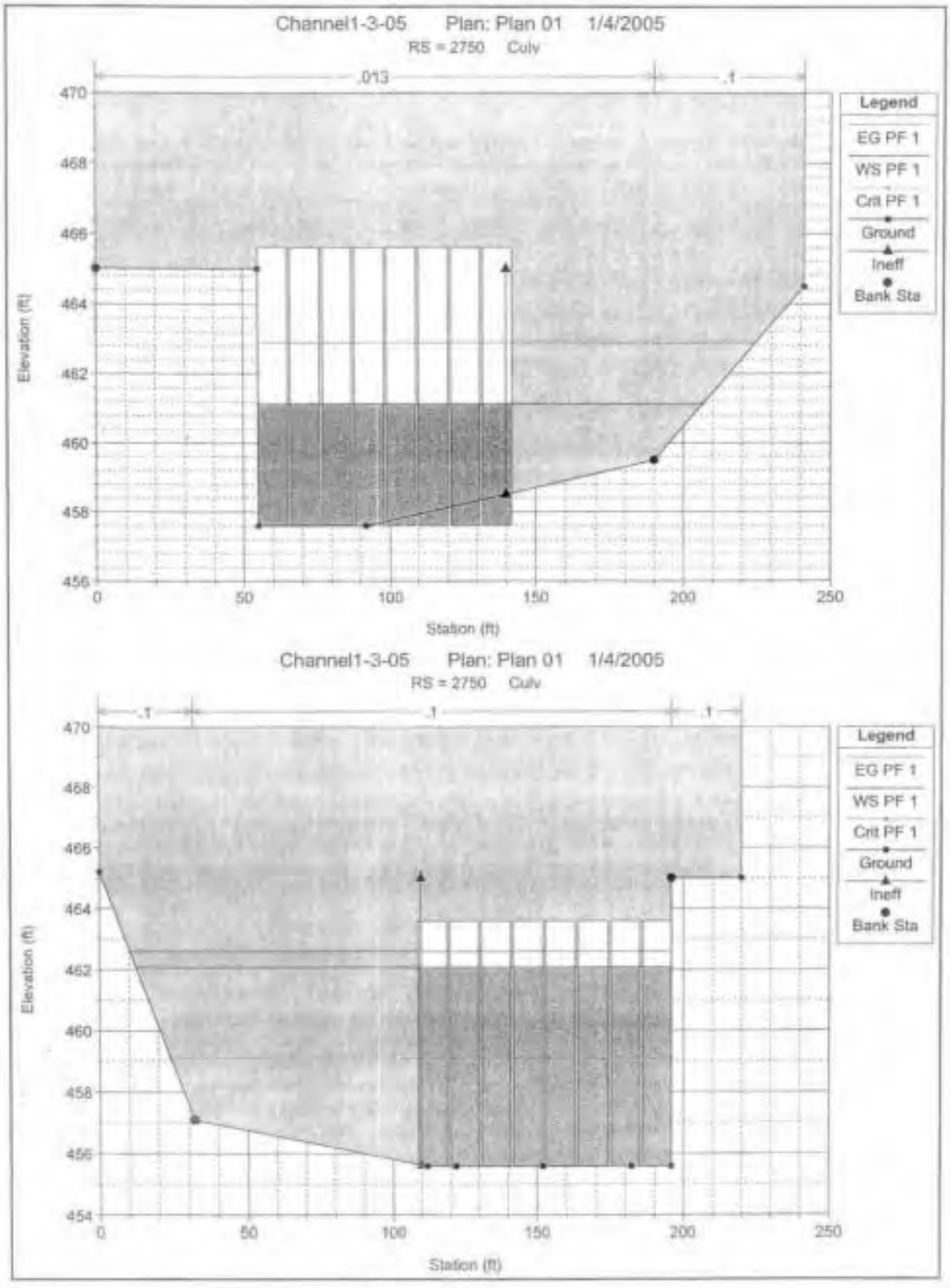
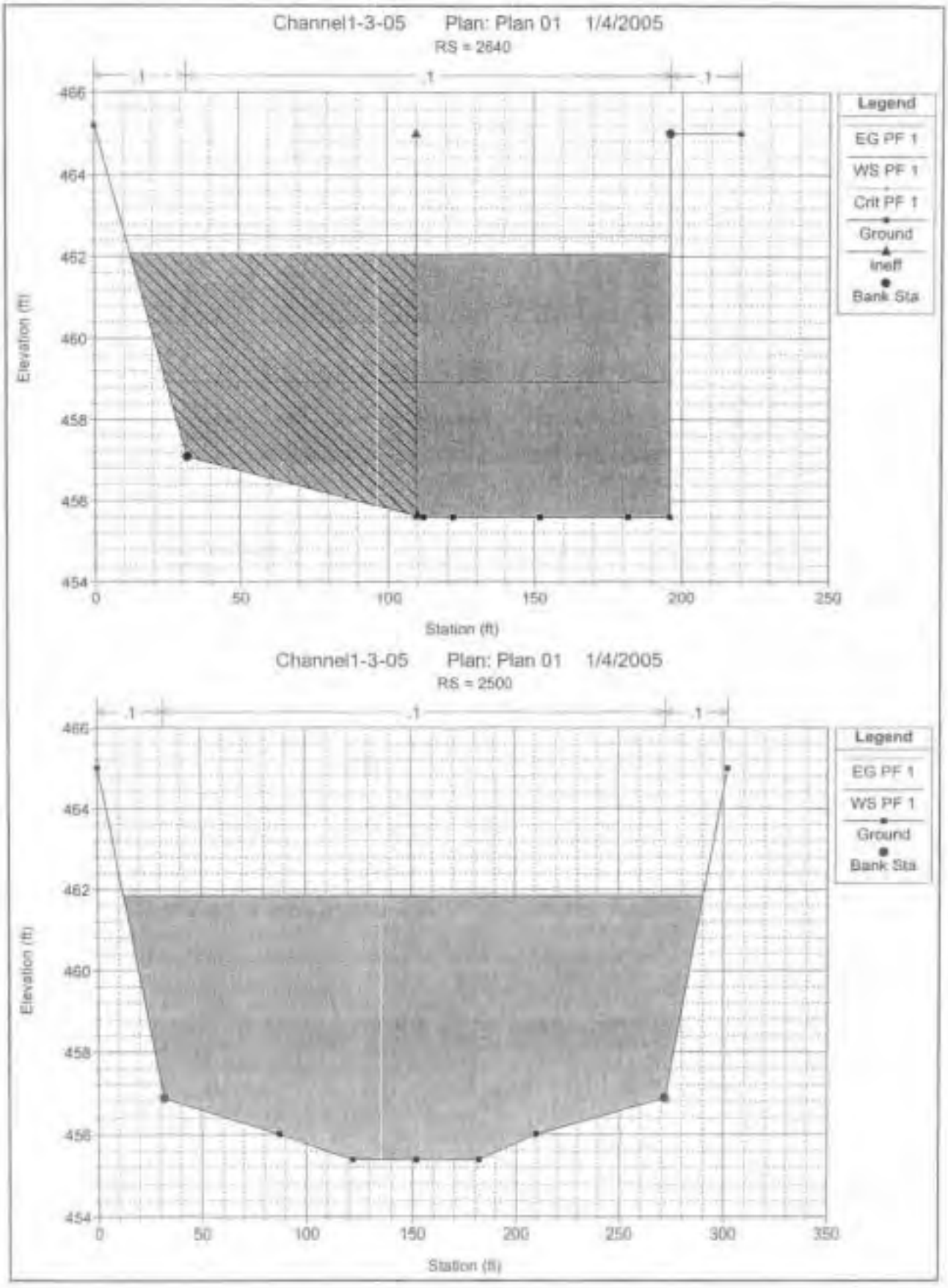
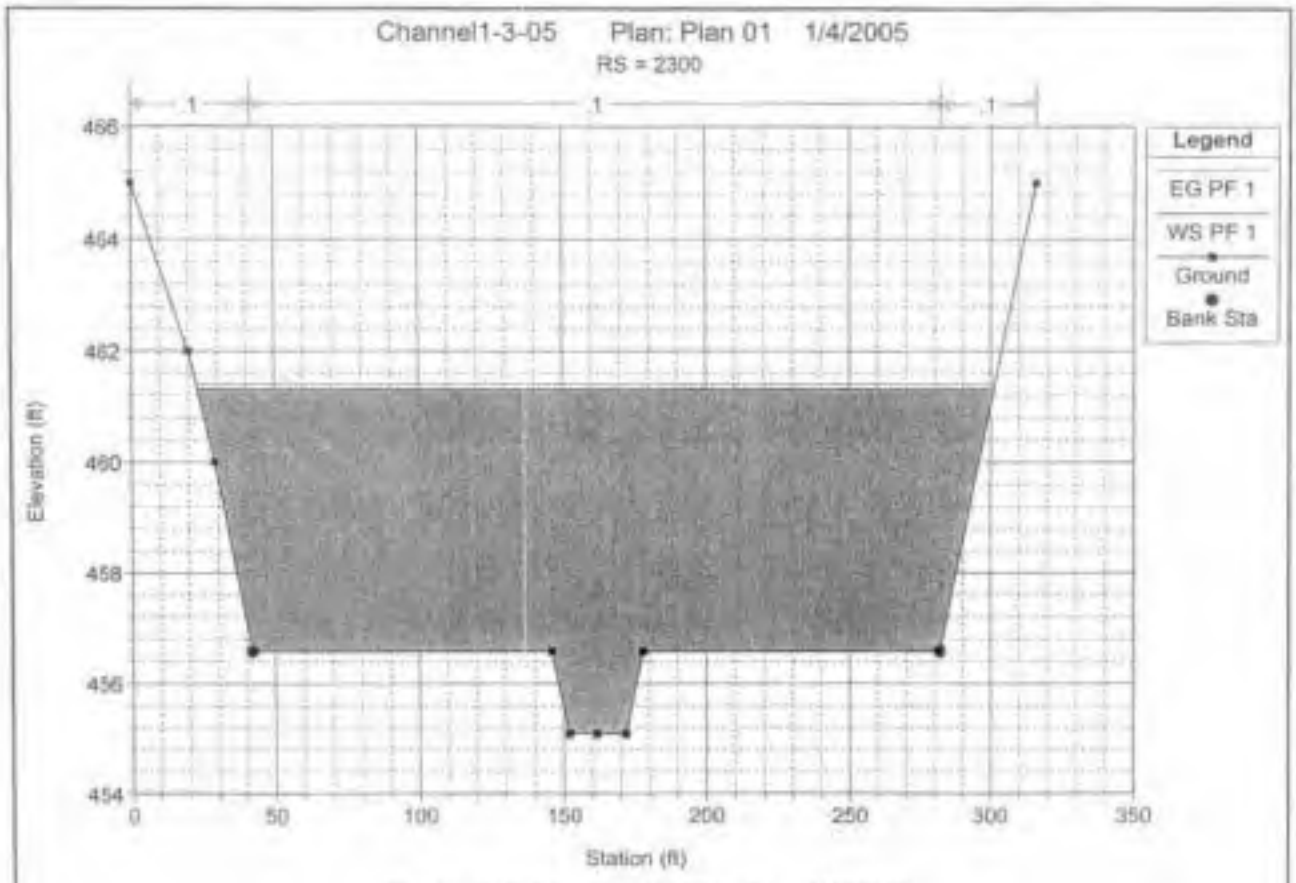
468
467
466
465
464
463
462
461
460
0
100
200
300
400
500
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 3600
.1
1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
468
467
466
465
464
463
462
461
460
459
0
50
100
150
200
250
300
Station (ft)

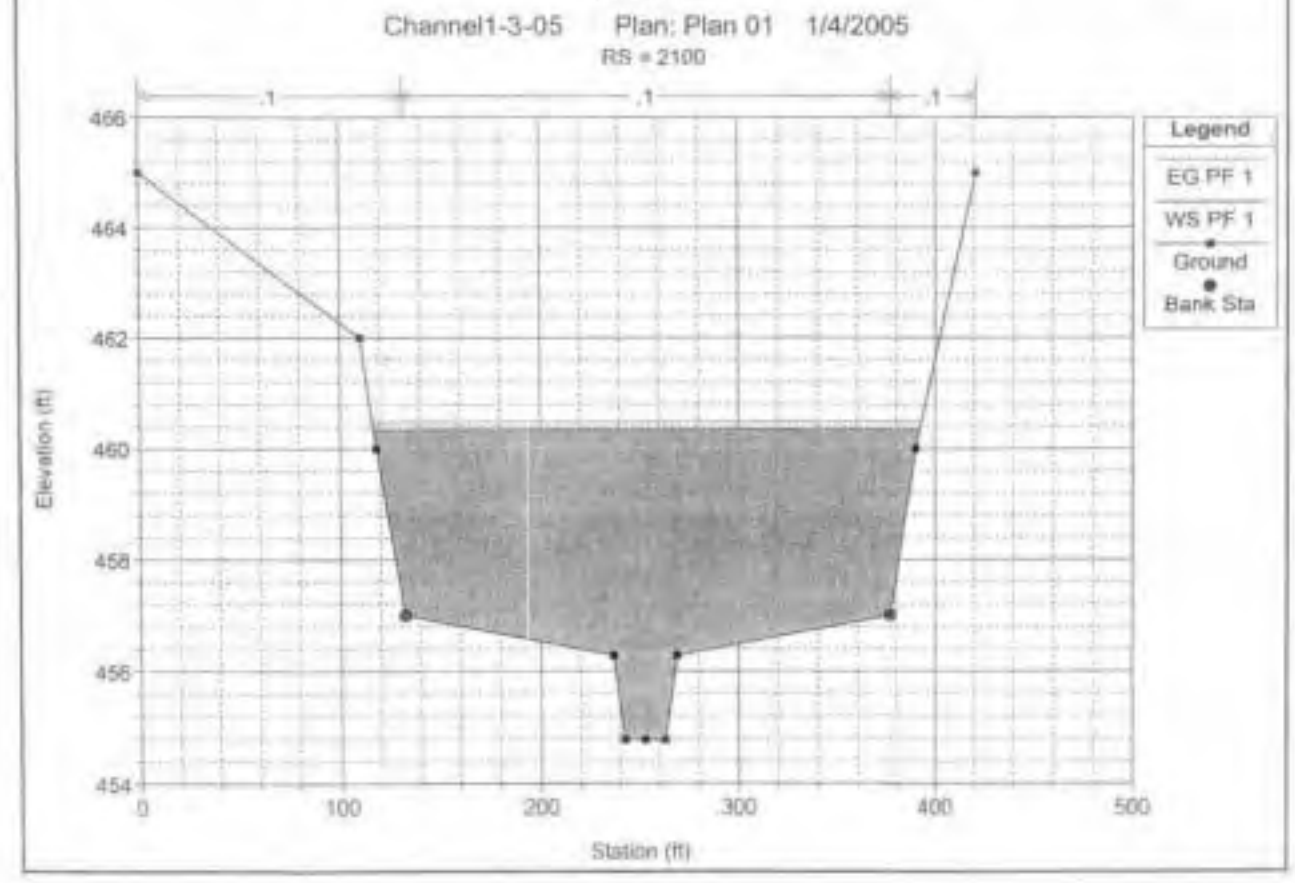

Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 3300
.1
.1
.1
466
465
464
463
462
461
460
459
Elevation (ft)
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 3050
.1
.1
.1
465
464
463
462
461
460
459
458
Elevation (ft)
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

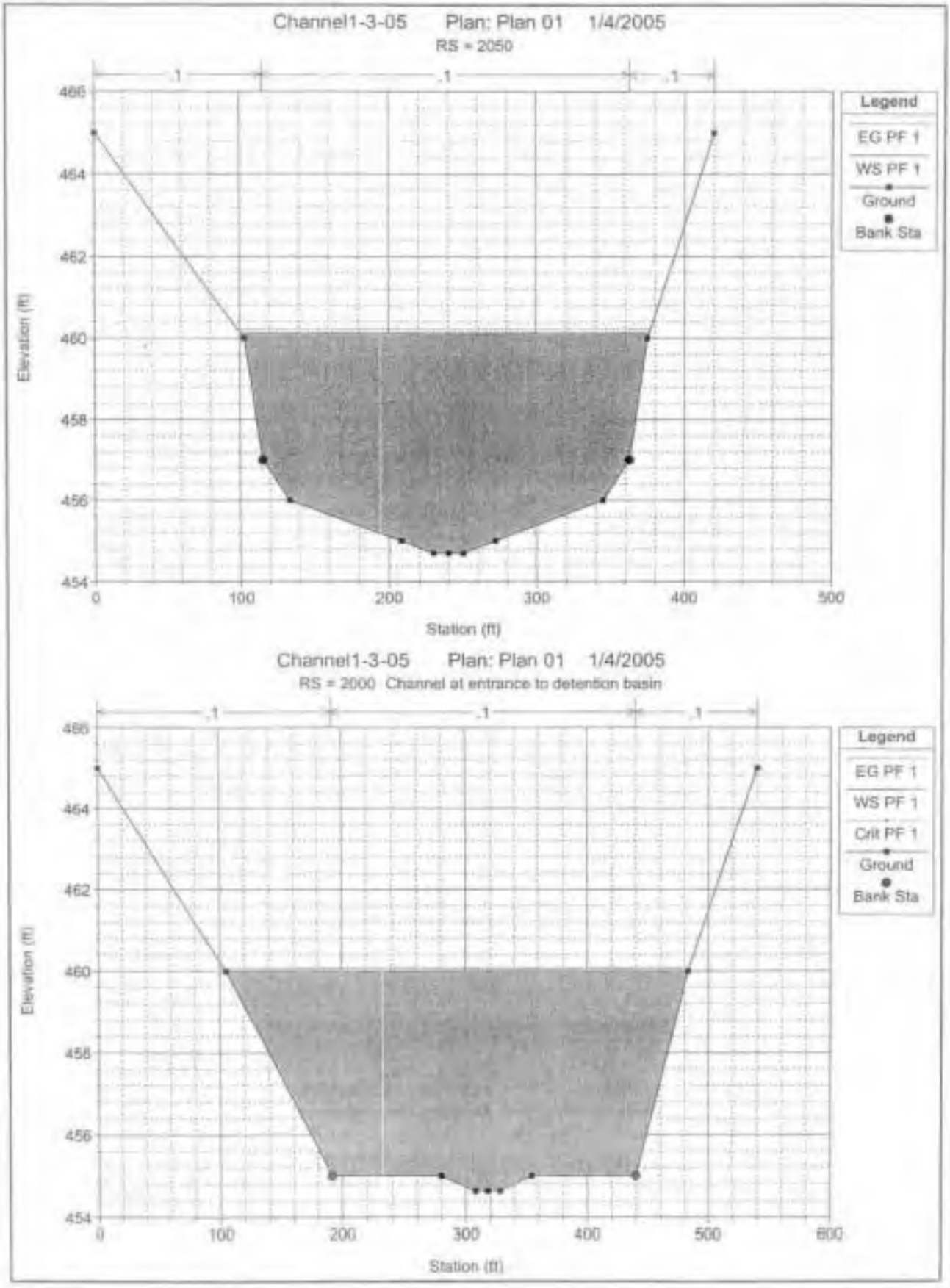

Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2900
.1
.013
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2850
.013
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2750 Culv
.013
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
470
468
466
464
462
460
458
456
0
50
100
150
200
250
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2750 Culv
.1
.1
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
470
468
466
464
462
460
458
456
454
0
50
100
150
200
250


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2640
.1
.1
.1
466
464
462
460
458
456
454
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2500
.1
.1
.1
466
464
462
460
458
456
454
Elevation (ft)
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2300
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
466
464
462
460
458
456
454
0
50
100
150
200
250
300
350
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2100
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
466
464
462
460
458
456
454
0
100
200
300
400
500
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2050
.1
.1
.1
466
464
462
460
458
456
454
Elevation (ft)
0
100
200
300
400
500
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2000 Channel at entrance to detention basin
.1
.1
.1
466
464
462
460
458
456
454
Elevation (ft)
0
100
200
300
400
500
600
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

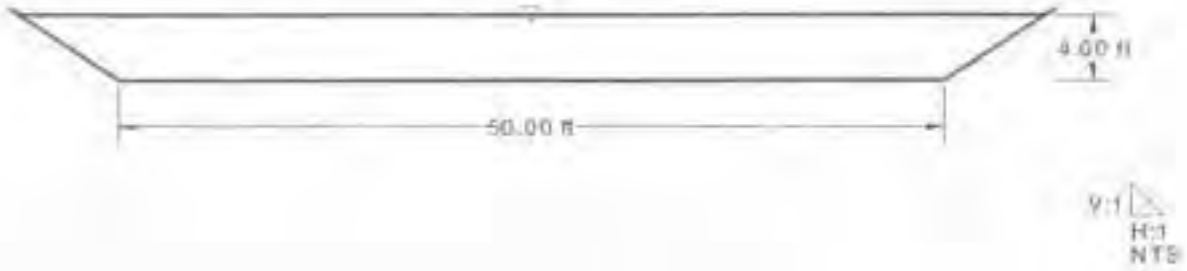
Input Data		
Mannings Coefficient	0.045	
Slope	0.006150	ft/ft
Depth	4.00	ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	50.00	ft

Results		
Discharge	1,331.30	cfs
Flow Area	224.0	ft²
Wetted Perimeter	64.42	ft
Top Width	62.00	ft
Critical Depth	2.73	ft
Critical Slope	0.022486	ft/ft
Velocity	5.94	ft/s
Velocity Head	0.55	ft
Specific Energy	4.55	ft
Froude Number	0.56	
Flow Type	Supercritical	

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

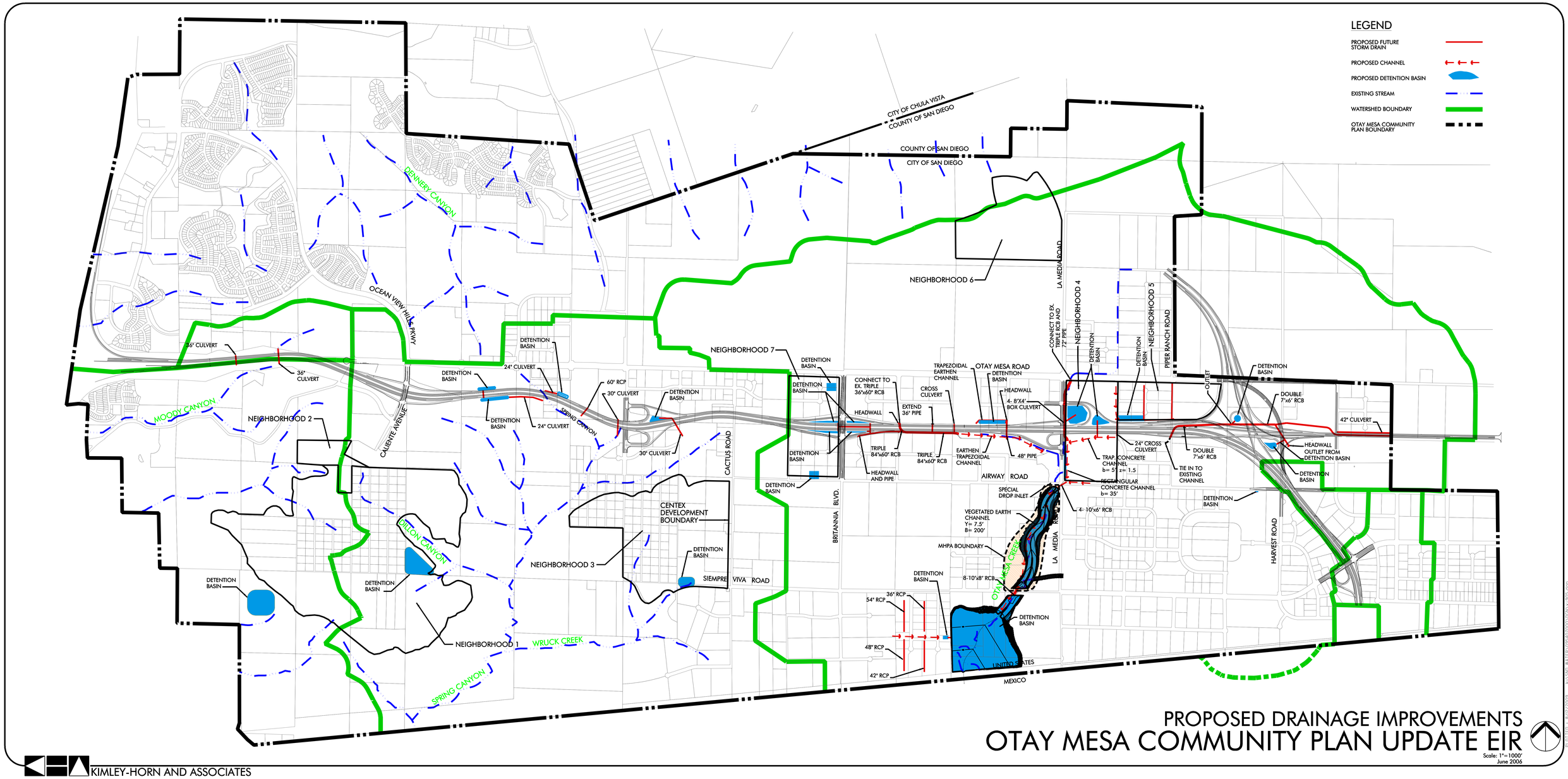
Section Data		
Mannings Coefficient	0.045	
Slope	0.000150	ft/ft
Depth	4.00	ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	50.00	ft
Discharge	1,331.30	cfs



V. PROPOSED DRAINAGE FACILITIES

For most of the Mesa, drainage facilities are constructed as part of development or road projects, and include only facilities in the immediate vicinity of the projects. For the proposed future private development, no designs are available to show these future facilities. Caltrans has prepared plans for their SR-905 project, and those facilities are shown on the attached map.

The only Master Planned facility which needs to be constructed before development takes place is the Main Channel and Detention basin in the East Watershed. Details of this system are presented in Section VI.



PROPOSED DRAINAGE IMPROVEMENTS
OTAY MESA COMMUNITY PLAN UPDATE EIR

Scale: 1"=1000'
June 2006

KIMLEY-HORN AND ASSOCIATES

VI. PROPOSED DRAINAGE ALTERNATIVES

The historical drainage on the Mesa, with its flat terrain and shallow swales for drainage paths, did not become a problem until development started taking place in the 1960s. This development started concentrating flows in culverts under roads and redefined some of the historical drainage paths. Some of the development solved problems in some areas, but impacted other areas by moving the problem downstream. One of these areas is the existing creek that parallels La Media Road and eventually crosses the border into Mexico. The frequent flooding along portions of this channel is a constraint to future development for some of the areas along the creek.

1. NO PROJECT

The alternative of doing nothing to improve the drainage along the main creek channel would prevent future development from taking place along portions of La Media Road. The existing creek is not deep enough to allow the adjacent properties to drain effectively. To provide continued access along the truck route during storms, if the channel is not constructed, the roads will need to be raised or alternative routes identified. The existing intersection of Airway Road and La Media Road floods after any significant precipitation. The adjacent roads are too low to allow significant flows to pass under them, so they flood frequently. If the roads are raised to allow more flow to pass under them, they will impact the already-developed adjacent property, parts of which would now be lower than the roads, creating even more difficult drainage issues for the properties.

2. CONCRETE CHANNEL

The 1999 Otay Mesa Drainage Study recommended a concrete channel from Otay Mesa Road to the Border Detention Basin. The recommended plan was a concrete channel along the east side of La Media Road until reaching Siempre Viva Road, where it crossed under La Media and followed on the north side of Siempre Viva to box culverts under Siempre Viva that connected to the Border Detention Basin. All of the concrete channel alternatives assumed that the existing creek with its habitat would continue to carry low flows. The 1999 cost for this alternative was $10.6 million, which would be approximately $14.9 million in 2005 dollars without land acquisition.

3. LA MEDIA CHANNEL AND BORDER DETENTION BASIN

The largest watershed on the Mesa is the East Watershed, which covers an area at 6.78 square miles (4,340 Acres). All of the flow from this watershed collects at a concentration point at a large culvert where it crosses the border with Mexico and flows under the airport access road and airport runway before flowing into the Tijuana River.

This portion at the Mesa is extremely flat, and the adjacent properties can not effectively drain into the existing small creek channel without raising the elevations of the roads and developments near the creek. To allow for future development and to accommodate runoff from proposed future projects, a new channel is required with inverts from 3 to 5 feet below the existing creek channel.

The proposed channel has a bottom width that varies from 240 feet at the new border detention basin to 200 feet from north of Siempre Viva Road to the Airway Road/La Media Road intersection. The side slopes will vary between 4:1 to 10:1. Heavy riparian vegetation will be allowed to grow in the channel and no annual maintenance will be required. Once the vegetation has matured, maintenance of dead or fallen trees may be required every few years. There will be a 12 foot wide access road on each bank. The Channel will contain the 100 year flood flow with mature vegetation growth.

From the Airway Road/La Media Road intersection, a 35 foot wide concrete channel along the east side of La Media Road will connect with the proposed Caltrans culverts which will be constructed with SR 905. The RCB culverts under the intersection will need to accommodate existing utilities in both roads, which may impact the intersection and the utilities.

The Border Detention Basin will be designed to attenuate the peak post-development flows down to their pre-development levels for flows from 5 year through 100 year storms. The outlet structure will be less than six feet high, and will not be under the jurisdiction of the State of California DSOD. The design of the outlet structure will be prepared with final plans for the project. The Detention Basin will be approximately 1700' by 1500' and cover an area of approximately 58 acres.

Border Detention Basin

Area:	58 Acres
Max. Water Depth:	6.0 Feet
Max. Storage Volume:	308 AF

The basin will be graded to appear natural. Natural vegetation will be allowed to grow in the basin and no annual maintenance will be required. A low-flow stream will be created through the basin. A Maintenance Assessment District may be created for maintaining the channel and detention basin.

The basin and channel will require the removal of approximately 915,000 CY of soil. It is assumed that this export will be used on adjacent properties to raise the building pad grades thereby limiting the haul distance. A preliminary cost estimate was prepared which reflects both the construction costs and the land acquisition costs. A Property Ownership Map which shows the ownership within the East Watershed is attached.

La Media Channel and Border Detention Basin

Preliminary Opinion of Probable Construction Cost

2/8/2005

Kimley-Horn and Associates

Construction Items

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Excavation	822,500	CY	$2	$1,645,000
2	Airway Road culvert (5-5'wx5'h)	300	CY	$1,500	$450,000
3	La Media/Airway Road intersection culvert (6-10'wx6'h)	1,500	CY	$1,500	$2,250,000
4	Siempre Viva Road culvert (8-10'wx8'h)	1,490	CY	$1,500	$2,235,000
5	Detention Basin Outlet Structure	1	LS	$100,000	$100,000
6	Traffic Control	1	LS	$100,000	$100,000
7	Utility Relocation	1	LS	$150,000	$150,000
8	Street Repair	1	LS	$50,000	$50,000
9	Erosion Control	1	LS	$50,000	$50,000
10	Revegetation	1	LS	$600,000	$600,000
		Subtotal			$7,630,000
		Contingency	20%		$1,526,000
		Total			$9,156,000

Land Acquisition

1	Land Acquisition (outside MHPA)*	2,510,000	SF	$4	$10,440,000
2	Land Acquisition (inside MHPA)**	1,820,000	SF	$1	$1,820,000
		Subtotal			$12,260,000
		Contingency	20%		$2,452,000
		Total			$14,712,000

Total Cost (Construction and Land Acquisition) $23,868,000

Notes: * Includes area of detention basin and channel south of Siempre Viva

** Includes entire area within MHPA boundary

*** Estimate does not include engineering, environmental, geotechnical, surveying, etc.

K:\005407000\Excel\[cost estimate.xls]Sheet1

OTAY MESA CPU

Earthwork Quantities

Cut: 822,500 CY

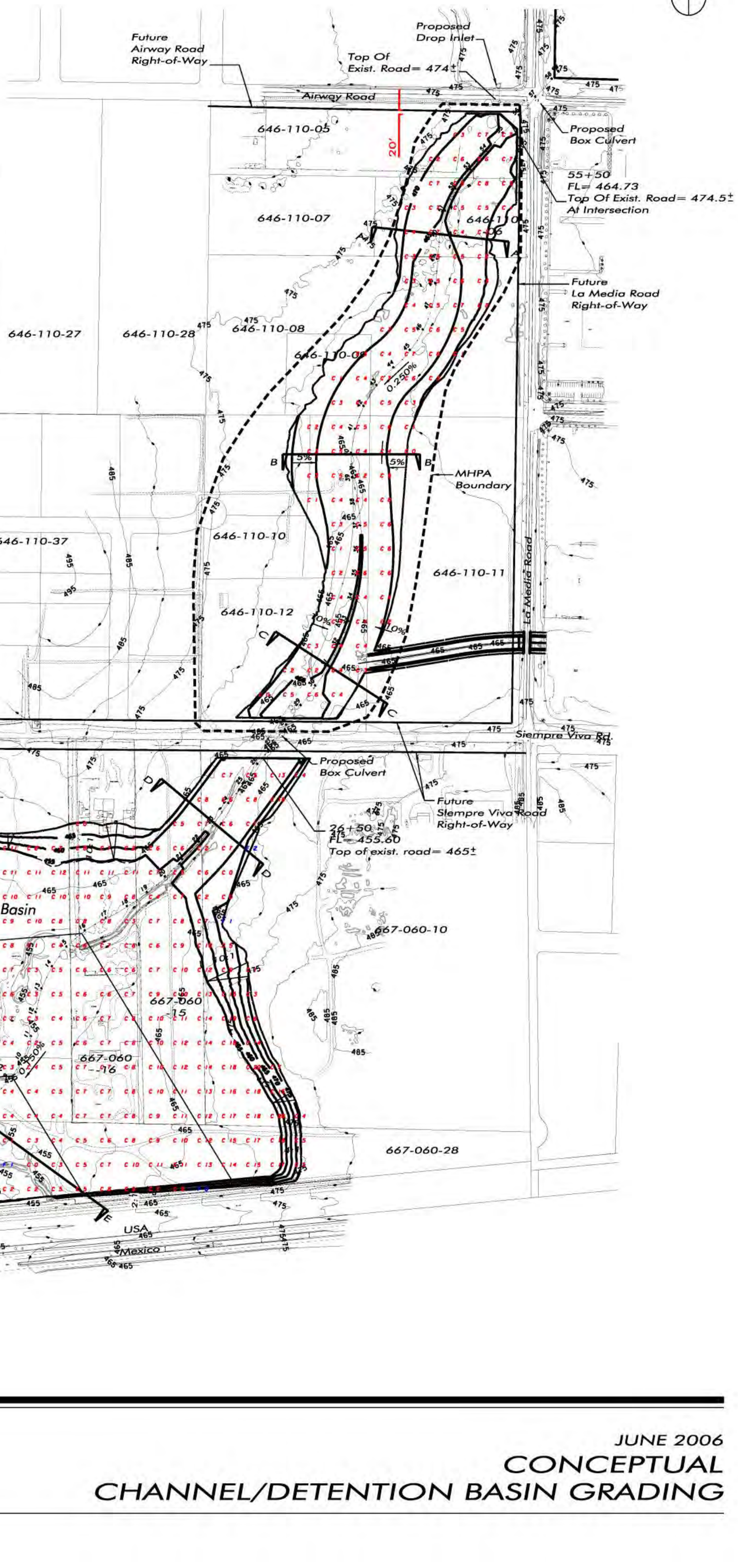
Fill: 900 CY

C = Cut depth in feet

F = Fill depth in feet

Detention Basin Volume: 308 AF

Max. Depth of Ponding: 6'



0 100 200 400

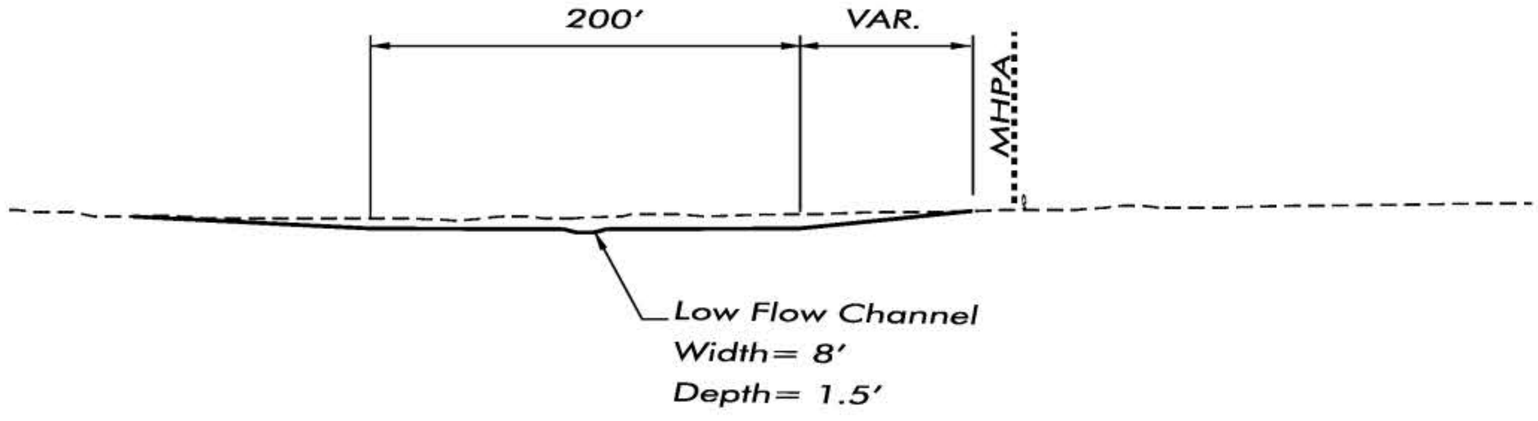
SCALE: 1" = 200'

KIMLEY-HORN and ASSOCIATES

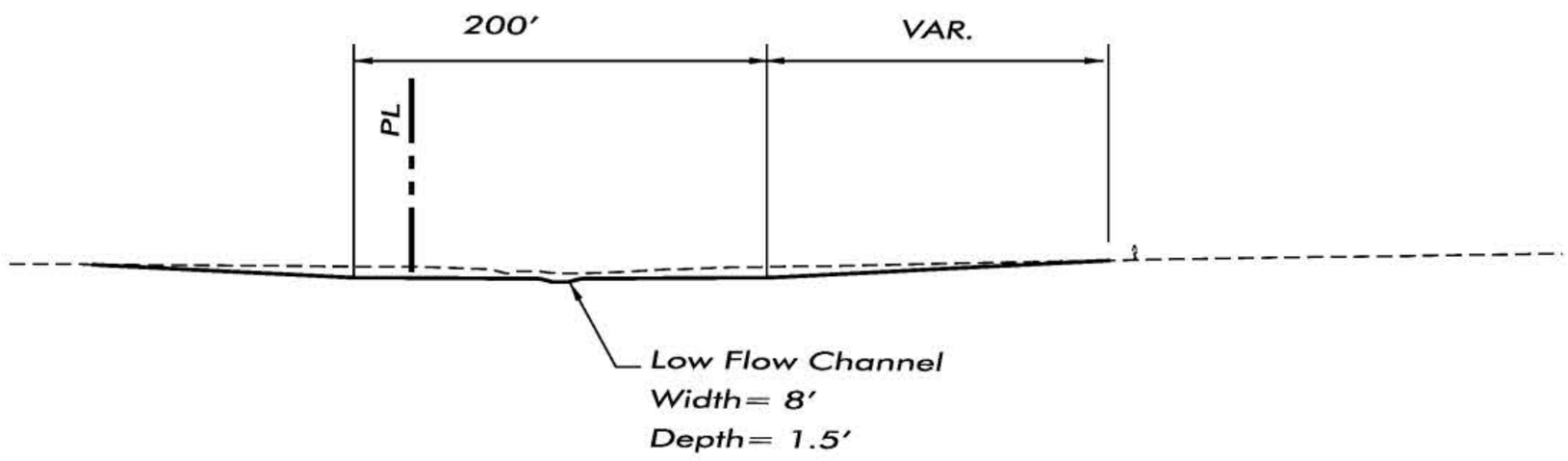
JUNE 2006

CONCEPTUAL CHANNEL/DETENTION BASIN GRADING

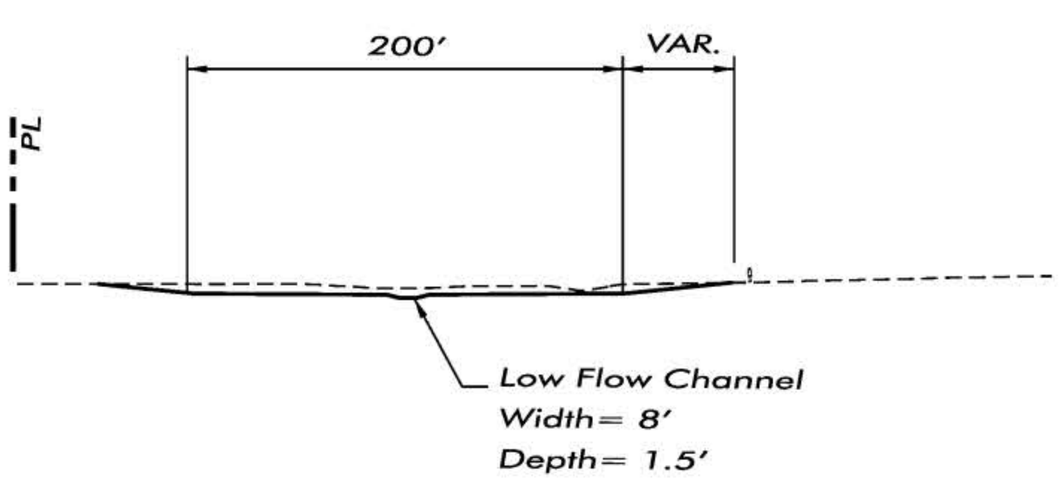
OTAY MESA CPU



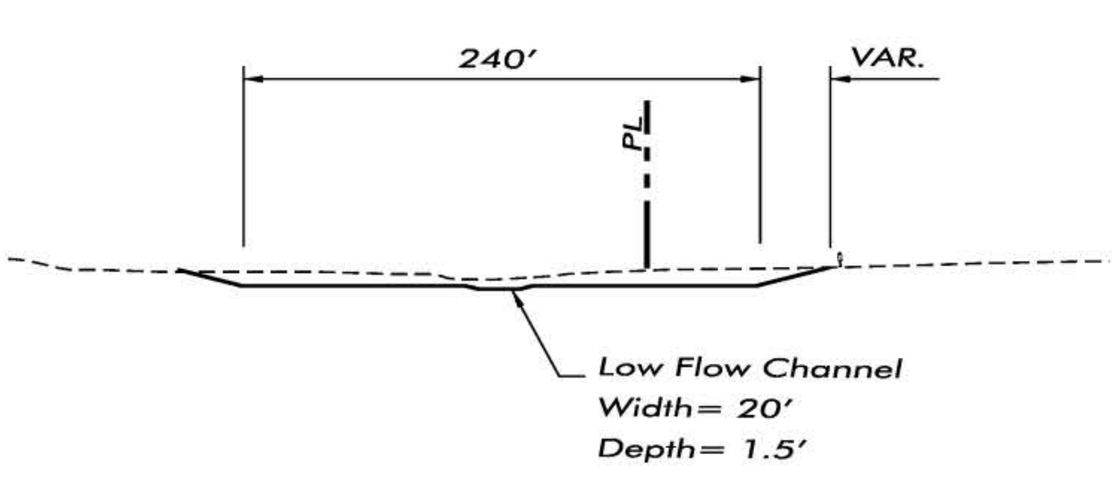
SECTION A-A



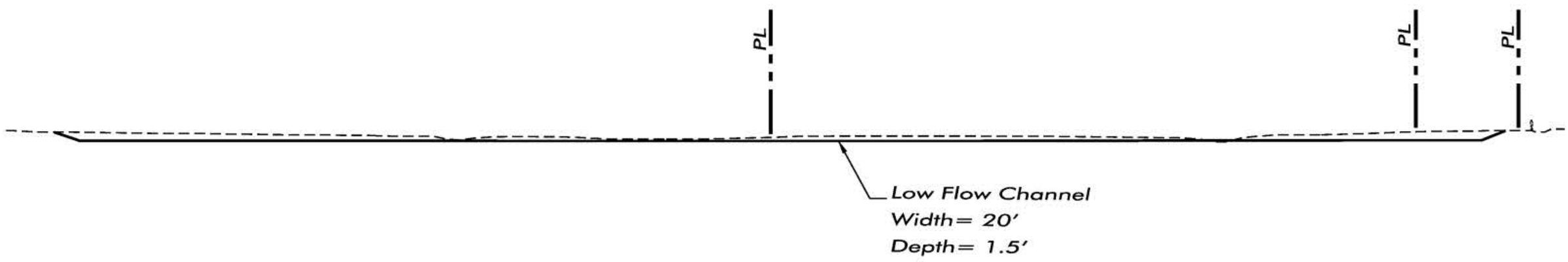
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

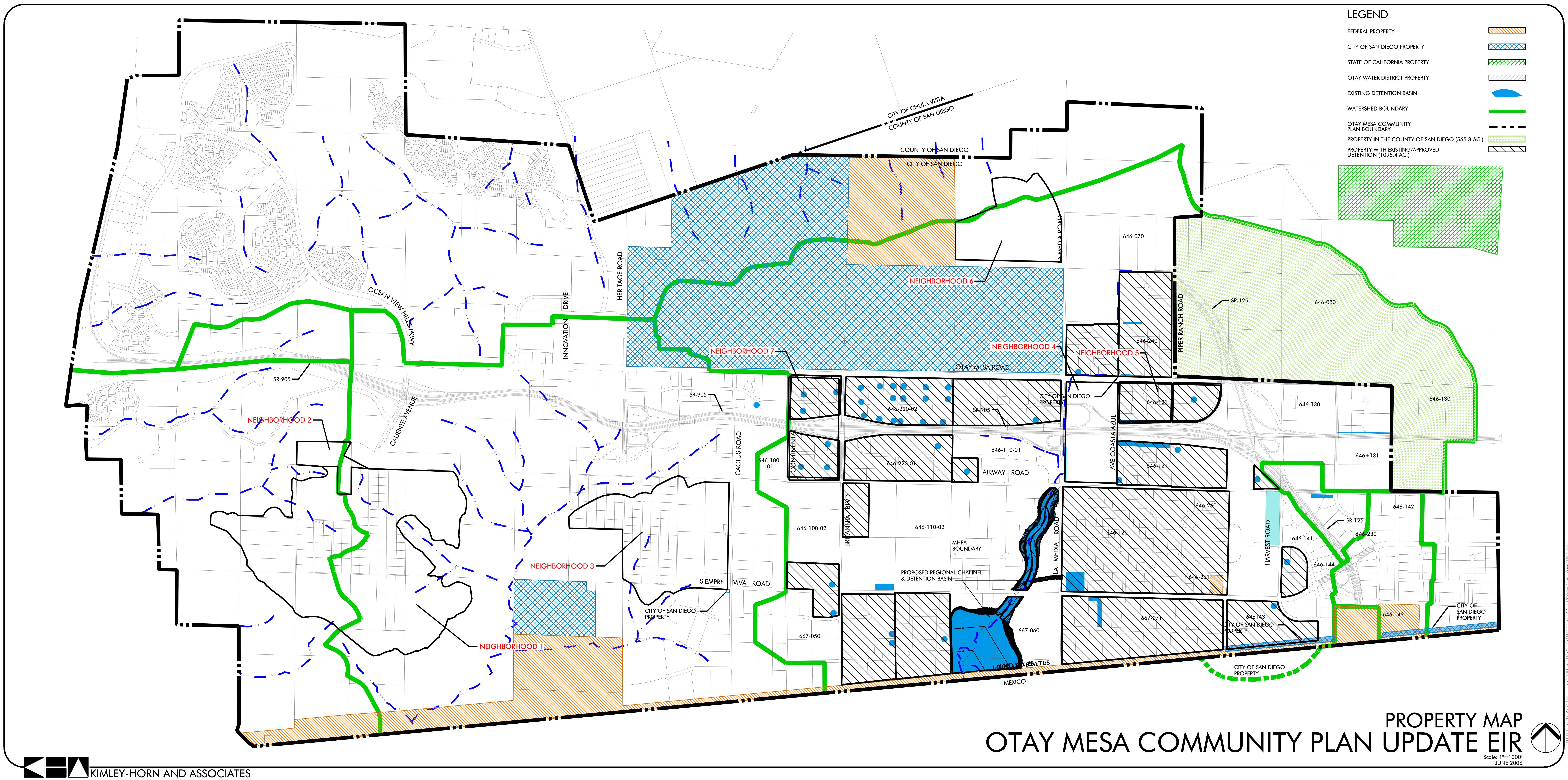
Note: No Vertical Exaggeration On Sections

0 25 50 100
SCALE: 1" = 50'

JUNE 2006

KIMLEY-HORN and ASSOCIATES

EARTHWORK CROSS SECTIONS


LEGEND
FEDERAL PROPERTY
CITY OF SAN DIEGO PROPERTY
STATE OF CALIFORNIA PROPERTY
OTAY WATER DISTRICT PROPERTY
EXISTING DETENTION BASIN
WATERSHED BOUNDARY
OTAY MESA COMMUNITY PLAN BOUNDARY
PROPERTY IN THE COUNTY OF SAN DIEGO (565.8 AC.)
PROPERTY WITH EXISTING/APPROVED DETENTION (1095.4 AC.)
CITY OF CHULA VISTA
COUNTY OF SAN DIEGO
CITY OF SAN DIEGO
NEIGHBORHOOD 1
NEIGHBORHOOD 2
NEIGHBORHOOD 3
NEIGHBORHOOD 4
NEIGHBORHOOD 5
NEIGHBORHOOD 6
NEIGHBORHOOD 7
OCEAN VIEW HILLS PKWY
CALIENTE AVENUE
INNOVATION DRIVE
HERITAGE ROAD
CACTUS ROAD
SIEMPRE VIVA ROAD
OTAY MESA ROAD
AIRWAY ROAD
BRITANNIA BLVD
LA MEDIA ROAD
AVE COSTA AZUL
PIPER RANCH ROAD
HARVEST ROAD
SR-905
SR-125
MHPA BOUNDARY
PROPOSED REGIONAL CHANNEL & DETENTION BASIN
CITY OF SAN DIEGO PROPERTY
UNITED STATES
MEXICO
PROPERTY MAP
OTAY MESA COMMUNITY PLAN UPDATE EIR
Scale: 1"=1000'
JUNE 2006
KIMLEY-HORN AND ASSOCIATES

VII. RECOMMENDED DRAINAGE DESIGN CRITERIA

Since the five watershed areas on the Mesa flow in every direction except east, they flow into different watersheds with different constraints and impacts. The runoff from the five watersheds will have different criteria for design of drainage facilities.

West Perimeter Watershed

This watershed consists of smaller Mesa-top watersheds with a total area of approximately 254 acres that drain to the west to three separate creeks in canyons and gullies. These creeks are carried under the SD&AE and Trolley tracks and through San Ysidro in buried storm drain systems. The storm drains under the tracks have hydraulic capacities of 30 cfs (18" RCP) and 125 cfs (36" RCP) based on the San Ysidro Boulevard Area Master Drainage plan prepared by BSI Consultants, February 15, 1996. Sub-basins OT3-7 and OT3-8 combine downstream into a single creek that flows to the 36" RCP. The current study estimates 140 cfs (Q100) will flow off of the Mesa into this sub-basin. This study does not address the capacity of the downstream system or include the hydrologic analysis for areas to the west of the Mesa, but clearly the 125 cfs capacity of the existing system will be exceeded. This area will need to be addressed in more detail during design of the upstream tributary development. Detention Basins are recommended which will reduce peak flows in the sub-basin to minimize impacts on the downstream system. These detention basins will reduce the peak, 50-year, and 100-year flow to predevelopment levels. Because of the unstable soils in this area, care should be taken that the proposed detention basins and relocated drainage facilities do not contribute to an increase in the risk of slides through increased saturation of the soil.

West Watershed

The West Watershed consists of smaller Mesa-top watersheds that drain into the tributary canyons of Spring Canyon. All of the flow from the watershed flows into Mexico at the Spring Canyon concentration point. Detention basins will be required to reduce the post-development peak flows to predevelopment levels for the 50-year and 100-year storm. If the detention basins concentrate flows at the upper edge of canyons, care must be taken to ensure that erosion potential is not increased downstream.

East Watershed

The East Watershed flows to Mexico at a single concentration point between Britannia and La Media roads. Requirements for the control of peak runoff from development in this watershed already exist. The "Notice" dated August 7, 1987 (page 2), sets criteria for detention basins and for storm drain sizing. As part of the future storm drain project in this watershed, a single detention basin will be constructed at the border. The construction of this basin will eliminate the need for individual on-site detention basins for subsequent development.

North Perimeter Watershed

These small watersheds along the northern edge of the Mesa flow into small canyons that flow into the Otay River. There are no peak flow attenuation requirements for flows from these watersheds. There may be water quality issues with the Otay River, and there may be erosion issues from storm drains on the Mesa. Only approximately 14 acres of Neighborhood 6 are in this watershed.

VIII. STORM WATER QUALITY REQUIREMENTS

Because of problems related to the poor water quality of storm water runoff from urban conveyance systems, the City requires that storm water Best Management Practices (BMPs) be constructed for all new projects. The storm water discharge contains pollution such as chemicals, trash, sediment, bacteria, metals, oil and grease. Construction projects which add impervious areas and change drainage patterns increase the discharge of these pollutants.

The Municipal Storm Water National Pollutant Discharge Elimination System Permit (NPDES Municipal Permit), approved February 21, 2001 by the San Diego Regional Water Quality Control Board (RWQCB), requires the City to implement regulations for constructing storm water BMPs for development projects.

In 2003, as part of the San Diego Municipal Code, the City published "Storm Water Standards – A Manual for Construction & Permanent Storm Water Best Management Practices Requirements." This manual is the reference document for all of the storm water issues encountered in development, including BMPs. Included in this report are Appendix C – Example Permanent Storm Water Best Management Practices, and the Storm Water Requirements Applicability Checklist from the City's Manual. Before preparing a drainage study, the "Storm Water Requirements Applicability Checklist" is completed. This checklist is used to determine the priority level of the project. Most of the projects on the Mesa will require Priority Project Permanent Storm Water BMPs and High Priority Construction Storm Water BMPs.

All projects subject to the priority permanent BMP requirements must include a "Water Quality Technical Report." From the manual, the report will include:

1. A drainage study report prepared by a civil engineer, hydrologist, or hydrogeologist registered in the State of California, with experience in the science of stream and river generated surface features (i.e., fluvial geomorphology) and water resources management, satisfactory to the City Engineer. The report shall consider the project area's location (from the larger watershed perspective), topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors to be protected specific to the project area's watershed.
2. A field reconnaissance to observe and report on downstream conditions, including undercutting erosion, slope stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies) and the area's susceptibility to erosion or habitat alteration as a result of any future upstream development.
3. A hydrologic analysis to include rainfall runoff characteristics from the project area including at a minimum, peak runoff, time of concentration, and detention volume (if appropriate). These characteristics shall be developed for the two-year and ten-year frequency, six-hour or 24-hour, type B storm for the coastal areas of San Diego County. The largest peak flow should be included in the report. The report shall also report the project's conditions of concern based on the hydrologic and downstream conditions discussed above. Where downstream conditions of concern have been identified, the drainage study shall establish that pre-project hydrologic conditions that minimize impacts on those downstream conditions of concern would be either improved or maintained by the proposed project, satisfactory to the City Engineer, by incorporating the permanent BMP requirements.

Appendix D of the Manual includes detailed guidelines for the Water Quality Technical Report.

There are numerous alternative permanent BMPs that can be used for each project. The alternatives include Site Design BMPs, Source Control BMPs, and Treatment Control BMPs. The Site Design BMPs are primary ways to reduce storm water runoff through means such as increased pervious areas, increased infiltration, use of natural channels, and appropriate landscaping. All of these except dry wells are applicable to the Mesa. Source Control BMPs are meant to control pollutants at their source before they enter storm water, and are all applicable to the Mesa. Treatment Control BMPs treat the storm water before it leaves the property, and include natural methods such as biofilters, detention basins, wetlands, and porous pavement, and mechanical methods such as filters and separators. The one Treatment Control BMP that is not applicable to the Mesa is infiltration, which is not very effective on the Mesa because of the clay soils.

Most of Otay Mesa drains to the south across the border with Mexico and eventually into the Tijuana River. A small portion flows north into the Otay River, and the far western part of the Mesa flows to the west through San Ysidro and then into the Tijuana River. The Tijuana River has been identified by the 2002 Clean Water Act as a "Section 303(d) Water Quality Limited" river. The pollutants of concern which are included in the attached pages from the USEPA, need to be listed, and the new development project's potential impacts on these pollutants need to be included in the project's drainage report.

Recommended Storm Water Policies

1. **Apply water quality protection measures to land development projects during project design, permitting, construction, and operations in order to minimize the quantity of runoff generated on-site, the disruption of natural water flows and the contamination of storm water runoff.**

    a. Increase on-site infiltration, and preserve, restore or incorporate natural drainage systems into site design
    b. Reduce the amount of impervious surfaces through selection of materials, site planning, and narrowing street widths where possible.
    c. Increase the use of natural vegetation and landscaping in drainage design.
    d. Avoid conversion of areas particularly susceptible to erosion and sediment loss (e.g.: steep slopes), and where unavoidable, enforce regulations that minimize these impacts.
    e. Avoid land use, site development, and zoning regulations that limit impacts on, and protect the natural integrity of topography, drainage systems, and water bodies.
    f. Maintain landscape design standards that minimize the use of pesticides and herbicides.
    g. Enforce maintenance requirements in development permit conditions.

2. **Require construction contractors to comply with accepted storm water pollution prevention planning practices for all projects.**

    a. Minimize the amount of graded land surface exposed to erosion and enforce control ordinances
    b. Continue routine inspection practices to check for proper erosion control methods and housekeeping practices during construction.
    c. Ensure that contractors are aware of and implement urban runoff control programs.

3. **Encourage measures to promote the proper collection and disposal of pollutants at the source, rather than allowing them to enter the storm drain system.**

    a. Promote the provision of used oil recycling and/or hazardous waste recycling facilities and drop-off locations.
    b. Follow up on complaints of illegal discharges and accidental spills to storm drains, waterways, and canyons.

APPENDIX C

EXAMPLE PERMANENT STORM WATER BEST MANAGEMENT PRACTICES

The following are a list of BMPs may be used to minimize the introduction of pollutants of concern that may result in significant impacts to receiving waters. Other BMPs approved by the Development Services Department as being equal or more effective in pollutant reduction than comparable BMPs identified below are acceptable. All BMPs must comply with local zoning and building codes and other applicable regulations.

Site Design BMPs

Minimizing Impervious Areas

- Reduce sidewalk widths
- Incorporate landscaped buffer areas between sidewalks and streets.
- Design residential streets for the minimum required pavement widths
- Minimize the number of residential street cul-de-sacs and incorporate landscaped areas to reduce their impervious cover
- Use open space development that incorporates smaller lot sizes
- Increase building density while decreasing the building footprint
- Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together
- Reduce overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in spillover parking areas

Increase Rainfall Infiltration

- Use permeable materials for private sidewalks, driveways, parking lots, and interior roadway surfaces (examples: hybrid lots, parking groves, permeable overflow parking, etc.)
- Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas, and avoid routing rooftop runoff to the roadway or the urban runoff conveyance system

Maximize Rainfall Interception

- Maximizing canopy interception and water conservation by preserving existing native trees and shrubs, and planting Additional native or drought tolerant trees and large shrubs.

Minimize Directly Connected Impervious Areas (DCIAs)

- Draining rooftops into adjacent landscaping prior to discharging to the storm water conveyance system

- Draining parking lots into landscape areas co-designed as biofiltration areas
- Draining roads, sidewalks, and impervious trails into adjacent landscaping

Slope and Channel Protection

Use of natural drainage systems to the maximum extent practicable

- Stabilized permanent channel crossings
- Planting native or drought tolerant vegetation on slopes
- Energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined Channels

Maximize Rainfall Interception

- Cisterns
- Foundation planting

Increase Rainfall Infiltration

- Dry wells

Source Control BMPs

- Storm water conveyance system stenciling and signage
- Outdoor material and trash storage area designed to reduce or control rainfall runoff
- Efficient irrigation system

Treatment Control BMPs

Biofilters

- Grass swale
- Grass strip
- Wetland vegetation swale
- Bioretention

Detention Basins

- Extended/dry detention basin with grass lining
- Extended/dry detention basin with impervious lining

Infiltration

- Infiltration basin
- Infiltration trench

Pervious Paving
- Porous asphalt
- Porous concrete
- Porous modular concrete block

Wet Ponds and Wetlands
- Wet pond (permanent pool)
- Constructed wetland

Drainage Inserts
- Catch basin/storm drain inserts
- Catch basin screens

Filtration Systems
- Media filtration
- Sand filtration

Hydrodynamic Separation Systems
- Swirl concentrator
- Cyclone separator
- Baffle boxes

City of San Diego
Development Services
1222 First Ave., MS-302
San Diego, CA 92101
(619) 446-5000 for information

THE CITY OF SAN DIEGO

Storm Water Requirements Applicability Checklist

Project Address:	Assessor Parcel Number(s):	Project Number *(for City Use Only)*

Complete Sections 1 and 2 of the following checklist to determine your project's permanent and construction storm water best management practices requirements. This form must be completed and submitted with your permit application.

Section 1 - Permanent Storm Water BMP Requirements:

If any answers to Part A are answered "Yes," your project is subject to the "Priority Project Permanent Storm Water BMP Requirements," and "Standard Permanent Storm Water BMP Requirements" of the Storm Water Standards Manual, Section III, "Permanent Storm Water BMP Selection Procedure." If all answers to Part A are "No," and any answers to Part B are "Yes," your project is only subject to the Standard Permanent Storm Water BMP Requirements. If every question in Part A and B is answered "No," your project is exempt from permanent storm water requirements.

Part A: Determine Priority Project Permanent Storm Water BMP Requirements.

Does the project meet the definition of one or more of the priority project categories?*

1.	Detached residential development of 10 or more units	Yes	No
2.	Attached residential development of 10 or more units	Yes	No
3.	Commercial development greater than 100,000 square feet	Yes	No
4.	Automotive repair shop	Yes	No
5.	Restaurant	Yes	No
6.	Steep hillside development greater than 5,000 square feet	Yes	No
7.	Project discharging to receiving waters within Water Quality Sensitive Areas	Yes	No
8.	Parking lots greater than or equal to 5,000 square feet or with at least 15 parking spaces, and potentially exposed to urban runoff	Yes	No
9.	Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater	Yes	No
10.	Significant redevelopment over 5,000 square feet	Yes	No

** Refer to the definitions section in the Storm Water Standards for expanded definitions of the priority project categories.*

Limited Exclusion: *Trenching and resurfacing work associated with utility projects are not considered priority projects. Parking lots, buildings and other structures associated with utility projects are priority projects if one or more of the criteria in Part A is met. If all answers to Part A are "No", continue to Part B.*

Part B: Determine Standard Permanent Storm Water Requirements.

Does the project propose:

1.	New impervious areas, such as rooftops, roads, parking lots, driveways, paths and sidewalks?	Yes	No
2.	New pervious landscape areas and irrigation systems?	Yes	No
3.	Permanent structures within 100 feet of any natural water body?	Yes	No
4.	Trash storage areas?	Yes	No
5.	Liquid or solid material loading and unloading areas?	Yes	No
6.	Vehicle or equipment fueling, washing, or maintenance areas?	Yes	No
7.	Require a General NPDES Permit for Storm Water Discharges Associated with Industrial Activities (Except construction)?*	Yes	No
8.	Commercial or industrial waste handling or storage, excluding typical office or household waste?	Yes	No
9.	Any grading or ground disturbance during construction?	Yes	No
10.	Any new storm drains, or alteration to existing storm drains?	Yes	No

*To find out if your project is required to obtain an Individual General NPDES Permit for Storm Water Discharges Associated with Industrial Activities, visit the State Water Resources Control Board web site at, www.swrcb.ca.gov/stormwtr/industrial.html

OVER

Section 2. Construction Storm Water BMP Requirements:

If the answer to question 1 of Part C is answered "Yes," your project is subject to Section IV of the Storm Water Standards Manual, "Construction Storm Water BMP Performance Standards," and must prepare a Storm Water Pollution Prevention Plan (SWPPP). If the answer to question 1of Part C is "No," but the answer to any of the remaining questions is "Yes," your project is subject to Section IV of the Storm Water Standards Manual, "Construction Storm Water BMP Performance Standards," and must prepare a Water Pollution Control Plan (WPCP). If every question in Part C is answered "No," your project is exempt from any construction storm water BMP requirements. If any of the answers to the questions in Part C are "Yes," complete the construction site prioritization in Part D below.

Part C: Determine Construction Phase Storm Water Requirements.

Would the project meet any of these criteria during construction?

1. Is the project subject to California's statewide General NPDES Permit for Storm Water Discharges Associated With Construction Activities? ..... Yes No
2. Does the project propose grading or soil disturbance? ..... Yes No
3. Would storm water or urban runoff have the potential to contact any portion of the construction area, including washing and staging areas? ..... Yes No
4. Would the project use any construction materials that could negatively affect water quality if discharged from the site (such as, paints, solvents, concrete, and stucco)? ..... Yes No

Part D: Determine Construction Site Priority

In accordance with the Municipal Permit, each construction site with construction storm water BMP requirements must be designated with a priority: high, medium or low. This prioritization must be completed with this form, noted on the plans, and included in the SWPPP or WPCP. Indicate the project's priority in one of the check boxes using the criteria below, and existing and surrounding conditions of the project, the type of activities necessary to complete the construction and any other extenuating circumstances that may pose a threat to water quality. The City reserves the right to adjust the priority of the projects both before and during construction. [Note: The construction priority does NOT change construction BMP requirements that apply to projects; all construction BMP requirements must be identified on a case-by-case basis. The construction priority does affect the frequency of inspections that will be conducted by City staff. See Section IV.1 for more details on construction BMP requirements.]

☐ 1) High Priority

a) Projects where the site is 50 acres or more and grading will occur during the wet season

b) Projects 5 acres or more and tributary to an impaired water body for sediment (e.g., Peñasquitos watershed)

c) Projects 5 acres or more within or directly adjacent to or discharging directly to a coastal lagoon or other receiving water within an environmentally sensitive area.

d) Projects, active or inactive, adjacent or tributary to sensitive water bodies

☐ 2) Medium Priority

a) Capital Improvement Projects where grading occurs, however a Storm Water Pollution Prevention Plan (SWPPP) is not required under the State General Construction Permit (i.e., water and sewer replacement projects, intersection and street re-alignments, widening, comfort stations, etc.)

b) Permit projects in the public right-of-way where grading occurs, however SWPPPs are not required, such as installation of sidewalk, substantial retaining walls, curb and gutter for an entire street frontage, etc.

c) Permit projects on private property where grading permits are required (i.e., cuts over 5 feet, fills over 3 feet), however, Notice Of Intents (NOIs) and SWPPPs are not required.

☐ 3) Low Priority

a) Capital Projects where minimal to no grading occurs, such as signal light and loop installations, street light installations, etc.

b) Permit projects in the public right-of-way where minimal to no grading occurs, such as pedestrian ramps, driveway additions, small retaining walls, etc.

c) Permit projects on private property where grading permits are not required, such as small retaining walls, single-family homes, small tenant improvements, etc.

Name of Owner or Agent *(Please Print)*:	Title:
Signature:	Date:

APPENDICES

Appendix A

- AES Hydrology Calculations

```
**********************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                       2003,1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-2003 Advanced Engineering Software (aes)
          Ver. 1.5A Release Date: 01/01/2003  License ID 1499

                          Analysis prepared by:

                    Kimley-Horn and Associates San Diego
                          517 4th Avenue Suite 301
                        San Diego, California 92101
                      (619) 234-9411 Fax (619) 234-9433

 ************************** DESCRIPTION OF STUDY **************************
* Otay Mesa Watershed Analysis                                            *
* 50 Year Storm Event P=1.70                                              *
* 5/12/05 AMC                                                             *
 **************************************************************************

  FILE NAME: C:\Drainage\407000\OT1-1.DAT
  TIME/DATE OF STUDY: 08:03 05/12/2005
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  1985 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   1.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 1.00
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-   CROWN TO   STREET-CROSSFALL:    CURB  GUTTER-GEOMETRIES:   MANNING
     WIDTH  CROSSFALL   IN-  / OUT-/PARK-   HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY     (FT)    (FT)  (FT)  (FT)    (n)
--- ------  ---------  ------------------  ------ ------ ------ ------ -------
  1   30.0      20.0   0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**********************************************************************
  FLOW PROCESS FROM NODE   3100.00 TO NODE   3101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
**********************************************************************
  GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  84
```

```
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.86(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    106.00
 DOWNSTREAM ELEVATION(FEET) =    104.32
 ELEVATION DIFFERENCE(FEET) =      1.68
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.86
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.715
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   3101.00 TO NODE   3102.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0240
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =   5.41   Tc(MIN.) =  16.27
 LONGEST FLOWPATH FROM NODE   3100.00 TO NODE   3102.00 =   250.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3102.00 TO NODE   3103.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.092
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   19.30   SUBAREA RUNOFF(CFS) =   18.17
 TOTAL AREA(ACRES) =   19.40   TOTAL RUNOFF(CFS) =   18.29
 TC(MIN.) =  16.27

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  33
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
 FLOW PROCESS FROM NODE   3110.00 TO NODE   3111.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    110.00
```

```
 DOWNSTREAM ELEVATION(FEET) =    108.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   3111.00 TO NODE   3112.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =   9.91   Tc(MIN.) =  20.76
 LONGEST FLOWPATH FROM NODE   3110.00 TO NODE   3112.00 =   400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3112.00 TO NODE   3113.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.786
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   14.70   SUBAREA RUNOFF(CFS) =   11.83
 TOTAL AREA(ACRES) =   14.80   TOTAL RUNOFF(CFS) =   11.95
 TC(MIN.) =  20.76

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3200.00 TO NODE   3201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.86(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   122.00
 DOWNSTREAM ELEVATION(FEET) =   120.29
 ELEVATION DIFFERENCE(FEET) =     1.71
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.86
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.716
```

```
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   3201.00 TO NODE   3202.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0240
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  24.94   Tc(MIN.) =  35.80
 LONGEST FLOWPATH FROM NODE   3200.00 TO NODE   3202.00 =   900.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3202.00 TO NODE   3203.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.358
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   47.00   SUBAREA RUNOFF(CFS) =   26.61
 TOTAL AREA(ACRES) =     47.10   TOTAL RUNOFF(CFS) =   26.74
 TC(MIN.) =  35.80

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
 FLOW PROCESS FROM NODE   3300.00 TO NODE   3301.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.83(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   108.00
 DOWNSTREAM ELEVATION(FEET) =   106.13
 ELEVATION DIFFERENCE(FEET) =     1.87
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.83
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.721
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
```

```
 FLOW PROCESS FROM NODE   3201.00 TO NODE   3202.00 IS CODE =  51
----------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
======================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0267
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.56   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =   6.90   Tc(MIN.) =  17.73
 LONGEST FLOWPATH FROM NODE   3300.00 TO NODE   3202.00 =   300.00 FEET.
**********************************************************************
 FLOW PROCESS FROM NODE   3202.00 TO NODE   3303.00 IS CODE =  81
----------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
======================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.980
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   11.70   SUBAREA RUNOFF(CFS) =   10.42
 TOTAL AREA(ACRES) =     11.80   TOTAL RUNOFF(CFS) =   10.55
 TC(MIN.) =  17.73
**********************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
======================================================================

**********************************************************************
 FLOW PROCESS FROM NODE   3400.00 TO NODE   3401.00 IS CODE =  21
----------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
======================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.84(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    118.00
 DOWNSTREAM ELEVATION(FEET) =    116.20
 ELEVATION DIFFERENCE(FEET) =      1.80
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.84
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.719
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

**********************************************************************
 FLOW PROCESS FROM NODE   3401.00 TO NODE   3402.00 IS CODE =  51
----------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
```

```
 CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0257
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.56   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  18.91   Tc(MIN.) =  29.75
 LONGEST FLOWPATH FROM NODE   3400.00 TO NODE   3402.00 =   700.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3402.00 TO NODE   3403.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.418
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   34.90   SUBAREA RUNOFF(CFS) =   23.27
 TOTAL AREA(ACRES) =     35.00   TOTAL RUNOFF(CFS) =   23.39
 TC(MIN.) =  29.75

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3500.00 TO NODE   3501.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    110.00
 DOWNSTREAM ELEVATION(FEET) =    108.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   3501.00 TO NODE   3502.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
```

```
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =   9.91   Tc(MIN.) =  20.76
 LONGEST FLOWPATH FROM NODE   3500.00 TO NODE   3502.00 =   400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3502.00 TO NODE   3503.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.788
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   16.40   SUBAREA RUNOFF(CFS) =   13.20
 TOTAL AREA(ACRES) =   16.50   TOTAL RUNOFF(CFS) =   13.32
 TC(MIN.) =  20.76

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
 FLOW PROCESS FROM NODE   3600.00 TO NODE   3601.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.83(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   108.00
 DOWNSTREAM ELEVATION(FEET) =   106.13
 ELEVATION DIFFERENCE(FEET) =     1.87
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.83
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.721
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   3601.00 TO NODE   3602.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0267
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.56   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =   6.90   Tc(MIN.) =  17.73
```

```
 LONGEST FLOWPATH FROM NODE   3600.00 TO NODE   3602.00 =   300.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3602.00 TO NODE   3603.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.980
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   12.10   SUBAREA RUNOFF(CFS) =   10.78
 TOTAL AREA(ACRES) =     12.20   TOTAL RUNOFF(CFS) =   10.90
 TC(MIN.) =  17.73

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3700.00 TO NODE   3701.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    120.00
 DOWNSTREAM ELEVATION(FEET) =    118.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   3701.00 TO NODE   3702.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   730.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  21.92   Tc(MIN.) =  32.77
 LONGEST FLOWPATH FROM NODE   3700.00 TO NODE   3702.00 =   800.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3702.00 TO NODE   3703.00 IS CODE =  81
```

```
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
------------------------------------------------------------------------
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.332
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   46.00   SUBAREA RUNOFF(CFS) =   27.57
 TOTAL AREA(ACRES) =     46.10   TOTAL RUNOFF(CFS) =   27.69
 TC(MIN.) =  32.77
************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
------------------------------------------------------------------------

************************************************************************
 FLOW PROCESS FROM NODE    3800.00 TO NODE    3801.00 IS CODE =  21
------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    125.00
 DOWNSTREAM ELEVATION(FEET) =    123.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12
************************************************************************
 FLOW PROCESS FROM NODE    3801.00 TO NODE    3802.00 IS CODE =  51
------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  27.93   Tc(MIN.) =  38.78
 LONGEST FLOWPATH FROM NODE    3800.00 TO NODE    3802.00 =  1000.00 FEET.
************************************************************************
 FLOW PROCESS FROM NODE    3802.00 TO NODE    3803.00 IS CODE =  81
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
------------------------------------------------------------------------
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.195
```

```
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   51.30   SUBAREA RUNOFF(CFS) =   27.59
 TOTAL AREA(ACRES) =     51.40   TOTAL RUNOFF(CFS) =   27.71
 TC(MIN.) =  38.78

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2100.00 TO NODE   2101.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    128.00
 DOWNSTREAM ELEVATION(FEET) =    126.22
 ELEVATION DIFFERENCE(FEET) =      1.78
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.718
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2101.00 TO NODE   2102.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1030.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0255
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.56   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  30.92   Tc(MIN.) =  41.77
 LONGEST FLOWPATH FROM NODE   2100.00 TO NODE   2102.00 =  1100.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2102.00 TO NODE   2103.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.139
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   33.20   SUBAREA RUNOFF(CFS) =   17.02
```

```
 TOTAL AREA(ACRES) =     33.30   TOTAL RUNOFF(CFS) =   17.14
 TC(MIN.) =  41.77

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2200.00 TO NODE   2201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    163.00
 DOWNSTREAM ELEVATION(FEET) =    161.24
 ELEVATION DIFFERENCE(FEET) =      1.76
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.718
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2201.00 TO NODE   2202.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2430.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0252
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.56   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  72.97   Tc(MIN.) =  83.82
 LONGEST FLOWPATH FROM NODE   2200.00 TO NODE   2202.00 =  2500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2202.00 TO NODE   2203.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.727
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =  126.10   SUBAREA RUNOFF(CFS) =   41.25
 TOTAL AREA(ACRES) =   126.20   TOTAL RUNOFF(CFS) =   41.37
 TC(MIN.) =  83.82

****************************************************************************
```

```
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    2180.00 TO NODE    2181.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED = 10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    130.00
 DOWNSTREAM ELEVATION(FEET) =    128.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =     0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE    2181.00 TO NODE    2182.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =  10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  33.94   Tc(MIN.) =  44.79
 LONGEST FLOWPATH FROM NODE    2160.00 TO NODE    2182.00 =  1200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    2182.00 TO NODE    2183.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.089
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   97.00   SUBAREA RUNOFF(CFS) =   47.54
 TOTAL AREA(ACRES) =    97.10   TOTAL RUNOFF(CFS) =   47.66
 TC(MIN.) =  44.79

****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================
```

```
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.86(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    122.00
 DOWNSTREAM ELEVATION(FEET) =    120.29
 ELEVATION DIFFERENCE(FEET) =      1.71
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.86
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.716
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2401.00 TO NODE   2402.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   830.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0244
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  24.94   Tc(MIN.) =  35.80
 LONGEST FLOWPATH FROM NODE   2400.00 TO NODE   2402.00 =   900.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2402.00 TO NODE   2403.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.258
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   67.70   SUBAREA RUNOFF(CFS) =   38.34
 TOTAL AREA(ACRES) =   67.80   TOTAL RUNOFF(CFS) =   38.46
 TC(MIN.) =  35.80

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2500.00 TO NODE   2501.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
```

```
 UPSTREAM ELEVATION(FEET) =    130.00
 DOWNSTREAM ELEVATION(FEET) =    128.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2501.00 TO NODE   2502.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  33.94   Tc(MIN.) =  44.79
 LONGEST FLOWPATH FROM NODE   2500.00 TO NODE   2502.00 =  1200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2502.00 TO NODE   2503.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.089
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   40.70   SUBAREA RUNOFF(CFS) =   19.95
 TOTAL AREA(ACRES) =   40.80   TOTAL RUNOFF(CFS) =   20.07
 TC(MIN.) =  44.79

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2600.00 TO NODE   2601.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   130.00
 DOWNSTREAM ELEVATION(FEET) =   128.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
```

```
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2601.00 TO NODE   2602.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  33.94   Tc(MIN.) =  44.79
 LONGEST FLOWPATH FROM NODE   2600.00 TO NODE   2602.00 =  1200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2602.00 TO NODE   2603.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.089
 GRASS FAIR COVER RUNOFF COEFFICIENT =.4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   34.70   SUBAREA RUNOFF(CFS) =   17.00
 TOTAL AREA(ACRES) =   34.80   TOTAL RUNOFF(CFS) =   17.13
 TC(MIN.) =  44.79

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2700.00 TO NODE   2701.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   105.00
 DOWNSTREAM ELEVATION(FEET) =   103.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   7.213
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.536
 SUBAREA RUNOFF(CFS) =      0.16
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.16

****************************************************************************
 FLOW PROCESS FROM NODE   2701.00 TO NODE   2702.00 IS CODE =  51
```

```
------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.16
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.03
 TRAVEL TIME(MIN.) =   3.96   Tc(MIN.) =  11.17
 LONGEST FLOWPATH FROM NODE   2700.00 TO NODE   2702.00 =   200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2702.00 TO NODE   2703.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.667
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   14.80   SUBAREA RUNOFF(CFS) =   17.76
 TOTAL AREA(ACRES) =   14.90   TOTAL RUNOFF(CFS) =   17.92
 TC(MIN.) =  11.17

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2800.00 TO NODE   2801.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.16(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   128.00
 DOWNSTREAM ELEVATION(FEET) =    26.22
 ELEVATION DIFFERENCE(FEET) =   101.78
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.18
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.831
 SUBAREA RUNOFF(CFS) =      0.13
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.13

****************************************************************************
 FLOW PROCESS FROM NODE   2801.00 TO NODE   2802.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1030.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.13
 FLOW VELOCITY(FEET/SEC.) =   0.58   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  29.68   Tc(MIN.) =  39.86
 LONGEST FLOWPATH FROM NODE   2800.00 TO NODE   2802.00 =  1100.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2802.00 TO NODE   2803.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.174
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   81.20   SUBAREA RUNOFF(CFS) =   42.90
 TOTAL AREA(ACRES) =   81.30   TOTAL RUNOFF(CFS) =   43.03
 TC(MIN.) =  39.86

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2900.00 TO NODE   2901.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.84(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   118.00
 DOWNSTREAM ELEVATION(FEET) =   116.20
 ELEVATION DIFFERENCE(FEET) =     1.80
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.84
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.719
 SUBAREA RUNOFF(CFS) =     0.12
 TOTAL AREA(ACRES) =     0.10   TOTAL RUNOFF(CFS) =     0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2901.00 TO NODE   2902.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
```

```
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.56   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  18.91   Tc(MIN.) =  29.75
 LONGEST FLOWPATH FROM NODE   2900.00 TO NODE   2902.00 =   700.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2902.00 TO NODE   2903.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.418
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   36.80   SUBAREA RUNOFF(CFS) =   23.48
 TOTAL AREA(ACRES) =   36.90   TOTAL RUNOFF(CFS) =   23.60
 TC(MIN.) =  29.75

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2910.00 TO NODE   2911.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   108.00
 DOWNSTREAM ELEVATION(FEET) =   106.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =     0.12
 TOTAL AREA(ACRES) =     0.10   TOTAL RUNOFF(CFS) =     0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2911.00 TO NODE   2912.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =     0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =   6.91   Tc(MIN.) =  17.76
 LONGEST FLOWPATH FROM NODE   2910.00 TO NODE   2912.00 =   300.00 FEET.
```

```
****************************************************************************
 FLOW PROCESS FROM NODE   2912.00 TO NODE   2913.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.978
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   12.80   SUBAREA RUNOFF(CFS) =   11.39
 TOTAL AREA(ACRES) =     12.90   TOTAL RUNOFF(CFS) =   11.51
 TC(MIN.) =  17.76

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2100.00 TO NODE   2101.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    160.00
 DOWNSTREAM ELEVATION(FEET) =    158.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2101.00 TO NODE   2102.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  69.97   TC(MIN.) =  80.82
 LONGEST FLOWPATH FROM NODE   2100.00 TO NODE   2102.00 =  2400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2102.00 TO NODE   2103.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
------------------------------------------------------------------------
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.744
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =  128.30   SUBAREA RUNOFF(CFS) =   42.96
 TOTAL AREA(ACRES) =   128.60   TOTAL RUNOFF(CFS) =   43.09
 TC(MIN.) =  80.82

************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
************************************************************************

************************************************************************
 FLOW PROCESS FROM NODE   2110.00 TO NODE   2111.00 IS CODE =  21
------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    143.00
 DOWNSTREAM ELEVATION(FEET) =    141.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

************************************************************************
 FLOW PROCESS FROM NODE   2111.00 TO NODE   2112.00 IS CODE =  51
------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  48.95   Tc(MIN.) =  59.80
 LONGEST FLOWPATH FROM NODE   2110.00 TO NODE   2112.00 =  1700.00 FEET.

************************************************************************
 FLOW PROCESS FROM NODE   2112.00 TO NODE   2113.00 IS CODE =  81
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
------------------------------------------------------------------------
  50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.904
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
```

```
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =  275.50   SUBAREA RUNOFF(CFS) =  112.04
 TOTAL AREA(ACRES) =   275.60   TOTAL RUNOFF(CFS) =  112.16
 TC(MIN.) =  59.80

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2120.00 TO NODE   2121.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    113.00
 DOWNSTREAM ELEVATION(FEET) =    111.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2121.00 TO NODE   2122.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  12.91   Tc(MIN.) =  23.76
 LONGEST FLOWPATH FROM NODE   2120.00 TO NODE   2122.00 =   500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2122.00 TO NODE   2123.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.639
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   23.50   SUBAREA RUNOFF(CFS) =   17.33
 TOTAL AREA(ACRES) =   23.60   TOTAL RUNOFF(CFS) =   17.45
```

```
 TC(MIN.) =  23.76
****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE    2130.00 TO NODE    2131.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    115.00
 DOWNSTREAM ELEVATION(FEET) =    113.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE    2131.00 TO NODE    2132.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   530.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  15.92   Tc(MIN.) =  26.77
 LONGEST FLOWPATH FROM NODE   2130.00 TO NODE   2132.00 =   600.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    2132.00 TO NODE    2133.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.518
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   61.40   SUBAREA RUNOFF(CFS) =   41.94
 TOTAL AREA(ACRES) =   61.50   TOTAL RUNOFF(CFS) =   42.06
 TC(MIN.) =  26.77

****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
```

```
------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
========================================================================

************************************************************************
 FLOW PROCESS FROM NODE   2140.00 TO NODE   2141.00 IS CODE =  21
------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    125.00
 DOWNSTREAM ELEVATION(FEET) =    123.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

************************************************************************
 FLOW PROCESS FROM NODE   2141.00 TO NODE   2142.00 IS CODE =  51
------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  27.93   Tc(MIN.) =  38.78
 LONGEST FLOWPATH FROM NODE   2140.00 TO NODE   2142.00 =  1000.00 FEET.

************************************************************************
 FLOW PROCESS FROM NODE   2142.00 TO NODE   2143.00 IS CODE =  81
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.195
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   48.30   SUBAREA RUNOFF(CFS) =   25.97
 TOTAL AREA(ACRES) =   48.40   TOTAL RUNOFF(CFS) =   26.10
 TC(MIN.) =  38.78

************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
========================================================================
```

```
****************************************************************************
 FLOW PROCESS FROM NODE   2150.00 TO NODE   2151.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    150.00
 DOWNSTREAM ELEVATION(FEET) =    148.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2151.00 TO NODE   2152.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  57.96   Tc(MIN.) =  68.81
 LONGEST FLOWPATH FROM NODE   2150.00 TO NODE   2152.00 =  2000.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2152.00 TO NODE   2153.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.826
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =  153.70   SUBAREA RUNOFF(CFS) =   57.10
 TOTAL AREA(ACRES) =   153.80   TOTAL RUNOFF(CFS) =   57.22
 TC(MIN.) =  68.81

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2160.00 TO NODE   2161.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-B)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    160.00
 DOWNSTREAM ELEVATION(FEET) =    158.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2161.00 TO NODE   2162.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  69.97   Tc(MIN.) =  80.82
 LONGEST FLOWPATH FROM NODE   2160.00 TO NODE   2162.00 =  2400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2162.00 TO NODE   2163.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.744
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =  121.60   SUBAREA RUNOFF(CFS) =   40.72
 TOTAL AREA(ACRES) =   121.70   TOTAL RUNOFF(CFS) =   40.84
 TC(MIN.) =  80.82

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
 FLOW PROCESS FROM NODE   2170.00 TO NODE   2171.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
```

```
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    175.00
 DOWNSTREAM ELEVATION(FEET) =    173.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   2171.00 TO NODE   2172.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2910.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) =  87.99   Tc(MIN.) =  98.84
 LONGEST FLOWPATH FROM NODE   2170.00 TO NODE   2172.00 =  3000.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2172.00 TO NODE   2173.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.654
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =   60.20   SUBAREA RUNOFF(CFS) =   17.70
 TOTAL AREA(ACRES) =     60.30   TOTAL RUNOFF(CFS) =   17.83
 TC(MIN.) =  98.84

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   9990.00 TO NODE   9991.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
 WITH 10-MIN. ADDED =  10.85(MIN.)
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =   1300.00
```

```
 DOWNSTREAM ELEVATION(FEET) =   1298.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 NATURAL WATERSHED TIME OF CONCENTRATION =  10.85
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.717
 SUBAREA RUNOFF(CFS) =      0.12
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
 FLOW PROCESS FROM NODE   9991.00 TO NODE   9992.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  9930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0300
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.12
 FLOW VELOCITY(FEET/SEC.) =   0.55   FLOW DEPTH(FEET) =   0.02
 TRAVEL TIME(MIN.) = 298.21   Tc(MIN.) = 309.06
 LONGEST FLOWPATH FROM NODE   9990.00 TO NODE   9992.00 = 10000.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   9992.00 TO NODE   9993.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.313
 GRASS FAIR COVER RUNOFF COEFFICIENT = .4500
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  84
 SUBAREA AREA(ACRES) =  774.70   SUBAREA RUNOFF(CFS) =  109.22
 TOTAL AREA(ACRES) =   774.80   TOTAL RUNOFF(CFS) =  109.34
 TC(MIN.) = 309.06
****************************************************************************
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =    774.80  TC(MIN.) =    309.06
 PEAK FLOW RATE(CFS)    =    109.34
****************************************************************************

 END OF RATIONAL METHOD ANALYSIS
```

Q100

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                       2003,1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-2003 Advanced Engineering Software (aes)
          Ver. 1.5A Release Date: 01/01/2003  License ID 1499

                          Analysis prepared by:

                    Kimley-Horn and Associates San Diego
                          517 4th Avenue Suite 301
                          San Diego, California 92101
                       (619) 234-9411 Fax (619) 234-9433

 ************************** DESCRIPTION OF STUDY **************************
* Otay Mesa Watershed Analysis                                            *
* 100 Year Storm Event P=1.90                                             *
* 5/20/05 AMC                                                             *
 **************************************************************************

  FILE NAME: C:\Drainage\407000\CPU100yr.DAT
  TIME/DATE OF STUDY: 11:16 05/20/2005
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   1.900
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 1.00
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-   CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL   IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
=== ====== ========== ================== ====== ===== ====== ===== ========
  1   30.0     20.0   0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE   3100.00 TO NODE   3101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
--------------------------------------------------------------------------
  STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  93
```

```
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    106.00
 DOWNSTREAM ELEVATION(FEET) =    104.32
 ELEVATION DIFFERENCE(FEET) =      1.68
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.387
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3101.00 TO NODE   3102.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0240
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   3.50   Tc(MIN.) =   7.89
 LONGEST FLOWPATH FROM NODE   3100.00 TO NODE   3102.00 =   250.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3102.00 TO NODE   3103.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.730
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   19.30   SUBAREA RUNOFF(CFS) =   51.11
 TOTAL AREA(ACRES) =   19.40   TOTAL RUNOFF(CFS) =   51.37
 TC(MIN.) =   7.89

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3110.00 TO NODE   3111.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    110.00
 DOWNSTREAM ELEVATION(FEET) =    108.25
 ELEVATION DIFFERENCE(FEET) =      1.75
```

```
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =     4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =       0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3111.00 TO NODE   3112.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.66   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   6.42   Tc(MIN.) =  10.75
 LONGEST FLOWPATH FROM NODE   3110.00 TO NODE   3112.00 =   400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3112.00 TO NODE   3113.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.055
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   14.70   SUBAREA RUNOFF(CFS) =   31.89
 TOTAL AREA(ACRES) =     14.80   TOTAL RUNOFF(CFS) =   32.10
 TC(MIN.) =  10.75

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  23
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3200.00 TO NODE   3201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    122.00
 DOWNSTREAM ELEVATION(FEET) =    120.29
 ELEVATION DIFFERENCE(FEET) =      1.71
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.361
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
```

```
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3201.00 TO NODE   3202.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   830.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0240
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  16.16   Tc(MIN.) =  20.52
 LONGEST FLOWPATH FROM NODE   3200.00 TO NODE   3202.00 =   900.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3202.00 TO NODE   3203.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.014
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   47.00   SUBAREA RUNOFF(CFS) =   67.20
 TOTAL AREA(ACRES) =     47.10   TOTAL RUNOFF(CFS) =   67.34
 TC(MIN.) =  20.52

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   3300.00 TO NODE   3301.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   108.00
 DOWNSTREAM ELEVATION(FEET) =   106.13
 ELEVATION DIFFERENCE(FEET) =     1.87
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =   4.233
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3201.00 TO NODE   3202.00 IS CODE =  51
```

```
------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0267
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.96   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   4.48   Tc(MIN.) =   8.71
 LONGEST FLOWPATH FROM NODE   3300.00 TO NODE   3202.00 =   300.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3302.00 TO NODE   3303.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.500
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   11.70   SUBAREA RUNOFF(CFS) =   29.07
 TOTAL AREA(ACRES) =     11.80   TOTAL RUNOFF(CFS) =   29.32
 TC(MIN.) =   8.71

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3400.00 TO NODE   3401.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    118.00
 DOWNSTREAM ELEVATION(FEET) =    116.20
 ELEVATION DIFFERENCE(FEET) =      1.80
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.287
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3401.00 TO NODE   3402.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
```

```
 CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0257
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  12.26   Tc(MIN.) =  16.55
 LONGEST FLOWPATH FROM NODE   3400.00 TO NODE   3402.00 =   700.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3402.00 TO NODE   3403.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.313
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   34.90   SUBAREA RUNOFF(CFS) =   57.32
 TOTAL AREA(ACRES) =     35.00   TOTAL RUNOFF(CFS) =   57.48
 TC(MIN.) =  16.55

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3500.00 TO NODE   3501.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   110.00
 DOWNSTREAM ELEVATION(FEET) =   108.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =   4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =     0.36
 TOTAL AREA(ACRES) =     0.10   TOTAL RUNOFF(CFS) =     0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3501.00 TO NODE   3502.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
```

```
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.66   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   6.42   Tc(MIN.) =  10.75
 LONGEST FLOWPATH FROM NODE   3500.00 TO NODE   3502.00 =   400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3502.00 TO NODE   3503.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.055
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   16.40   SUBAREA RUNOFF(CFS) =   35.57
 TOTAL AREA(ACRES) =   16.50   TOTAL RUNOFF(CFS) =   35.79
 TC(MIN.) =  10.75

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3600.00 TO NODE   3601.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   108.00
 DOWNSTREAM ELEVATION(FEET) =   106.13
 ELEVATION DIFFERENCE(FEET) =     1.87
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =   4.233
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE
 SUBAREA RUNOFF(CFS) =     0.36
 TOTAL AREA(ACRES) =     0.10   TOTAL RUNOFF(CFS) =     0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3601.00 TO NODE   3602.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVEL-TIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0267
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =     0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   4.48   Tc(MIN.) =   9.71
 LONGEST FLOWPATH FROM NODE   3600.00 TO NODE   3602.00 =   300.00 FEET.
```

```
****************************************************************************
 FLOW PROCESS FROM NODE   3602.00 TO NODE   3603.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.500
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   12.10   SUBAREA RUNOFF(CFS) =   30.06
 TOTAL AREA(ACRES) =     12.20   TOTAL RUNOFF(CFS) =   30.31
 TC(MIN.) =   8.71

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   3700.00 TO NODE   3701.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    120.00
 DOWNSTREAM ELEVATION(FEET) =    118.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   3701.00 TO NODE   3702.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  730.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =  10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =  0.86   FLOW DEPTH(FEET) =  0.04
 TRAVEL TIME(MIN.) =  14.21   Tc(MIN.) =  18.54
 LONGEST FLOWPATH FROM NODE   3700.00 TO NODE   3702.00 =   800.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   3702.00 TO NODE   3703.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
------------------------------------------------------------------------
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.150
STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
SOIL CLASSIFICATION IS "D"
S.C.S. CURVE NUMBER (AMC II) =  93
AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
SUBAREA AREA(ACRES) =   46.00   SUBAREA RUNOFF(CFS) =   70.22
TOTAL AREA(ACRES) =   46.10   TOTAL RUNOFF(CFS) =   70.37
TC(MIN.) =  18.54

****************************************************************************
FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
>>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
FLOW PROCESS FROM NODE   3800.00 TO NODE   3801.00 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
SOIL CLASSIFICATION IS "D"
S.C.S. CURVE NUMBER (AMC II) =  93
INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
UPSTREAM ELEVATION(FEET) =   125.00
DOWNSTREAM ELEVATION(FEET) =   123.25
ELEVATION DIFFERENCE(FEET) =     1.75
SUBAREA OVERLAND TIME OF FLOW(MIN.) =   4.329
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =     0.36
TOTAL AREA(ACRES) =     0.10   TOTAL RUNOFF(CFS) =     0.36

****************************************************************************
FLOW PROCESS FROM NODE   3801.00 TO NODE   3802.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
CHANNEL LENGTH THRU SUBAREA(FEET) =   930.00
REPRESENTATIVE CHANNEL SLOPE =  0.0250
CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
CHANNEL FLOW THRU SUBAREA(CFS) =     0.36
FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
TRAVEL TIME(MIN.) =  18.10   Tc(MIN.) =  22.43
LONGEST FLOWPATH FROM NODE   3800.00 TO NODE   3802.00 =  1000.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE   3802.00 TO NODE   3803.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.901
STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
```

```
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   51.30   SUBAREA RUNOFF(CFS) =   69.25
 TOTAL AREA(ACRES) =     51.40   TOTAL RUNOFF(CFS) =   69.38
 TC(MIN.) =  22.43

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2100.00 TO NODE   2101.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =    128.00
 DOWNSTREAM ELEVATION(FEET) =    126.22
 ELEVATION DIFFERENCE(FEET) =      1.78
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.303
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2101.00 TO NODE   2102.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1030.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0255
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  20.05   Tc(MIN.) =  24.35
 LONGEST FLOWPATH FROM NODE   2100.00 TO NODE   2102.00 =  1100.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2102.00 TO NODE   2103.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.803
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   33.20   SUBAREA RUNOFF(CFS) =   42.50
```

```
 TOTAL AREA(ACRES) =     33.30   TOTAL RUNOFF(CFS) =   42.63
 TC(MIN.) =  24.35

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2200.00 TO NODE   2201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    163.00
 DOWNSTREAM ELEVATION(FEET) =    161.24
 ELEVATION DIFFERENCE(FEET) =      1.76
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.319
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2201.00 TO NODE   2202.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2430.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0252
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  47.30   Tc(MIN.) =  51.62
 LONGEST FLOWPATH FROM NODE   2200.00 TO NODE   2202.00 =  2500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2202.00 TO NODE   2203.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.111
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =  126.10   SUBAREA RUNOFF(CFS) =   99.43
 TOTAL AREA(ACRES) =   126.20   TOTAL RUNOFF(CFS) =   99.51
 TC(MIN.) =  51.62

****************************************************************************
```

```
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    2180.00 TO NODE    2181.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    130.00
 DOWNSTREAM ELEVATION(FEET) =    128.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE    2181.00 TO NODE    2182.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.66   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  22.00   Tc(MIN.) =  26.32
 LONGEST FLOWPATH FROM NODE    2180.00 TO NODE    2182.00 =  1200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    2182.00 TO NODE    2183.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.715
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   97.00   SUBAREA RUNOFF(CFS) =  118.10
 TOTAL AREA(ACRES) =    97.10   TOTAL RUNOFF(CFS) =  118.22
 TC(MIN.) =  26.32

****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================
```

```
****************************************************************************
 FLOW PROCESS FROM NODE   2190.00 TO NODE   2191.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    110.00
 DOWNSTREAM ELEVATION(FEET) =    108.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2191.00 TO NODE   2192.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   6.42   Tc(MIN.) =  10.75
 LONGEST FLOWPATH FROM NODE   2190.00 TO NODE   2192.00 =   400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2192.00 TO NODE   2193.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.055
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   27.60   SUBAREA RUNOFF(CFS) =   59.87
 TOTAL AREA(ACRES) =   27.70   TOTAL RUNOFF(CFS) =   60.09
 TC(MIN.) =  10.75

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
 FLOW PROCESS FROM NODE   2300.00 TO NODE   2301.00 IS CODE =  21
----------------------------------------------------------------------------
```

```
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) = 93
 INITIAL SUBAREA FLOW-LENGTH(FEET) = 70.00
 UPSTREAM ELEVATION(FEET) = 113.00
 DOWNSTREAM ELEVATION(FEET) = 111.25
 ELEVATION DIFFERENCE(FEET) = 1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) = 4.328
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) = 0.36
 TOTAL AREA(ACRES) = 0.10 TOTAL RUNOFF(CFS) = 0.36

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 FLOW PROCESS FROM NODE 2301.00 TO NODE 2302.00 IS CODE = 51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 CHANNEL LENGTH THRU SUBAREA(FEET) = 450.00
 REPRESENTATIVE CHANNEL SLOPE = 0.0250
 CHANNEL BASE(FEET) = 10.00 "Z" FACTOR = 50.000
 MANNING'S FACTOR = 0.030 MAXIMUM DEPTH(FEET) = 2.00
 CHANNEL FLOW THRU SUBAREA(CFS) = 0.36
 FLOW VELOCITY(FEET/SEC.) = 0.86 FLOW DEPTH(FEET) = 0.04
 TRAVEL TIME(MIN.) = 8.76 Tc(MIN.) = 13.09
 LONGEST FLOWPATH FROM NODE 2300.00 TO NODE 2302.00 = 520.00 FEET.

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 FLOW PROCESS FROM NODE 2302.00 TO NODE 2303.00 IS CODE = 81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.691
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) = 93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) = 20.00 SUBAREA RUNOFF(CFS) = 38.22
 TOTAL AREA(ACRES) = 20.10 TOTAL RUNOFF(CFS) = 38.41
 TC(MIN.) = 13.09

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 FLOW PROCESS FROM NODE 0.00 TO NODE 0.00 IS CODE = 13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 FLOW PROCESS FROM NODE 2400.00 TO NODE 2401.00 IS CODE = 21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
```

```
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    122.00
 DOWNSTREAM ELEVATION(FEET) =    120.29
 ELEVATION DIFFERENCE(FEET) =      1.71
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.361
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE    2401.00 TO NODE    2402.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =   830.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0244
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  16.16   Tc(MIN.) =  20.52
 LONGEST FLOWPATH FROM NODE    2400.00 TO NODE    2402.00 =   900.00 FEET

****************************************************************************
 FLOW PROCESS FROM NODE    2402.00 TO NODE    2403.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.014
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   67.70   SUBAREA RUNOFF(CFS) =   96.79
 TOTAL AREA(ACRES) =   67.80   TOTAL RUNOFF(CFS) =   96.94
 TC(MIN.) =  20.52

****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  33
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    2500.00 TO NODE    2501.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    130.00
 DOWNSTREAM ELEVATION(FEET) =    128.25
```

```
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2501.00 TO NODE   2502.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  22.00   Tc(MIN.) =  26.32
 LONGEST FLOWPATH FROM NODE   2500.00 TO NODE   2502.00 =  1200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2502.00 TO NODE   2503.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.715
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   40.70   SUBAREA RUNOFF(CFS) =   49.55
 TOTAL AREA(ACRES) =     40.80   TOTAL RUNOFF(CFS) =   49.67
 TC(MIN.) =  26.32

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2600.00 TO NODE   2601.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   130.00
 DOWNSTREAM ELEVATION(FEET) =   128.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
```

```
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2601.00 TO NODE   2602.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  22.00   Tc(MIN.) =  26.32
 LONGEST FLOWPATH FROM NODE   2600.00 TO NODE   2602.00 =  1200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2602.00 TO NODE   2603.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.715
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   34.70   SUBAREA RUNOFF(CFS) =   42.25
 TOTAL AREA(ACRES) =   34.80   TOTAL RUNOFF(CFS) =   42.37
 TC(MIN.) =  26.32

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2700.00 TO NODE   2701.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   105.00
 DOWNSTREAM ELEVATION(FEET) =   103.25
 ELEVATION DIFFERENCE(FEET) =     1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =   4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
```

```
 FLOW PROCESS FROM NODE   2701.00 TO NODE   2702.00 IS CODE =  51
----------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
======================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =   2.53   Tc(MIN.) =   6.86
 LONGEST FLOWPATH FROM NODE   2700.00 TO NODE   2702.00 =   200.00 FEET.
**********************************************************************
 FLOW PROCESS FROM NODE   2702.00 TO NODE   2703.00 IS CODE =  81
----------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
======================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.083
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   14.80   SUBAREA RUNOFF(CFS) =   42.90
 TOTAL AREA(ACRES) =   14.90   TOTAL RUNOFF(CFS) =   43.19
 TC(MIN.) =   6.86

**********************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
======================================================================

**********************************************************************
 FLOW PROCESS FROM NODE   2800.00 TO NODE   2801.00 IS CODE =  21
----------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
======================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   70.00
 UPSTREAM ELEVATION(FEET) =   138.00
 DOWNSTREAM ELEVATION(FEET) =   26.22
 ELEVATION DIFFERENCE(FEET) =   101.78
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =   2.726
 WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

**********************************************************************
 FLOW PROCESS FROM NODE   2801.00 TO NODE   2802.00 IS CODE =  51
----------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
```

```
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1030.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  20.05   Tc(MIN.) =  22.78
 LONGEST FLOWPATH FROM NODE   2800.00 TO NODE   2802.00 =  1100.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2802.00 TO NODE   2803.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
----------------------------------------------------------------------------
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.683
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   81.20   SUBAREA RUNOFF(CFS) =  108.53
 TOTAL AREA(ACRES) =     81.30   TOTAL RUNOFF(CFS) =  108.67
 TC(MIN.) =  22.78

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
----------------------------------------------------------------------------

****************************************************************************
 FLOW PROCESS FROM NODE   2900.00 TO NODE   2901.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
----------------------------------------------------------------------------
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    116.00
 DOWNSTREAM ELEVATION(FEET) =    116.20
 ELEVATION DIFFERENCE(FEET) =      1.80
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.287
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2901.00 TO NODE   2902.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
```

```
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  12.26   Tc(MIN.) =  16.55
 LONGEST FLOWPATH FROM NODE   2900.00 TO NODE   2902.00 =   700.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2902.00 TO NODE   2903.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.313
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   36.60   SUBAREA RUNOFF(CFS) =   60.44
 TOTAL AREA(ACRES) =     36.90   TOTAL RUNOFF(CFS) =   60.60
 TC(MIN.) =  16.55

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2910.00 TO NODE   2911.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    108.00
 DOWNSTREAM ELEVATION(FEET) =    106.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2911.00 TO NODE   2912.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
----------------------------------------------------------------------------
 CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
```

```
 TRAVEL TIME(MIN.) =   4.48   Tc(MIN.) =   8.80
 LONGEST FLOWPATH FROM NODE   2910.00 TO NODE   2912.00 =   200.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2912.00 TO NODE   2913.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.475
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   12.80   SUBAREA RUNOFF(CFS) =   31.58
 TOTAL AREA(ACRES) =     12.90   TOTAL RUNOFF(CFS) =   31.83
 TC(MIN.) =   8.80

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2100.00 TO NODE   2101.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    160.00
 DOWNSTREAM ELEVATION(FEET) =    158.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2101.00 TO NODE   2102.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  45.35   Tc(MIN.) =  49.68
 LONGEST FLOWPATH FROM NODE   2100.00 TO NODE   2102.00 =  2400.00 FEET.

****************************************************************************
```

```
 FLOW PROCESS FROM NODE   2102.00 TO NODE   2103.00 IS CODE =  81
----------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
======================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.138
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =  128.30   SUBAREA RUNOFF(CFS) =  103.70
 TOTAL AREA(ACRES) =    128.40   TOTAL RUNOFF(CFS) =  103.78
 TC(MIN.) =  49.68

**********************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
======================================================================

**********************************************************************
 FLOW PROCESS FROM NODE   2110.00 TO NODE   2111.00 IS CODE =  21
----------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
======================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    143.00
 DOWNSTREAM ELEVATION(FEET) =    141.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

**********************************************************************
 FLOW PROCESS FROM NODE   2111.00 TO NODE   2112.00 IS CODE =  51
----------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
======================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1630.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  31.73   Tc(MIN.) =  36.06
 LONGEST FLOWPATH FROM NODE   2110.00 TO NODE   2112.00 =  1700.00 FEET.

**********************************************************************
 FLOW PROCESS FROM NODE   2112.00 TO NODE   2113.00 IS CODE =  81
----------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
======================================================================
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.400
STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
SOIL CLASSIFICATION IS "D"
S.C.S. CURVE NUMBER (AMC II) =  93
AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
SUBAREA AREA(ACRES) =  275.50   SUBAREA RUNOFF(CFS) =  273.81
TOTAL AREA(ACRES) =   275.60   TOTAL RUNOFF(CFS) =  273.91
TC(MIN.) =  36.06
****************************************************************************
FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
>>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
FLOW PROCESS FROM NODE   2120.00 TO NODE   2121.00 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
SOIL CLASSIFICATION IS "D"
S.C.S. CURVE NUMBER (AMC II) =  93
INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
UPSTREAM ELEVATION(FEET) =    113.00
DOWNSTREAM ELEVATION(FEET) =  111.25
ELEVATION DIFFERENCE(FEET) =    1.75
SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =      0.36
TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
FLOW PROCESS FROM NODE   2121.00 TO NODE   2122.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00
REPRESENTATIVE CHANNEL SLOPE =  0.0250
CHANNEL BASE(FEET) =   10.00  "Z" FACTOR =  50.000
MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
TRAVEL TIME(MIN.) =   8.37   Tc(MIN.) =  12.70
LONGEST FLOWPATH FROM NODE   2120.00 TO NODE   2122.00 =   500.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE   2122.00 TO NODE   2123.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.744
STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
SOIL CLASSIFICATION IS "D"
S.C.S. CURVE NUMBER (AMC II) =  93
```

```
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   23.50   SUBAREA RUNOFF(CFS) =   45.79
 TOTAL AREA(ACRES) =     23.60   TOTAL RUNOFF(CFS) =   45.98
 TC(MIN.) =  12.70

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   2130.00 TO NODE   2131.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    115.00
 DOWNSTREAM ELEVATION(FEET) =    113.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2131.00 TO NODE   2132.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =   530.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  10.32   Tc(MIN.) =  14.64
 LONGEST FLOWPATH FROM NODE   2130.00 TO NODE   2132.00 =   600.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2132.00 TO NODE   2133.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.503
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   61.40   SUBAREA RUNOFF(CFS) =  109.12
 TOTAL AREA(ACRES) =     61.50   TOTAL RUNOFF(CFS) =  109.30
 TC(MIN.) =  14.64
```

```
****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    2140.00 TO NODE    2141.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    125.00
 DOWNSTREAM ELEVATION(FEET) =    123.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.326
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE    2141.00 TO NODE    2142.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =   930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  18.10   Tc(MIN.) =  22.43
 LONGEST FLOWPATH FROM NODE    2140.00 TO NODE    2142.00 =  1000.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    2142.00 TO NODE    2143.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.901
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   48.30   SUBAREA RUNOFF(CFS) =   65.20
 TOTAL AREA(ACRES) =   48.40   TOTAL RUNOFF(CFS) =   65.33
 TC(MIN.) =  22.43

****************************************************************************
 FLOW PROCESS FROM NODE       0.00 TO NODE       0.00 IS CODE =  13
----------------------------------------------------------------------------
```

```
 FLOW PROCESS FROM NODE   2160.00 TO NODE   2161.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    160.00
 DOWNSTREAM ELEVATION(FEET) =    158.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2161.00 TO NODE   2162.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2330.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET)=   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR =0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  45.35   Tc(MIN.) =  49.68
 LONGEST FLOWPATH FROM NODE   2160.00 TO NODE   2162.00 =  2400.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2162.00 TO NODE   2163.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL,INTENSITY(INCH/HOUR) =  1.138
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =  121.60   SUBAREA RUNOFF(CFS) =   98.28
 TOTAL AREA(ACRES) =   121.70   TOTAL RUNOFF(CFS) =   98.36
 TC(MIN.) =  49.68

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE   2170.00 TO NODE   2171.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
```

```
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =    175.00
 DOWNSTREAM ELEVATION(FEET) =    173.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   2171.00 TO NODE   2172.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0250
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) =  57.03   Tc(MIN.) =  61.36
 LONGEST FLOWPATH FROM NODE   2170.00 TO NODE   2172.00 =  3000.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   2172.00 TO NODE   2173.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.993
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =   60.20   SUBAREA RUNOFF(CFS) =   42.46
 TOTAL AREA(ACRES) =   60.30   TOTAL RUNOFF(CFS) =   42.53
 TC(MIN.) =  61.36

****************************************************************************
 FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
****************************************************************************

****************************************************************************
 FLOW PROCESS FROM NODE   9990.00 TO NODE   9991.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
****************************************************************************
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
```

```
 UPSTREAM ELEVATION(FEET) =   1300.00
 DOWNSTREAM ELEVATION(FEET) =   1298.25
 ELEVATION DIFFERENCE(FEET) =      1.75
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.328
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.006
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.36
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
 FLOW PROCESS FROM NODE   9991.00 TO NODE   9992.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
****************************************************************************
 CHANNEL LENGTH THRU SUBAREA(FEET) =  9930.00
 REPRESENTATIVE CHANNEL SLOPE =  0.0300
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.36
 FLOW VELOCITY(FEET/SEC.) =   0.86   FLOW DEPTH(FEET) =   0.04
 TRAVEL TIME(MIN.) = 193.29   Tc(MIN.) = 197.62
 LONGEST FLOWPATH FROM NODE   9990.00 TO NODE   9992.00 = 10000.00 FEET

****************************************************************************
 FLOW PROCESS FROM NODE   9992.00 TO NODE   9993.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
****************************************************************************
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.467
 STREETS & ROADS (DITCHES) RUNOFF COEFFICIENT = .7100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  93
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7100
 SUBAREA AREA(ACRES) =  774.70   SUBAREA RUNOFF(CFS) =  256.98
 TOTAL AREA(ACRES) =   774.80   TOTAL RUNOFF(CFS) =  257.02
 TC(MIN.) = 197.62
****************************************************************************
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =    774.80  TC(MIN.) =    197.62
 PEAK FLOW RATE(CFS)   =    257.02
****************************************************************************
****************************************************************************
 END OF RATIONAL METHOD ANALYSIS
```

Appendix B

- HEC-1 Model

OTAY CPU HEC-1 12-21-04

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*             VERSION 4.1               *
*                                       *
*   RUN DATE  21DEC04  TIME 07:13:00    *
*                                       *
*****************************************

                                      U.S. ARMY CORPS OF ENGINEERS
                                      HYDROLOGIC ENGINEERING CENTER
                                      609 SECOND STREET
                                      DAVIS, CALIFORNIA 95616
                                      (916) 756-1104
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
                                   HEC-1 INPUT                                          PAGE 1

LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           *DIAGRAM
  1        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
  2        ID
  3        ID      ******************************************************************
  4        ID      OTAY MESA HYDROLOGY
  5        ID      ******************************************************************
  6        ID
  7        ID      KIMLEY-HORN AND ASSOCIATES, INC
  8        ID      100 YEAR, 6 HOUR STORM EVENT
  9        ID      FILE: IN*0100WEB-6D-IN2.TXT OUT 0100WEB-615
 10        ID      LHH 8-11-00; MODIFIED 7-27-05 BY KLM
 11        ID
 12        IT      2                   300
 13        IO      5

 14        KK     A1  RUNOFF HYDROGRAPH
 15        BA  0.076
 16        PB   2.89
 17        PI 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024
 18        PI 0.0024 0.0024 0.0024 0.0024 0.0024 0.0031 0.0031 0.0031 0.0031 0.0031
 19        PI 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031
 20        PI 0.0037 0.0037 0.0037 0.0037 0.0037 0.0037 0.0037 0.0037 0.0037 0.0037
 21        PI 0.0047 0.0047 0.0047 0.0047 0.0047 0.0047 0.0047 0.0047 0.0053 0.0053
 22        PI 0.0053 0.0057 0.0057 0.0057 0.0067 0.0067 0.0067 0.0083 0.0083 0.0083
 23        PI 0.0150 0.0189 0.0270 0.0380 0.0440 0.0420 0.0340 0.0280 0.0220 0.0220
 24        PI 0.0202 0.0184 0.0160 0.0140 0.0116 0.0083 0.0083 0.0081 0.0077 0.0077
 25        PI 0.0077 0.0071 0.0073 0.0073 0.0067 0.0067 0.0067 0.0053 0.0053 0.0053
 26        PI 0.0048 0.0048 0.0048 0.0048 0.0048 0.0048 0.0048 0.0048 0.0048 0.0048
 27        PI 0.0048 0.0048 0.0048 0.0048 0.0048 0.0038 0.0036 0.0036 0.0036 0.0036
 28        PI 0.0036 0.0036 0.0036 0.0036 0.0036 0.0036 0.0036 0.0036 0.0036 0.0036
 29        PI 0.0032 0.0032 0.0032 0.0032 0.0032 0.0032 0.0032 0.0032 0.0032 0.0032
 30        PI 0.0032 0.0032 0.0032 0.0032 0.0032 0.0028 0.0028 0.0028 0.0028 0.0028
 31        PI 0.0028 0.0028 0.0028 0.0028 0.0028 0.0028 0.0028 0.0028 0.0028 0.0028
 32        PI 0.0026 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025
 33        PI 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025 0.0025
 34        PI 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024
 35        LS             83.9
 36        UD  0.240

 37        KK     A2  RUNOFF HYDROGRAPH
 38        BA  0.031
 39        PB   2.89
 40        LS             88.1
 41        UD  0.061

 42        KK     A3  RUNOFF HYDROGRAPH
 43        BA  0.218
 44        PB   2.89
 45        LS             83.9
 46        UD  0.190
                                   HEC-1 INPUT                                          PAGE 2
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 47           KK   CP-01  COMBINE HYDROGRAPHS FROM A1, 97, AND 01
 48           HC       3

 49           KK  CP-A10  ROUTE FROM CP 01
 50           RK    1899  0.009   0.30                 TRAP    100     20

 51           KK      A5  RUNOFF HYDROGRAPH
 52           BA   0.082
 53           PB    2.60
 54           LS            81.0
 55           UD   0.061

 56           KK  CP-A10  ROUTE FROM A5
 57           RK    1255  0.003   0.013                TRAP     75      0

 58           KK     A10  RUNOFF HYDROGRAPH
 59           BA   0.093
 60           PB    2.90
 61           LS            84.0
 62           UD   0.061

 63           KK  CP-A10  COMBINE HYDROGRAPHS FROM A5 AND A10
 64           HC       3

 65           KK  CP-A15  ROUTE FROM CP A10
 66           RK    1320  0.011   0.027                TRAP     50     20

 67           KK     A15  RUNOFF HYDROGRAPH
 68           BA   0.098
 69           PB    2.80
 70           LS            89.9
 71           UD   0.087

 72           KK  CP-A15  COMBINE HYDROGRAPHS FROM CP-01, CP-A10, AND A15
 73           HC       3

 74           KK  CP-A20  ROUTE FROM CP-A15
 75           RK    3400  0.008   0.020                TRAP    200     20

 76           KK      95  RUNOFF HYDROGRAPH FROM 95
 77           BA   0.097
 78           PB    2.75
 79           LS            87.9
 80           UD   0.080

 81           KK  CP-A20  ROUTE FROM 95
 82           RK    1800  0.008   0.020                TRAP    200     20

 83           KK     A20  RUNOFF HYDROGRAPH
 84           BA   0.254
 85           PB    2.75
 86           LS            88.0
 87           UD   0.184
                                                HEC-1 INPUT                                  PAGE

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 88           KK     A25  RUNOFF FROM A25
 89           BA   0.010
 90           PB    2.60
 91           LS            88.0
 92           UD   0.076

 93           KK     A27  RUNOFF HYDROGRAPH
 94           BA   0.321
 95           PB    2.60
 96           LS            93.0
 97           UD   0.061

 98           KK  CP-A20  COMBINE HYDROGRAPHS FROM CP-A15, 95, A25, A27  AND A20
 99           HC       5

100           KK  CP-A25 ROUTE FROM CP-A20
101           RK    1200  0.005   0.02                 TRAP     20

102           KK     A21  RUNOFF HYDROGRAPH FROM A21
103           BA   0.051
104           PB    2.65
105           LS            93.0
106           UD   0.068

107           KK  CP-A25  ROUTE FROM A21
108           RK     422  0.035   0.013                CIRC    2.5

109           KK  CP A25 COMBINE HYDROGRAPHS FROM A21, CP-A20
110           HC       2

111           KK  CP-A10 ROUTE FROM CP-A25
112           RK    1100  0.005   0.020                TRAP     20

113           KK     D25  RUNOFF HYDROGRAPH
114           BA   0.134
115           PB    2.60
116           LS            93.7
117           UD   0.120

118           KK     D20  RUNOFF HYDROGRAPH
```

```
119          BA   0.163
120          PB    2.79
121          LS            81.9
122          UD   0.254

123          KK  CP-026  ROUTE FROM 020
124          RK     996   0.001   0.020           TRAP     100     40

125          KK     026  RUNOFF HYDROGRAPH
126          BA   0.125
127          PB    2.58
128          LS            83.3
129          UD   0.384
                                  HEC-1 INPUT                                          PAGE 4

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

130          KK  CP-030  COMBINE HYDROGRAPHS FROM 026, 020 AND 030
131          HC       3

132          KK  CP-045 ROUTE FROM 030
133          RK     595   0.007   0.030           TRAP      75      4

134          KK     045  RUNOFF HYDROGRAPH
135          BA   0.075
136          PB    2.58
137          LS            93.9
138          UD   0.137

139          KK  CP-045  COMBINE HYDROGRAPHS FROM 045, CP 045
140          HC       2

141          KK  CP-050 ROUTE FROM CP-045
142          RK    2106   0.007   0.015           TRAP      75      0

143          KK     057  RUNOFF HYDROGRAPH
144          BA   0.527
145          PB    2.45
146          LS            93.9
147          UD   0.172

148          KK  CP-050
149          RK    1500   0.007   0.015           TRAP      75      4

150          KK     050  RUNOFF HYDROGRAPH
151          BA   0.483
152          PB    2.45
153          LS            93.8
154          UD   0.185

155          KK  CP-050  COMBINE HYDROGRAPHS FROM  CP-045, 057, 050
156          HC       3

157          KK  CP-010  ROUTE FROM CP-050
158          RK    1050   0.007   0.015

159          KK     010  RUNOFF HYDROGRAPH
160          BA   0.082
161          PB    2.75
162          LS            81.7
163          UD   0.087

164          KK  CP-010  COMBINE HYDROGRAPHS FROM 010,CP-050
165          HC            81.9

166          KK  CP-016  ROUTE FROM CP-010
167          RK    2100   0.007   0.015           TRAP      75      1
                                  HEC-1 INPUT                                          PAGE 5

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

168          KK     016  RUNOFF HYDROGRAPH
169          BA   0.318
170          PB    2.60
171          LS            83.8
172          UD   0.088

173          KK     060
174          BA   0.148
175          PB    2.46
176          LS            89.1
177          UD   0.086

178          KK  CP-016 ROUTE FROM CP-060
179          RK     500   0.007   0.015           TRAP      10      1

180          KK  CP-016  COMBINE HYDROGRAPHS FROM 060, 016, CP-010
181          HC       3

182          KK  CP-A30  ROUTE FROM CP-016
183          RK    2700   0.002   0.002   0.040   TRAP      30      1

184          KK     A30  RUNOFF HYDROGRAPH
185          BA   0.070
186          PB    2.50
187          LS            90.5
188          UD   0.061

189          KK  CP-A30  COMBINE HYDROGRAPHS FROM A30, CP-016, CP-021
```

```
          KC       3

          KK  CP-A31  ROUTE FROM CP-A30
          RK    1600   0.002   0.040              TRAP      10       3

          KK     A28  RUNOFF HYDROGRAPH
          BA   1.021
          PB    2.60
          LS              93.0
          UD   0.041

          KK  CP-A31  RUNOFF HYDROGRAPH
          RK    1200   0.005    0.03              TRAP      12       3

          KK     A31  RUNOFF HYDROGRAPH
          BA   1.047
          PB    2.60
          LS              91.4
          UD   0.061

          KK  CP-A31  COMBINE HYDROGRAPHS FROM CP-A30, A28, A31
          HC       3
                                         HEC-1 INPUT                                        PAGE  6

LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          KK  CP-S1A  ROUTE FROM CP-A31
          RK    1600   0.002   0.040              TRAP      20       3

          KK     B10
          KM              BASIN 10
          BA   .0067
          PB     2.0
          LS       0      81      77
          UD    .064

          KK     B20
          KM              BASIN 20
          BA   .0055
          LS       0      82      72
          UD    .087

          KK     C12           COMBINE B10 & B20
          HC       2

          KK      C2           ROUTE CHANNEL NUMBER 2
          UK     350    .010     .08     100
          RK     120    .005    .035              TRAP      10       3

          KK     B30
          KM              BASIN 30
          BA   .0052
          LS       0      86      42
          UD    .095

          KK     C23           COMBINE B20 OUT & B30
          HC       2

          KK      C3           ROUTE CHANNEL NUMBER 3
          RK    1100    .005    .035              TRAP      12       3

          KK     B40
          KP       3
          KM              BASIN 40
          BA   .0942
          LS       0      91      65
          UD    .024

          KK    RD41           ROUTE B40 THROUGH B10: STORM DRAIN
          UK    1050    .020     .08     100
          RK     500    .015    .015              CIRC     1.5

          KK     B50
          KP       1
          KM              BASIN 50
          BA   .0781
          LS       0      92      62
          UD    .019
                                         HEC-1 INPUT                                        PAGE

LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          KK     C45           COMBINE B40 & B50 @ B10
          HC       2

          KK     C54
          BA    .012
          UK     230     .012     .08     100
          RK    1320     .015    .015              CIRC      4              YES

          KK    CC54
          KM       COMBINE AT  CONC. PT. 1
          HC       2

          KK     CP2
          KM       ROUTE TO CONC. PT. 2
          BA    .040
          UK     650     .011     .08     100
          RK    1320     .015    .015              CIRC      4              YES
```

```
263          KK    CCP3
264          KM       COMBINE AT CONC. PT. 3
265          HC       2

266          KK     MX1
267          KM       MEXICO BASIN 1
268          BA   .0215
269          LS       0      85      90
270          UD    .097

271          KK     MX2
272          KM       MEXICO BASIN 2
273          BA   .0783
274          LS       0      87      60
275          UD    .115

276          KK    MX12
277          KM       COMBINE MEXICO AND BORDER AREA
278          HC       2

279          KK   MX12I
280          KM       ROUTE TO CP3A
281          RK     200    .015    .015              CIRC       5

282          KK     MX3
283          KM       BORDER CORRIDOR
284          BA   .0215
285          LS       0      88      70
286          UD    .025

287          KK    CP3A
288          KM       COMBINE AT CONC. PT. 3A
289          HC       2
                                              HEC-1 INPUT                                                   PAGE 8

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


290          KK    RCP3
291          KM       ROUTE TO CONC. PT. 3A
292          RK     750    .015    .015              CIRC       8

293          KK    CCP3
294          KM       COMBINE AT CONC. PT. 3
295          HC       2

296          KK    RCP2
297          KM       ROUTE TO CONC. PT. 2
298          RK     400    .015    .015              CIRC       7

299          KK     RP2
300          KM       RUNOFF TO CONC. PT. 2
301          BA   .0473
302          UK     550    .012     .08     100
303          RK    1300    .015    .015              CIRC       4

304          KK    CCP2
305          KM       COMBINEAT CONC. PT. 2
306          HC       2

307          KK    SVSW
308          KM       SIEMPRE VIVA SU WATERSHED
309          BA   .0646
310          UK     450    .015     .08     100
311          RK    1000    .015    .015              CIRC       8

312          KK      EB
313          KM       WATERSHED EAST OF PREVIOUS DET. BASIN
314          BA   .0184
315          UK     250    .010     .08     100
316          RK     100    .015    .017              CIRC       2

317          KK      WB
318          KM       WATERSHED WEST OF PREVIOUS DET. BASIN
319          BA   .0158
320          UK     400    .013     .08     100
321          RK     160    .015    .015              CIRC       2

322          KK    WSVR
323          KM       WEST SIEMPRE VIVA RD.
324          BA   .0128
325          UK     250    .012     .08     100
326          RK     600    .015    .015              CIRC       4

327          KK     CP1
328          HC       7
                                              HEC-1 INPUT                                                   PAGE 9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


329          KK      O1  RUNOFF HYDROGRAPH
330          BA   0.516
331          PB    2.70
332          LS          87.8
333          UD   0.141

334          KK   CP-O1  COMBINE HYDROGRAPHS FROM SIO. CP1 AND O1
335          HC       2
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```
336          KK  CP-G18  COMBINE HYDROGRAPHS FROM CP-G1, CP-A11
337          HC       2

338          KK  CP-G13  ROUTE FROM CP-G18
339          RK    1300   0.004   0.050             TRAP      30

340          KK     A60  RUNOFF HYDROGRAPH
341          BA   0.033
342          PB    2.35
343          LS            93.0
344          UD   0.070

345          KK  CP-A60  ROUTE FROM A60
346          RK    1000   0.005   0.013             CIRC       2

347          KK     B55  RUNOFF HYDROGRAPH
348          BA   0.482
349          PB    2.35
350          LS            91.7
351          UD   0.140

352          KK  CP-A50  ROUTE FROM B55
353          RK    2500   0.004   0.013             TRAP      15

354          KK     A50  RUNOFF HYDROGRAPH
355          BA   0.250
356          PB    2.35
357          LS            93.4
358          UD   0.121

359          KK  CP-A59  COMBINE HYDROGRAPHS FROM A60, B55, AND A50
360          HC       3

361          KK     A50
362          DT     A50
363          DI       0     215    1000
364          DQ       0    0.01     485

365          KK     A42  RUNOFF HYDROGRAPH
366          BA   0.332
367          PB    2.47
368          LS            93.0
369          UD   0.046
                                                HEC-1 INPUT                                      PAGE 1

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

370          KK  CP-A40  COMBINE HYDROGRAPHS FROM A50 AND A42
371          HC       2

372          KK  CP-A41  ROUTE FROM CP-A40
373          RK    1000   0.002   0.040             TRAP      40

374          KK     A40  RUNOFF HYDROGRAPH
375          BA   0.012
376          PB    2.40
377          LS            93.8
378          UD   0.057

379          KK  CP-A45  ROUTE FROM A41
380          RK    2000   0.005   0.040             TRAP      40

381          KK     A35  RUNOFF HYDROGRAPH
382          BA   0.065
383          PB    2.50
384          LS            93.8
385          UD   0.076

386          KK  CP-A45  ROUTE FROM A35
387          RK    2000   0.001   0.040             TRAP       5

388          KK     A45  RUNOFF HYDROGRAPH
389          BA   0.121
390          PB    2.45
391          LS            94.0
392          UD   0.112

393          KK  CP-A43  COMBINE HYDROGRAPHS FROM CP-A40, A40 AND A45
394          HC       4

395          KK     A45
396          DT     A45
397          DI       0      40    1000
398          DQ       0    0.01     940

399          KK  CP-G10  ROUTE FROM CP-A43
400          RK    2800   0.003   0.040             TRAP      25     1.0

401          KK     G10  RUNOFF FROM HYDROGRAPH
402          BA   0.261
403          PB    2.50
404          LS            94.4
405          UD   0.125

406          KK  CP-G11  COMBINE HYDROGRAPHS FROM A1-DET, CP-A44, AND A11
407          HC       3
                                                HEC-1 INPUT                                      PAGE 1

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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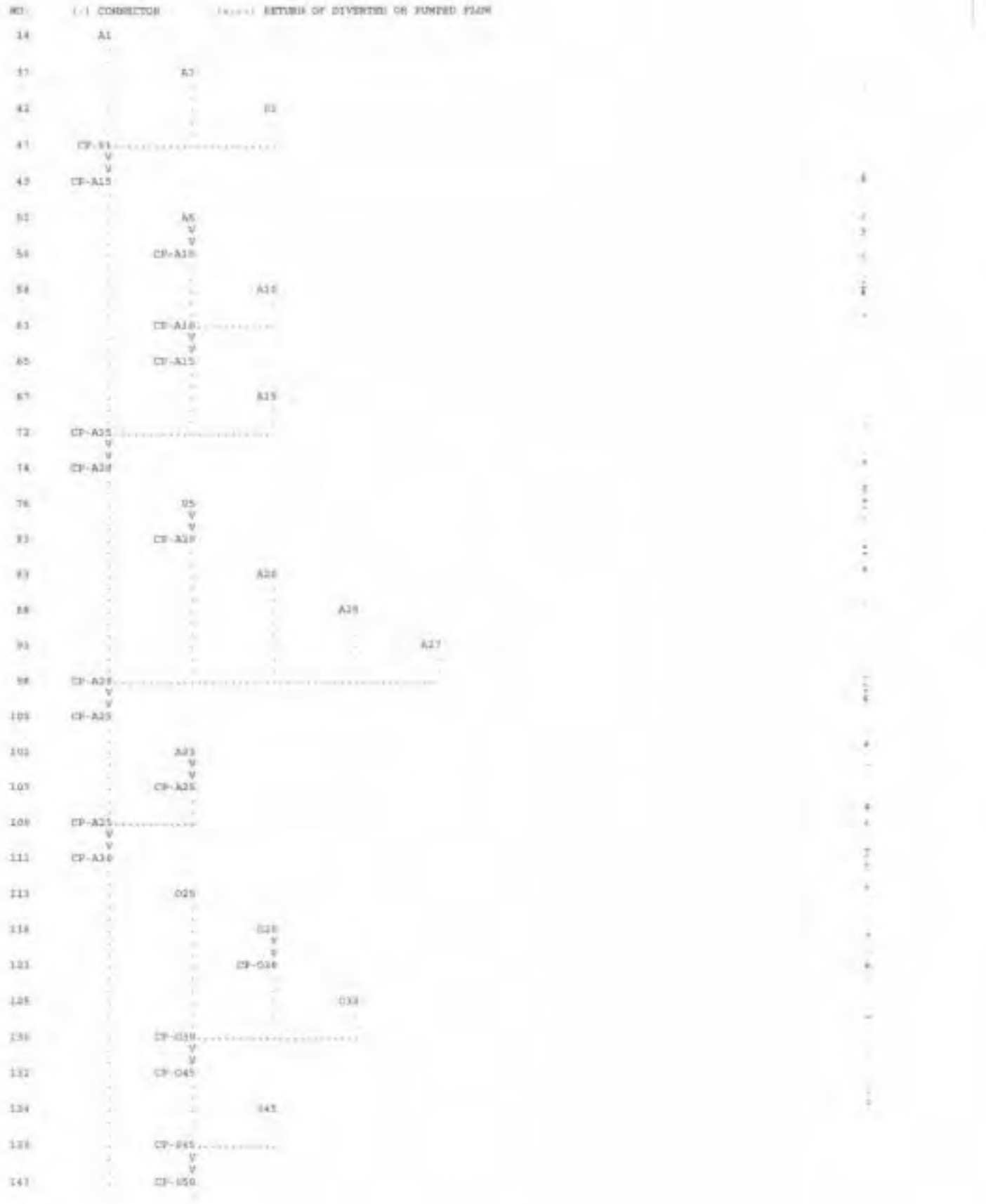
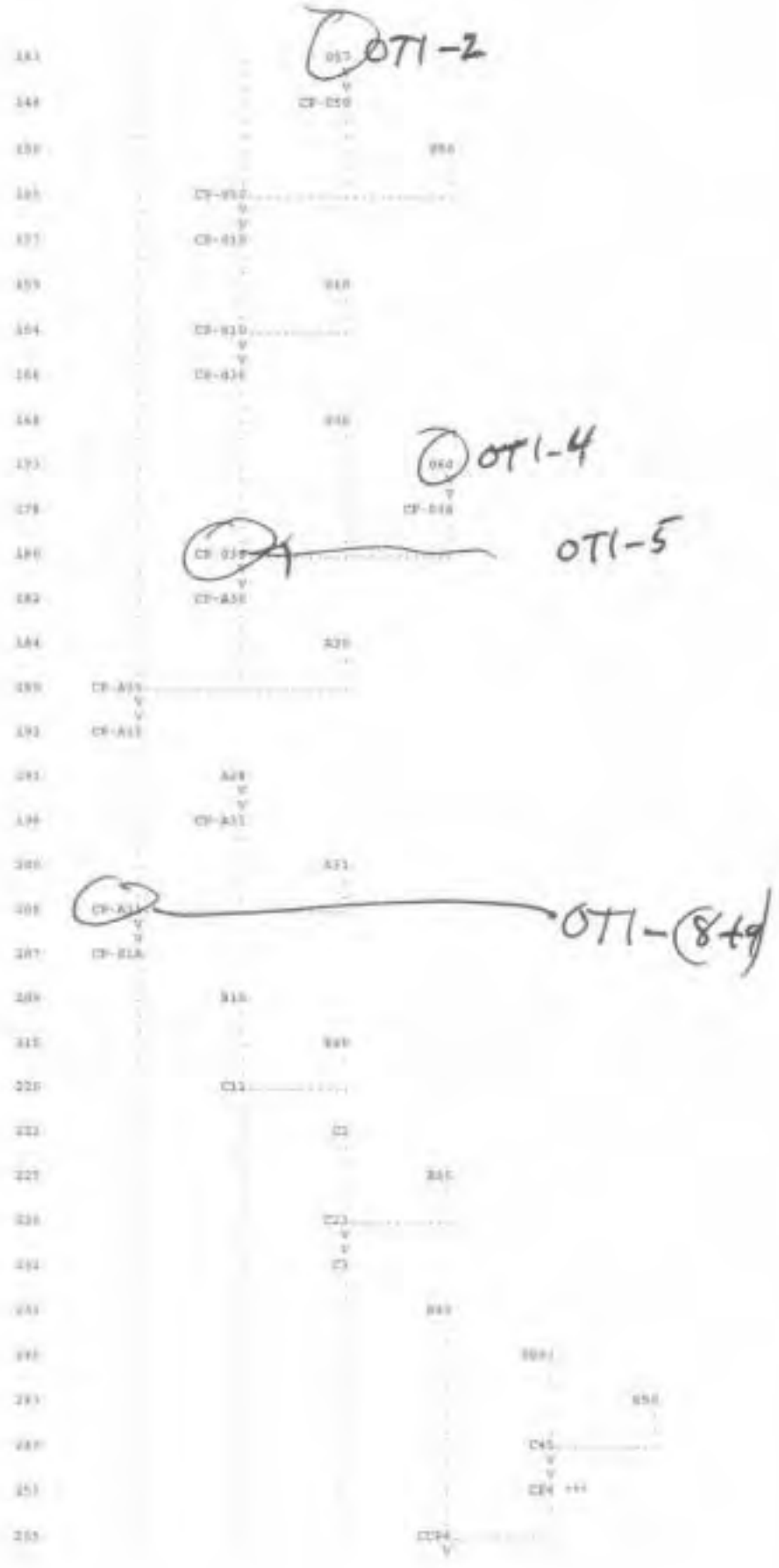
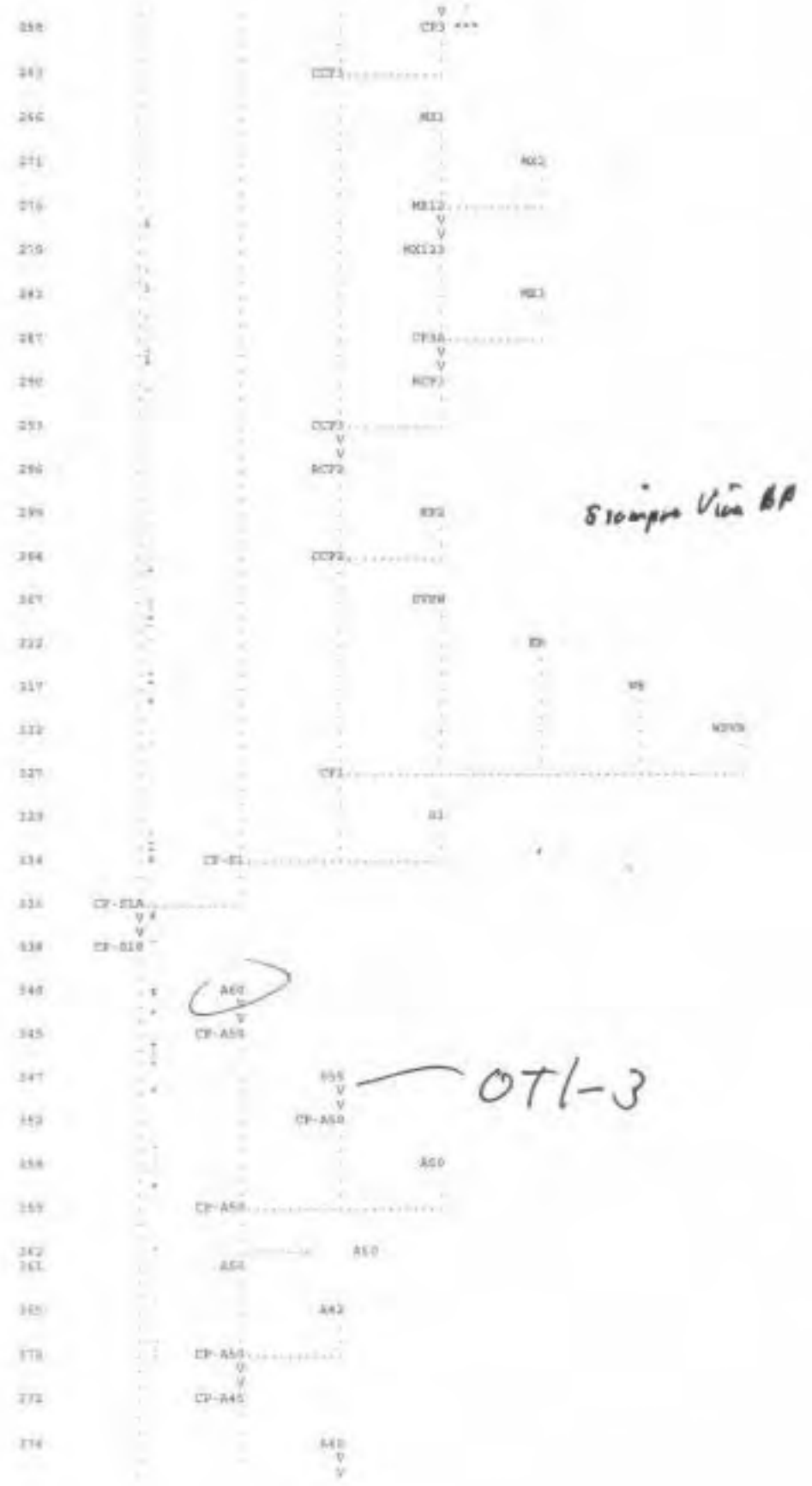
```
408            KK  CP-A10  ROUTE FROM CP-A10
409            RD    2400   0.004   0.040              TRAP      80      0.8

410            KK     A45  RUNOFF HYDROGRAPH FROM A45
411            BA   0.055
412            PB    2.30
413            LS             93.0
414            UD   0.037

415            KK  CP-A25 ROUTE FROM A45
416            RK    2910   0.010   0.040              TRAP     100      33

417            KK     A25  RUNOFF HYDROGRAPH
418            BA   0.082
419            PB    2.30
420            LS             83.5
421            UD   0.244

422            KK  CP-A25  COMBINE HYDROGRAPHS FROM A45 AND A25
423            HC       2

424            KK  CP-A20  ROUTE FROM CP-A25
425            RK    1460   0.004   0.030              TRAP      40       3

426            KK     A20  RUNOFF HYDROGRAPH
427            BA   0.136
428            PB    2.30
429            LS             83.5
430            UD   0.176

431            KK  CP-A20  COMBINE HYDROGRAPHS FROM CP-A25  AND A20
432            HC       2

433            KK  CP-A10  ROUTE FROM CP-A20
434            RK    3500   0.004   0.045              TRAP      35       3

435            KK     A15  RUNOFF HYDROGRAPH
436            BA   0.128
437            PB    2.40
438            LS             83.6
439            UD   0.883

440            KK  CP-A30  ROUTE FROM A15
441            RK    2800   0.004   0.040              TRAP      55       3

442            KK     A10  RUNOFF HYDROGRAPH
443            BA   0.040
444            PB    2.30
445            LS             93.8
446            UD   0.051
                                            HEC-1 INPUT                                                   PAGE 11

LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

447            KK  CP-B25  ROUTE FROM B30
448            RK    2320   0.002   0.025              TRAP       8       3

449            KK     B25  RUNOFF HYDROGRAPH
450            BA   0.127
451            PB    2.30
452            LS             91.8
453            UD   0.070

454            KK  CP-B25  COMBINE HYDROGRAPHS FROM B30 AND B25
455            HC       2

456            KK  CP-B25  ROUTE FROM CP-B25
457            RK    2700   0.003   0.040              TRAP      16       3

458            KK     B15  RUNOFF HYDROGRAPH
459            BA   0.074
460            PB    2.30
461            LS             94.5
462            UD   0.078

463            KK  CP-B30
464            RK    1500   0.015  0.040              TRAP      10       3

465            KK     B10  RUNOFF HYDROGRAPH
466            BA   0.128
467            PB    2.45
468            LS             83.6
469            UD   0.465

470            KK  CP-D10  COMBINE HYDROGRAPHS FROM CP-D10, CP-A20, A15, CP-B25, B15 AND B10
471            KO       1
472            HC       6

473            KK  DB-D10  DETENTION BASIN AT BORDER
474            RS       1    STOR
475            SV       0      53      71     166     266     317
476            SE       0       2       4       6       8       9
477            SQ       0      20     150     150    1000    2085
478            ZZ

               SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
```


(-) CONNECTOR
(+++) RETURN OF DIVERTED OR PUMPED FLOW
A1
A7
D1
CP-A15
A5
CP-A10
A10
CP-A10
CP-A15
A15
CP-A25
CP-A20
D5
CP-A20
A20
A25
A27
CP-A25
CP-A25
A23
CP-A25
CP-A25
CP-A30
D25
D30
CP-D30
D33
CP-D30
CP-D45
D45
CP-D45
CP-D50


OTI-2
OTI-4
OTI-5
OTI-(8+9)



Siempre Vía BP

OTI-3

```
379                            CP-A45
                                 .
381                                          A35
                                               V
                                               V
386                                      CP-A45

388                                                      A45

393                   CP-A45.............................
                                                         +
395                      .-------->      A45
395                     A45
                          V
                          V
399                   CP-A10
                            ->
401                               A10
                                                         +
406             CP-A10...........................           OT1-12
                   V
                   V
409             CP-A10

413                     A65
                          V
                          V
415                   CP-S25

417                               S25

422                   CP-S25...........
                          V
                          V
424                   CP-S20

426                               S20

431                   CP-S20...........
                          V
                          V
433                   CP-S10

435                               S15
                                    V
                                    V
440                            CP-S32

442                                          B20
                                               V
                                               V
447                                      CP-B25

449                                                      B25

454                                      CP-B25..........        OT1-11
                                               V
                                               V
456                                      CP-B25

458                                                      B15
                                                           V
                                                           V
462                                                  CP-B20

465                                                               B20

471             CP-B20......................................................
                   V
                   V
473             DR-B20      OT1-14
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*****************************************
*                                       *                                         *
*
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                         *   U.S. ARMY CORPS OF
ENGINEERS     *
*                 JUN    1998           *                                         *   HYDROLOGIC ENGINEERING
CENTER    *
*               VERSION 4.1             *                                         *        609 SECOND
STREET        *
```

```
*                                   *                                                              *      DAVIS, CALIFORNIA
95616          *
 *  RUN DATE   21DEC04  TIME  07:53:03   *                                                         *          (916) 756-1104
*
 *                                  *                                                              *
*
 ******************************************
 ****************************************



                                 .....1.......2.......3.......4.......5.......6.......7.......8.......9......10

                                 ***********************************************************************
                                 UTAH MESA HYDROLOGY
                                 ***********************************************************************

                                 KIMLEY-HORN AND ASSOCIATES, INC.
                                 100 YEAR, 6 HOUR STORM EVENT
                                 FILE: IN=9300WDB-ID-INL.TXT OUT 9300WDB-015
                                 LNN 8-31-98  MODIFIED 7-27-99 BY SLM

  33 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          0  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          2  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1   0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1   0  ENDING DATE
                     NDTIME       0958  ENDING TIME
                     ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL      .03 HOURS
        *             TOTAL TIME BASE     9.97 HOURS

        ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** ***


           ***************
           *             *
  473 KK   *    DB-015   *       DETENTION BASIN AT BORDEN
           *             *
           ***************

              HYDROGRAPH ROUTING DATA

  474 RS         STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                      ITYP        STOR  TYPE OF INITIAL CONDITION
                     RSVRIC        .00  INITIAL CONDITION
                          X        .00  WORKING R AND D COEFFICIENT

  475 SV          STORAGE          .0      11.5      71.0     161.0     268.0     319.0

  476 SE        ELEVATION         .00      2.00      4.50      6.00      8.00      9.00

  477 SQ        DISCHARGE          0.        25       120       300      1000      2200

                                                              ***

*********************************************************************************************************************
***********

                                               HYDROGRAPH AT STATION   DB-015

*********************************************************************************************************************
***********
                                     *                                            *
  DA MON HRMN ORD   OUTFLOW  STORAGE    STAGE * DA MON HRMN ORD  OUTFLOW  STORAGE    STAGE * DA MON HRMN ORD  OUTFLOW
STORAGE   STAGE
                                     *                                            *
   1    0000   1       0.        .0       .0 *  1    0320 101     587.    215.7     7.0 *  1    0640 201     875.
226.1     7.1
   1    0002   2       0.        .0       .0 *  1    0322 102     682.    218.1     7.0 *  1    0642 202     888.
219.0     7.0
   1    0004   3       0.        .0       .0 *  1    0324 103     695.    220.2     7.1 *  1    0644 203     881.
227.9     7.0
   1    0006   4       0.        .0       .0 *  1    0326 104     708.    222.2     7.1 *  1    0646 204     879.
226.8     7.0
   1    0008   5       0.        .0       .0 *  1    0328 105     720.    224.1     7.1 *  1    0648 205     866.
```

216.7	7.6										
1	0010	6	0.	.0	.0 * 1	0330 106	732.	226.9	7.2 * 1	0650 206	659.
214.5	7.0										
1	0012	7	0.	.0	.0 * 1	0332 107	742.	227.9	7.2 * 1	0652 207	652.
213.3	6.9										
1	0014	8	0.	.0	.0 * 1	0334 108	752.	229.1	7.2 * 1	0654 208	644.
212.1	6.9										
1	0016	9	0.	.0	.0 * 1	0336 109	761.	230.3	7.3 * 1	0656 209	635.
210.9	6.9										
1	0018	10	0.	.1	.0 * 1	0338 110	770.	231.4	7.3 * 1	0658 210	628.
209.7	6.9										
1	0020	11	0.	.1	.0 * 1	0340 111	778.	233.2	7.3 * 1	0700 211	620.
208.4	6.8										
1	0022	12	0.	.1	.0 * 1	0342 112	786.	234.4	7.3 * 1	0702 212	611.
207.2	6.8										
1	0024	13	0.	.2	.0 * 1	0344 113	793.	235.5	7.4 * 1	0704 213	604.
205.9	6.9										
1	0026	14	0.	.2	.0 * 1	0346 114	799.	236.5	7.4 * 1	0706 214	596.
204.7	6.8										
1	0028	15	0.	.3	.0 * 1	0348 115	805.	237.5	7.4 * 1	0708 215	588.
203.6	6.7										
1	0030	16	1.	.3	.1 * 1	0350 116	811.	238.4	7.4 * 1	0710 216	580.
202.3	6.7										
1	0032	17	1.	.4	.1 * 1	0352 117	816.	239.2	7.4 * 1	0712 217	572.
200.9	6.7										
1	0034	18	1.	.4	.1 * 1	0354 118	821.	239.9	7.4 * 1	0714 218	564.
199.8	6.7										
1	0036	19	1.	.4	.1 * 1	0356 119	826.	240.6	7.5 * 1	0716 219	557.
198.6	6.6										
1	0038	20	1.	.5	.1 * 1	0358 120	830.	241.3	7.5 * 1	0718 220	549.
197.2	6.6										
1	0040	21	1.	.5	.1 * 1	0400 121	834.	241.9	7.5 * 1	0720 221	541.
196.0	6.6										
1	0042	22	1.	.6	.1 * 1	0402 122	837.	242.4	7.5 * 1	0722 222	533.
194.7	6.6										
1	0044	23	1.	.6	.1 * 1	0404 123	840.	242.9	7.5 * 1	0724 223	526.
193.5	6.5										
1	0046	24	1.	.7	.1 * 1	0406 124	843.	243.4	7.5 * 1	0726 224	518.
192.3	6.5										
1	0048	25	1.	.8	.1 * 1	0408 125	846.	243.8	7.5 * 1	0728 225	510.
191.1	6.5										
1	0050	26	1.	.8	.1 * 1	0410 126	848.	244.1	7.5 * 1	0730 226	503.
190.0	6.5										
1	0052	27	2.	.9	.2 * 1	0412 127	850.	244.5	7.5 * 1	0732 227	495.
188.8	6.4										
1	0054	28	2.	.9	.2 * 1	0414 128	852.	244.8	7.5 * 1	0734 228	488.
187.7	6.4										
1	0056	29	2.	1.0	.2 * 1	0416 129	853.	245.0	7.5 * 1	0736 229	481.
186.5	6.4										
1	0058	30	2.	1.1	.2 * 1	0418 130	855.	245.2	7.6 * 1	0738 230	474.
185.4	6.4										
1	0100	31	2.	1.2	.2 * 1	0420 131	856.	245.4	7.6 * 1	0740 231	466.
184.3	6.4										
1	0102	32	2.	1.2	.2 * 1	0422 132	857.	245.5	7.6 * 1	0742 232	459.
183.2	6.3										
1	0104	33	2.	1.3	.2 * 1	0424 133	858.	245.7	7.6 * 1	0744 233	452.
182.1	6.3										
1	0106	34	3.	1.4	.3 * 1	0426 134	858.	245.7	7.6 * 1	0746 234	446.
181.0	6.3										
1	0108	35	3.	1.5	.3 * 1	0428 135	859.	245.8	7.6 * 1	0748 235	439.
179.9	6.5										
1	0110	36	3.	1.6	.3 * 1	0430 136	859.	245.8	7.6 * 1	0750 236	432.
178.9	6.1										
1	0112	37	3.	1.8	.3 * 1	0432 137	859.	245.8	7.6 * 1	0752 237	425.
177.8	6.2										
1	0114	38	3.	1.9	.3 * 1	0434 138	859.	245.8	7.6 * 1	0754 238	419.
176.8	6.2										
1	0116	39	4.	2.0	.4 * 1	0436 139	859.	245.8	7.6 * 1	0756 239	412.
175.8	6.2										
1	0118	40	4.	2.2	.4 * 1	0438 140	858.	245.8	7.6 * 1	0758 240	406.
174.7	6.2										
1	0120	41	4.	2.4	.4 * 1	0440 141	858.	245.7	7.6 * 1	0800 241	399.
173.7	6.2										
1	0122	42	5.	2.5	.5 * 1	0442 142	857.	245.6	7.6 * 1	0802 242	393.
172.8	6.1										
1	0124	43	5.	2.7	.5 * 1	0444 143	857.	245.5	7.6 * 1	0804 243	387.
171.8	6.1										
1	0126	44	5.	2.9	.5 * 1	0446 144	856.	245.4	7.6 * 1	0806 244	381.
170.8	6.1										
1	0128	45	6.	3.1	.6 * 1	0448 145	855.	245.2	7.6 * 1	0808 245	375.
169.9	6.1										
1	0130	46	6.	3.4	.6 * 1	0450 146	854.	245.1	7.6 * 1	0810 246	369.
168.9	6.1										
1	0132	47	7.	3.6	.7 * 1	0452 147	853.	244.9	7.5 * 1	0812 247	363.
168.0	6.0										
1	0134	48	7.	3.8	.7 * 1	0454 148	851.	244.7	7.5 * 1	0814 248	357.
167.1	6.0										
1	0136	49	7.	4.1	.7 * 1	0456 149	850.	244.5	7.5 * 1	0816 249	351.
166.2	6.0										
1	0138	50	8.	4.5	.8 * 1	0458 150	849.	244.2	7.5 * 1	0818 250	349.
165.3	6.0										
1	0140	51	8.	4.8	.8 * 1	0500 151	847.	244.0	7.5 * 1	0820 251	347.
164.5	6.0										
1	0142	52	9.	4.9	.9 * 1	0502 152	846.	243.8	7.5 * 1	0822 252	345.
163.6	5.9										
1	0144	53	10.	5.2	1.0 * 1	0504 153	844.	243.5	7.5 * 1	0824 253	342.
162.7	5.9										
1	0146	54	10.	5.8	1.0 * 1	0506 154	842.	243.1	7.5 * 1	0826 254	342.
161.8	5.9										
1	0148	55	11.	6.5	1.1 * 1	0508 155	840.	242.9	7.5 * 1	0828 255	337.
161.0	5.9										

1	0159	59	15.	6.4	1.2	*	1	0916	156	839.	242.7	7.3	*	1	0836	256	336.
160.2	5.9																
1	0162	57	12.	6.8	1.2	*	1	0913	157	837.	242.4	7.5	*	1	0833	257	336.
159.2	5.9																
1	0154	58	13.	7.1	1.3	*	1	0914	158	835.	242.1	7.6	*	1	0834	258	334.
158.3	5.8																
1	0156	50	14.	7.8	1.4	*	1	0916	159	833.	241.8	7.5	*	1	0836	259	332.
157.5	5.8																
1	0159	60	15.	8.4	1.5	*	1	0916	160	831.	241.8	7.5	*	1	0838	260	330.
156.6	5.8																
1	0209	61	17.	9.2	1.7	*	1	0919	161	829.	241.1	7.5	*	1	0840	261	328.
155.8	5.8																
1	0201	62	18.	9.9	1.8	*	1	0922	162	826.	240.8	7.5	*	1	0843	262	327.
154.9	5.8																
4 1	0204	63	19.	10.7	1.9	*	1	0924	163	824.	240.4	7.5	*	1	0844	263	325.
154.1	5.7																
1	0206	64	21.	11.7	2.0	*	1	0926	164	822.	240.1	7.5	*	1	0846	264	323.
153.2	5.7																
1	0209	65	24.	12.8	2.1	*	1	0928	165	820.	239.7	7.4	*	1	0848	265	321.
152.4	5.7																
1	0211	66	27.	14.2	2.1	*	1	0930	166	817.	239.3	7.4	*	1	0850	266	320.
151.5	5.7																
1	0213	67	31.	16.0	2.2	*	1	0932	167	815.	238.9	7.4	*	1	0852	267	318.
150.7	5.7																
1	0214	68	36.	18.5	2.2	*	1	0934	168	812.	238.6	7.4	*	1	0854	268	316.
149.8	5.7																
1	0216	69	41.	21.7	2.4	*	1	0936	169	810.	238.2	7.4	*	1	0856	269	314.
149.0	5.6																
1	0218	70	54.	25.6	2.5	*	1	0938	170	808.	237.9	7.4	*	1	0858	270	312.
148.2	5.6																
1	0220	71	62.	30.8	2.7	*	1	0940	171	805.	237.6	7.4	*	1	0900	271	311.
147.4	5.6																
1	0221	72	78.	36.8	2.9	*	1	0943	172	803.	237.2	7.4	*	1	0902	272	309.
146.5	5.5																
1	0224	73	91.	43.7	3.1	*	1	0944	173	800.	236.7	7.4	*	1	0904	273	307.
145.8	5.5																
1	0226	74	168.	51.5	3.3	*	1	0946	174	798.	236.3	7.4	*	1	0906	274	306.
145.0	5.5																
1	0228	75	126.	59.9	1.6	*	1	0948	175	795.	235.9	7.4	*	1	0908	275	304.
144.2	5.5																
1	0230	76	145.	68.7	3.9	*	1	0950	176	793.	235.5	7.4	*	1	0910	276	302.
143.3	5.5																
1	0232	77	165.	77.9	4.1	*	1	0953	177	790.	235.1	7.4	*	1	0912	277	301.
142.5	5.5																
1	0234	78	185.	87.6	4.3	*	1	0954	178	788.	234.7	7.3	*	1	0914	278	299.
141.7	5.5																
1	0236	79	205.	97.0	4.5	*	1	0956	179	786.	234.3	7.3	*	1	0916	279	297.
141.0	5.5																
1	0238	80	225.	106.4	4.7	*	1	0958	180	783.	234.0	7.3	*	1	0918	280	296.
140.2	5.5																
1	0240	81	244.	115.6	4.9	*	1	0600	181	781.	233.6	7.3	*	1	0920	281	294.
139.4	5.4																
1	0242	82	262.	124.3	5.1	*	1	0602	182	778.	233.2	7.3	*	1	0922	282	292.
138.6	5.4																
1	0244	83	280.	132.7	5.3	*	1	0604	183	776.	232.8	7.3	*	1	0924	283	291.
137.8	5.4																
1	0246	84	296.	140.6	5.5	*	1	0606	184	773.	232.4	7.3	*	1	0926	284	289.
137.0	5.4																
1	0248	85	313.	147.8	5.6	*	1	0608	185	771.	232.1	7.3	*	1	0928	285	287.
136.1	5.4																
1	0250	86	328.	154.5	5.8	*	1	0610	186	768.	231.6	7.3	*	1	0930	286	286.
135.3	5.4																
1	0252	87	339.	160.9	5.9	*	1	0612	187	765.	231.2	7.3	*	1	0932	287	284.
134.4	5.3																
1	0254	88	355.	166.7	6.0	*	1	0614	188	762.	230.7	7.3	*	1	0934	288	283.
134.6	5.3																
1	0256	89	383.	171.2	6.1	*	1	0615	189	759.	230.3	7.3	*	1	0935	289	281.
133.7	5.3																
1	0258	90	421.	177.2	6.2	*	1	0618	190	755.	229.8	7.3	*	1	0938	290	279.
132.6	5.2																
1	0300	91	451.	181.8	6.4	*	1	0620	191	752.	228.9	7.2	*	1	0940	291	278.
131.7	5.1																
1	0301	92	474.	186.1	6.4	*	1	0622	192	747.	228.2	7.2	*	1	0942	292	276.
131.0	5.1																
1	0304	93	504.	190.2	6.5	*	1	0624	193	743.	227.9	7.2	*	1	0944	293	275.
130.1	5.2																
1	0306	94	529.	194.1	6.6	*	1	0626	194	741.	226.7	7.2	*	1	0946	294	273.
129.3	5.1																
1	0308	95	552.	197.8	6.6	*	1	0628	195	737.	225.9	7.2	*	1	0948	295	272.
128.8	5.1																
1	0310	96	576.	201.3	6.7	*	1	0630	196	734.	225.8	7.2	*	1	0950	296	270.
128.1	5.0																
1	0312	97	590.	204.4	6.8	*	1	0632	197	731.	224.1	7.1	*	1	0952	297	269.
127.3	5.0																
1	0314	98	615.	207.	6.9	*	1	0634	198	714.	223.1	7.1	*	1	0954	298	267.
126.5	5.0																
1	0316	99	654.	210.1	6.9	*	1	0636	199	709.	222.1	7.1	*	1	0956	299	266.
125.8	5.0																
1	0318	100	851.	211.1	6.9	*	1	0638	200	701.	221.1	7.1	*	1	0958	300	264.
125.1	5.0																

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YEAR FLOW	YEAR		MAXIMUM AVERAGE FLOW			
			1-DAY	24-HR	72-HR	7-DAY-MX
(CFS)	(MO)	(CFS)				
869.	4.5		158.	441.	441.	441.
		(INCHES)	.004	1.041	1.041	1.041

		(AC-FT)	216.	163.	163.	163.
PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	5.97-HR
(AC-FT)	(HR)					
246.	6.52		216.	150.	150.	150.
PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	5.97-HR
(FEET)	(HR)					
7.57	6.52		6.99	5.16	5.16	5.16

CUMULATIVE AREA = 5.41 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

TIME OF STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	WAY
					6 HOUR	24-HOUR	72-HOUR			
	HYDROGRAPH AT	A1	44.	2.17	12.	7.	7.	.38		
	HYDROGRAPH AT	A7	44.	2.17	6.	4.	4.	.53		
	HYDROGRAPH AT	01	153.	2.53	35.	21.	21.	.23		
	3 COMBINED AT	CP-01	229.	2.47	53.	32.	32.	.34		
	ROUTED TO	CP-A15	227.	2.63	54.	33.	33.	.34		
	HYDROGRAPH AT	A9	88.	2.27	10.	6.	6.	.06		
	ROUTED TO	CP-A10	85.	2.30	10.	6.	6.	.06		
	HYDROGRAPH AT	A10	117.	2.23	16.	10.	10.	.08		
	2 COMBINED AT	CP-A10	170.	2.27	66.	16.	16.	.13		
	ROUTED TO	CP-A25	170.	2.30	26.	16.	16.	.14		
	HYDROGRAPH AT	A15	124.	2.30	19.	11.	11.	.10		
	3 COMBINED AT	CP-A15	307.	2.33	98.	60.	60.	.53		
	ROUTED TO	CP-A20	306.	2.40	99.	60.	60.	.54		
	HYDROGRAPH AT	05	82.	2.30	14.	8.	8.	.10		
	ROUTED TO	CP-A20	81.	2.57	14.	8.	8.	.10		
	HYDROGRAPH AT	A20	231.	2.40	44.	27.	27.	.25		
	HYDROGRAPH AT	A25	12.	2.27	5.	2.	2.	.01		
	HYDROGRAPH AT	A27	34.	2.23	4.	2.	2.	.01		
	5 COMBINED AT	CP-A30	569.	2.50	165.	101.	101.	.89		
	ROUTED TO	CP-A30	567.	2.53	165.	101.	101.	.89		
	HYDROGRAPH AT	A31	79.	2.23	11.	7.	7.	.05		
	ROUTED TO	CP-A25	78.	2.27	11.	6.	6.	.05		
	2 COMBINED AT	CP-A25	644.	2.53	176.	107.	107.	1.02		
	ROUTED TO	CP-A30	644.	2.53	176.	107.	107.	1.02		
	HYDROGRAPH AT	D29	77.	2.50	17.	10.	10.	.11		
	HYDROGRAPH AT									

+		020	147.	2.57	58.	23.	22.	.36
+	ROUTED TO	CP-030	144.	2.47	55.	24.	23.	.36
+	HYDROGRAPH AT	030	65.	2.83	35.	9.	9.	.13
+	3 COMBINED AT	CP-030	279.	2.50	93.	41.	41.	.53
+	ROUTED TO	CP-040	276.	2.40	88.	41.	41.	.52
+	HYDROGRAPH AT	040	30.	2.33	16.	6.	6.	.08
+	2 COMBINED AT	CP-040	229.	2.57	84.	51.	51.	.61
+	ROUTED TO	CP-050	228.	2.60	84.	51.	51.	.61
+	HYDROGRAPH AT	057	575.	2.37	152.	82.	82.	.91
+	ROUTED TO	CP-060	573.	2.47	152.	82.	82.	.92
+	HYDROGRAPH AT	050	493.	2.40	92.	54.	54.	.62
+	3 COMBINED AT	CP-060	1181.	2.47	279.	166.	166.	1.68
+	ROUTED TO	CP-070	1180.	2.50	275.	165.	166.	1.69
+	HYDROGRAPH AT	070	68.	2.30	11.	7.	7.	.08
+	2 COMBINED AT	CP-070	1248.	2.50	286.	171.	171.	1.68
+	ROUTED TO	CP-075	1247.	2.50	287.	171.	171.	1.68
+	HYDROGRAPH AT	035	168.	2.27	24.	15.	15.	.12
+	HYDROGRAPH AT	060	99.	2.30	17.	10.	10.	.10
+	ROUTED TO	CP-035	94.	2.25	17.	10.	10.	.10
+	3 COMBINED AT	CP-035	1508.	2.50	327.	199.	198.	1.94
+	ROUTED TO	CP-A30	1507.	2.50	327.	196.	196.	1.94
+	HYDROGRAPH AT	A30	78.	2.27	12.	7.	7.	.07
+	3 COMBINED AT	CP-A30	2150.	2.50	514.	312.	312.	3.04
+	ROUTED TO	CP-A31	2145.	2.50	514.	312.	312.	3.04
+	HYDROGRAPH AT	A26	34.	2.23	6.	3.	3.	.02
+	ROUTED TO	CP-A31	33.	2.27	6.	3.	3.	.02
+	HYDROGRAPH AT	A31	71.	2.27	10.	6.	6.	.05
+	3 COMBINED AT	CP-A31	2156.	2.50	529.	321.	321.	3.11
+	ROUTED TO	CP-C1A	2154.	2.57	527.	324.	320.	3.11
+	HYDROGRAPH AT	B30	9.	2.20	1.	1.	1.	.01
+	HYDROGRAPH AT	B29	7.	2.20	1.	1.	1.	.01
+	2 COMBINED AT	C12	16.	2.20	2.	1.	1.	.01
+	HYDROGRAPH AT	C2	8.	2.33	1.	1.	1.	.01
+	HYDROGRAPH AT	E10	8.	2.20	0.	0.	0.	.01

2 COMBINED AT	CD1	9.	2.37	2.	1.	1.	.01
ROUTED TO	Z3	9.	2.46	1.	1.	1.	.01
HYDROGRAPH AT	B46	157.	2.20	17.	10.	10.	.09
HYDROGRAPH AT	3041	64.	2.47	15.	10.	10.	.09
HYDROGRAPH AT	B50	104.	2.20	14.	8.	8.	.08
2 COMBINED AT	C45	133.	2.20	29.	18.	18.	.17
HYDROGRAPH AT	CP4	161.	2.23	35.	22.	22.	.20
2 COMBINED AT	CCP4	283.	2.30	92.	52.	52.	.36
HYDROGRAPH AT	CP3	202.	2.27	58.	36.	36.	.34
2 COMBINED AT	CCP3	394.	2.43	69.	37.	37.	.35
HYDROGRAPH AT	MX1	42.	2.20	6.	3.	3.	.03
HYDROGRAPH AT	MX2	95.	2.20	13.	8.	8.	.08
2 COMBINED AT	MX12	137.	2.20	18.	11.	11.	.11
ROUTED TO	MX123	134.	2.20	18.	11.	11.	.11
HYDROGRAPH AT	MX3	22.	2.20	3.	2.	2.	.02
2 COMBINED AT	CP3A	158.	2.20	21.	13.	13.	.13
ROUTED TO	RCP3	156.	2.20	21.	13.	13.	.13
3 COMBINED AT	CCP3	455.	2.23	81.	50.	50.	.48
ROUTED TO	RCP3	454.	2.23	81.	50.	50.	.48
HYDROGRAPH AT	BP2	12.	2.50	6.	4.	4.	.05
2 COMBINED AT	CCP2	468.	2.23	87.	54.	54.	.53
HYDROGRAPH AT	JUNC	41.	2.47	9.	5.	5.	.06
HYDROGRAPH AT	BB	7.	2.37	1.	1.	1.	.01
HYDROGRAPH AT	NP	10.	2.47	2.	1.	1.	.02
HYDROGRAPH AT	NOVE	7.	2.40	1.	1.	1.	.01
5 COMBINED AT	CP1	501.	2.22	149.	92.	92.	.83
HYDROGRAPH AT	J1	679.	2.33	211.	68.	68.	.52
3 COMBINED AT	CP-J1	1116.	2.32	316.	192.	192.	1.26
2 COMBINED AT	CP-J10	1955.	2.53	736.	452.	452.	4.26
ROUTED TO	CP-J10	1955.	2.53	736.	452.	452.	4.26
HYDROGRAPH AT	A61	45.	2.23	9.	5.	5.	.05
ROUTED TO	CP-A61	44.	2.30	9.	5.	5.	.05
HYDROGRAPH AT	A52	461.	2.33	75.	48.	48.	.46
ROUTED TO	CP-A52	462.	2.37	77.	48.	48.	.48

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HYDROGRAPH AT A50	387.	2.33	46.	28.	28.	.25
3 COMBINED AT CP-A50	771.	2.33	151.	99.	99.	.76
DIVERSION TO A53	156.	2.33	8.	2.	2.	.76
HYDROGRAPH AT A54	615.	2.33	127.	77.	77.	.74
HYDROGRAPH AT A42	46.	2.23	6.	4.	4.	.93
2 COMBINED AT CP-A50	658.	2.27	133.	82.	80.	.80
ROUTED TO CP-A49	653.	2.40	113.	80.	80.	.89
HYDROGRAPH AT A40	45.	2.23	6.	4.	4.	.93
ROUTED TO CP-A40	44.	2.63	6.	4.	4.	.93
HYDROGRAPH AT A35	32.	2.27	15.	9.	9.	.86
ROUTED TO CP-A40	30.	2.63	13.	8.	8.	.88
HYDROGRAPH AT A46	154.	2.10	28.	14.	14.	.52
4 COMBINED AT CP-A46	919.	2.40	174.	106.	104.	1.02
DIVERSION TO A45	855.	2.37	138.	78.	76.	1.02
HYDROGRAPH AT A49	68.	2.37	50.	31.	31.	1.02
ROUTED TO CP-B10	68.	2.60	50.	30.	30.	1.02
HYDROGRAPH AT B10	271.	2.47	54.	32.	32.	.26
2 COMBINED AT CP-B10	1219.	2.53	819.	535.	515.	5.54
ROUTED TO CP-B10	1217.	2.60	816.	534.	514.	5.54
HYDROGRAPH AT B65	74.	2.23	10.	6.	6.	.05
ROUTED TO CP-B25	74.	2.53	10.	6.	6.	.05
HYDROGRAPH AT B25	38.	2.47	8.	5.	5.	.08
2 COMBINED AT CP-B25	111.	2.53	19.	11.	11.	.14
ROUTED TO CP-B20	108.	2.57	19.	11.	11.	.14
HYDROGRAPH AT B20	64.	2.43	14.	9.	8.	.14
2 COMBINED AT CP-B20	165.	2.57	32.	20.	20.	.27
ROUTED TO CP-B10	162.	2.73	32.	20.	20.	.27
HYDROGRAPH AT B16	187.	2.27	24.	15.	15.	.13
ROUTED TO CP-B10	183.	2.37	24.	15.	15.	.13
HYDROGRAPH AT B20	54.	2.23	7.	4.	4.	.06
ROUTED TO CP-B25	52.	2.30	7.	4.	4.	.06
HYDROGRAPH AT B35	182.	2.27	22.	14.	14.	.11
3 COMBINED AT CP-B25	212.	2.27	30.	19.	18.	.17
ROUTED TO						

Mt Airy 460 6 24 72 Area

	CP-830	300	2.43	76.	18.	18.	.47
HYDROGRAPH AT	815	100	2.27	25.	6.	6.	.09
ROUTED TO	CP-830	101	2.76	79.	8.	8.	.01
HYDROGRAPH AT	830	99	2.80	28.	27.	27.	.21
+ COMBINED AT	CP-830	1473.	2.69	961.	599.	551.	6.41
ROUTED TO	DR-310	855.	4.21	658.	441.	441.	6.41

7.87

SUMMARY OF KINEMATIC WAVE HUDDINGTON-CONDE ROUTING

6.78 mi 2

APPENDIX G-2

Review of Otay Mesa Drainage Studies

TETRA TECH

Review of Otay Mesa Drainage Studies

Contract H084445

Task Order No. 16

think BLUE SM
SAN DIEGO

Review of Otay Mesa Drainage Studies

Contract H084445

Task Order No. 16

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I. Introduction

Otay Mesa is a community located within the City of San Diego. Originally developed as an industrial area in 1985 in response to the creation of a U.S./Mexico border crossing, Otay Mesa now includes residential areas, an airport, and more than 1200 companies which sell and ship directly to Mexico or utilize the labor pool that commutes from Tijuana. Current development projects in the area include a major transportation project, State Route 905, to improve traffic in the region, with completion anticipated by 2013. With this, continued industrial and residential growth is anticipated. See Figure 1 for a map of Otay Mesa's location.

Figure 1. Location of Otay Mesa

Prior to development, the region was primarily an agricultural community. Effects of increased development were identified soon after it began. Because most of the Mesa drains south towards Mexico, concern arose over increased stormwater runoff crossing the border. In 1987, the City Council approved a contract to prepare the Otay Mesa Master Drainage Plan and published a Notice to "All Private Engineers" that established drainage requirements for development in Otay Mesa. The Notice required no increase in the rate of stormwater runoff from the property after development than it was before development, by the construction of stormwater detention basins on-site. The Notice also

indicated the plans of the City's Engineer Office, Flood Control Section, to prepare a plan for a main north–south channel from Otay Mesa Road to the Mexican border. The *Otay Mesa Drainage Master Plan- Preliminary Channel Design* was published in January 1988, and was updated in August 1999 (*Otay Mesa Drainage Study*), May 2005 (*Otay Mesa Community Plan Update*), and April 2007 (*Drainage Study for the Otay Mesa Community Plan Update*.)

Most existing drainage facilities were constructed as part of private development. These facilities are discontinuous because of the nature of individual development projects, which creates difficulties for subsequent developers that need to connect to private drainage facilities. Most development has occurred in the East Watershed of the Mesa, where most existing drainage facilities are located. These facilities consist of a system of storm drains, improved channels, and detention basins. Many of the detention basins discharge to natural drainages, which do not have adequate hydraulic capacity. Flooding therefore occurs occasionally in the area.

Because of continuing development in the area, recommendations and guidance provided in the previous drainage reports quickly become outdated. This document provides a review of the previous reports and summarizes report recommendations. Current land use and drainage patterns, as well as regulations regarding stormwater are also reviewed to provide up-to-date considerations and recommendations for the placement of storm water management facilities and to shed light on potential restoration projects that may be required to mitigate impacts to sensitive areas (e.g., vernal pools).

II. Review of Completed and Draft Planning and Engineering Reports

A. Introduction

The purpose of this report is to provide a summary of the engineering reports to gain a better understanding on the motivation behind the reports and to highlight considerations that may require additional thought weighed if progress were to be made in implementing the projects contained within the engineering reports.

B. Review of Pertinent Notices and Planning Reports

The following sections are a summary of four engineering reports for the Otay Mesa that were supplied to Tetra Tech by the City of San Diego.

August 7, 1987. Notice to All Private Engineers

The notice required all property in Otay Mesa that is within the watershed that drains to Mexico to be developed with the following requirements:

- Each property owner shall provide stormwater detention facilities so that there will be no increase in the rate of runoff due to development of the property.
- The detention facility shall be designed so that the rate of runoff from the property will be no greater after development than it was before development for a 5-year, 10-year, 25-year, and 50-year storm.
- All drainage facilities crossing four-lane major or higher classification streets shall be designed for a Q100 (existing). Other facilities, except the major channel described below, may be designed for Q50 (existing).

- The Drainage Design Manual shall be used as guidelines for design of drainage facilities, and computing design discharges.
- The City's Engineer Office, Flood Control Section, is preparing a preliminary plan for the main north-south channel from Otay Mesa Road near La Media to the Mexican border. The preliminary design will include the design Q (Q100 existing), the invert grade and the water surface elevation at the major road crossings.

January 1988. Otay Mesa Drainage Master Plan – Preliminary Channel Design

This document provided the initial preliminary design for the main channel indicated in the Notice, above.

Introduction: To prevent flooding problems, the City has required individual developments to regulated runoff from their property. The Mesa is zoned for industrial and commercial use. To allow for the planning and development of the area, an area-wide drainage collection and conveyance system is needed to serve the many individual properties. The report presented a preliminary channel design for a main channel to give Otay Mesa developers a basis for the design of the individual property storm drains.

Hydrologic Analyses: The hydrologic analysis was conducted using the US Army Corp of Engineers (US ACE) HEC-1 flood hydrograph computer model. The watershed was divided into 53 subareas, and the design storm was a 100-year, 6-hour event. The precipitation for the design event was estimated for the 53 subareas from the NOAA isopluvial map for San Diego. Other inputs for the program included the percent of impervious area in the subarea, the Soil Conservation Service (SCS) curve number, which was estimated from SCS soil maps and existing land uses, and the basin lag time. The HEC-1 model calculated peak discharges at 5 flow concentration points along the proposed channel route.

Hydraulic Analyses: The hydraulic analysis was conducted using the US ACE HEC-2 water surface profile computer program. The design discharges for various segments of the channel were those calculated using the HEC-1 model. A minimum of 1 foot of free board was assumed, and the top of road, top of bank, and channel invert elevations needed to develop cross-sectional input data was determined from maps, surveying notes, and road grading plans for the area. Other input parameters for the HEC-2 program were estimated, using the guidelines in the HEC-2 user's manual and independent hydraulic calculations, and included the Manning's "n" roughness coefficient and flow expansion and contraction coefficients. The analysis also assumed that there would be reinforced concrete box culverts placed at the road crossings and that the design would include a spreading basin at the terminus of the proposed channel. The purpose of the proposed spreading basin in the design was to reduce flow velocities, to spread flows such that the discharge to Mexico would occur in approximately the same area, to provide area for potential wetland mitigation, and to lessen the adverse aesthetic of a concrete channel. The results of the hydraulic analysis provided the optimal design of the main channel. The channel was designed as a concrete trapezoidal channel with a 2:1 slope.

Conclusions: The proposed channel would start at the south end of reinforced box concrete culverts under Otay Mesa Road just east of La Media Road, and then end with the spreading basin prior to discharge to Mexico. The proposed channel is approximately 7,570 feet (ft) long, with a width of 56 –

150 ft. The final 515 ft length of the channel would encompass the spreading basin, which would be approximately 600 ft wide. The spreading basin would be planted with natural riparian vegetation and would have a low-flow channel connecting the upstream concrete channel to the existing channel in Mexico.

August 9, 1999. Otay Mesa Drainage Study

This document provided an update to the 1988 Master Plan and identified a project that was compatible with new development plans for Otay Mesa and considered environmental constraints and alternative analyses.

Introduction: The goal of the document was to provide a primary drainage channel from Otay Mesa Road to the border with Mexico to accommodate runoff from existing and future development. Since the 1988 study, new channels, roads, development and detention basins had been constructed. The original project predicted construction of the channel described by 2005. The funding for the project was proposed to be collected from fees collected at the Final Map/ Building Permit approval for new developments.

Hydrologic Analysis: The new hydrologic analysis using the United States Army Corps of Engineers (US ACE) Hydraulic Engineering Center – HEC-1 model reflected runoff expected with new developments. The US ACE HEC-1 model was used, and the SCS method of analysis was used to estimate the rainfall on subareas with the study area. Guidance from the San Diego County Hydrology manual was used in providing required input for the program. The analysis derived subareas and flow concentration points based on existing drainage facilities, and where available, improvement plans for proposed facilities. If no improvement plan was available, the hydrologic criteria and drainage paths were based on assumptions of further development from master plans for the Mesa. The analysis included the proposed SR 905 and SR 125 freeways, and the proposed San Diego Air Commerce Center.

Hydraulic Analysis: Water surface profiles for the proposed channel were generated using the US ACE Hydraulic Engineering Center – River Analysis System (HECRAS), Version 1.2, a US ACE computer program. The HECRAS program determined steady state flow conditions based on user supplied cross section geometry and flow rates.

The slope of the proposed channel would be controlled by the gradual slope of the Mesa, the existing drainage facility located under Otay Mesa Road, and the channel elevation at the border. To convey the 100-year flood flow, the proposed channel would have to be very wide. A rectangular channel was recommended, as the rectangular shape carries the most flow per unit of area. The proposed rectangular channel would have a width of 40 ft across the inside bottom, plus wall width and channel access, such that the total width would be 55 ft. Any channel narrower and deeper than that proposed would possibly affect the ability of adjacent properties to properly drain. Existing sewer lines also constrained the depth of the proposed channel.

Environmental Constraints

Hydrologic: The future design of the Otay Mesa Master Drainage Plan would need to include future projects, including SR 905, SR 125, the Otay Mesa Road future realignment, and the Brown Field Airport. The project must meet the purpose and interest of the San Diego Environmentally Sensitive

Lands Ordinance. The channel design must also consider the effects of other planned projects in the vicinity and the concerns of the International Boundary and Water Commission (IBWC) regarding stormwater runoff rates. Permit requirements for the project would also likely include the use of soft bottom for the channel and incorporation of natural vegetation as much as possible, and demonstration that the project minimizes impacts to regional wildlife habitat.

Biological Resources: The Empire Center Mitigation Site, constructed in 1997 as part of a City, State and federal permitting action for an earlier project, included 5 acres of land in an area north of Airway Road and west of La Media Road and included over 12 created and naturally occurring vernal pools and habitat for San Diego button celery, a federally listed species. At least 14 vernal pools, encompassing approximately 25,756 ft^2, are located outside of the mitigation area. A patch of freshwater marsh was identified in the vernal pool restoration area. Mitigation at a probable ratio of 2:1 would be required to ameliorate any impacts to vernal pools and the freshwater marsh. Indirect effects to wetlands through changes in drainage patterns that could significantly affect their functionality would also possibly require mitigation.

Recommended actions for the Master Drainage Plan in reference to biological resources constraints included:

- Avoiding impacts to the Empire Centre Mitigation Site;
- Accurately mapping vernal pools with a survey crew in the spring;
- Avoiding impact to the vernal pools or concurrently mitigating impacts to the pools outside of the project site;
- Avoiding impacts to federally listed and narrow endemic plant species (i.e., San Diego celery-button, Otay tarplant, and variegated dudleya;
- Avoiding impacts to the San Diego Multi-Habitat Planning Area (MHPA);
- Including plans in the Master Drainage Plan to maintain low flow drainage patterns to avoid indirect effects on wetland habitats;
- Conduct surveys for burrowing owl burrows prior to development and impacts should be avoided or mitigated;
- Conduct protocol surveys for other potential federally listed species on the site;
- Mitigation of nonnative grassland at a ratio of 0.5:1.

Cultural Resources: Completion of a literature review and record searches at San Diego University and the San Diego Museum of Man was recommended for previously conducted archeological surveys.

Alternative Analyses

The objective of the alternatives analysis was to identify an alignment for the drainage channel that will efficiently convey the flows from an existing rectangular concrete box culvert under Otay Mesa Road to the U.S.-Mexico Border while minimizing impacts on environmentally sensitive areas and adjacent properties. The preferred alternative placed the channel along the east side of La Media to a box culvert crossing from the northeast corner to the northwest corner of the intersection of La Media with Siempre Viva Road. The channel continued along the north side of Siempre Viva from the box culvert outlet at La Media to a box culvert crossing to the south side of Siempre Viva to connect to the existing stream channel. This alternative was chosen as the preferred alternative because an existing drainage ditch is on the east side of La Media Road; the channel would intercept flows from

the east without potential conflicts from utilities in La Media Road; and flows from the west would continue to flow in the old drainage path. Additionally, the alternative minimizes impact on properties by following the property line and minimizes potential utilities conflicts in Siempre Viva Road by crossing under it through a box culvert at the existing stream location.

Possible funding mechanisms identified for funding the project included general obligation bonds, Mello-Roos Community Facilities Districts tax, special assessment bonds, and certificates of participation.

May 2005. Drainage Study for Otay Mesa Community Plan Update

The report was prepared as an appendix to the Otay Mesa Community Plan update EIR to provide a summary of existing drainage facilities and to provide alternatives for draining the Mesa. Most existing drainage facilities are located within East Watershed. The system existing at the time of the report was a combination of storm drains, improved channels, and detention basins, which discharge in many areas to natural drainage paths that do not have adequate hydraulic capacity. As many of the projects have been developed, portions of the properties have been dedicated to the city as drainage easements or flood water storage easements. These were presumably recorded as easements, however, this part of the Study was not verified.

Hydrologic Analysis: The Otay Mesa Drainage Study area included all of the Mesa area within the City of San Diego, divided into 5 watersheds (West Perimeter, West, North Perimeter, East, and Border Crossing), excluding the far northwest arm of the Mesa which had been fully developed. Most of Otay Mesa slopes from north to south with flow entering Mexico at several points. The perimeter of the Mesa drains into the adjacent canyons. The watershed boundaries on the Mesa are not well defined because the Mesa is flat, with stormwater run-off mostly sheet-flowing across the Mesa. Previous drainage study reports (1988, 1999) prepared hydrologic analyses for the East watershed. In the current report, new hydrologic models were developed using the HEC-1 model for the East watershed, since that was the hydrologic model previously used in analysis of the watershed. For the other main watersheds, West Perimeter and West, the AES-developed standard City of San Diego Modified Rational Method was used. The hydrologic analyses calculated that the total flow from these watersheds at the concentration point at the border for the 100-year flow was 5,793 cubic feet per second (cfs). The Spring Canyon open space in the West Watershed was calculated to contribute an additional 257 cfs.

Hydraulic Analysis: The HEC-RAS model was used to size the 100-year floodplain of Otay Mesa Creek based on current conditions. The model was also used to size the proposed new channel to contain the 100-year flow which would reduce or eliminate flooding impacts to nearby facilities. An existing channel that is tributary to the proposed main channel and located just upstream of the Siempre Viva Road Crossing is approximately 15 ft wide and 4 ft deep, with a hydraulic capacity of approximately 120 cfs. The 100-year flow in this channel however would be 1116 cfs. A new channel proposed for this tributary by this report is sized 50 ft wide with 1.5:1 side slopes to convey the 100 year flow. The cost estimate proposed by this report does not include this tributary channel.

Proposed Drainage Facilities: Caltrans had completed their plans for the SR-905 project. For proposed private development, the only Master Planned facility which would need to be constructed prior to

continued development is the Main Channel and the Detention Basin in the East Watershed. The Main Channel proposed by this report would have a bottom width of 240 ft at the Detention Basin to 200 ft from just north of Siempre Viva Road to the intersection of Airway Road and La Media Road. The side slopes would be 4:1 to 10:1 and heavy riparian vegetation would be allowed to grow in the channel. Hiking trails and access roads with a width of 12 feet would line each bank of the channel. At the Airway Road and La Media intersection, a 35 ft wide concrete channel would connect the channel with the proposed Caltrans culverts which would be constructed concurrently with SR 905.

The proposed Detention Basin was designed to attenuate peak flows from 5 year to 100 year storms, with dimensions of approximately 1700 ft by 1500 ft. The basin would encompass 58 acres with a maximum storage depth of 6.0 ft and a maximum storage volume of 308 acre-ft. The basin would be graded and vegetated to appear natural and to create a low flow stream. The basin and channel would require removal of 915,000 cubic yards of soil. It was assumed this soil would be used on adjacent properties to raise building pad grades.

A preliminary cost estimate was $23,868,000 to complete the proposed project.

Recommended Drainage Design Criteria: The current study estimated that approximately 140 cfs will flow off of Otay Mesa into the West Perimeter Watershed. Detention basins were recommended for this watershed to reduce peak flows to predevelopment levels. Because of unstable soils in the area, placement of these detention basins and relocation of drainage facilities should be planned carefully to avoid an increase in soil instability and slope failure.

The West Watershed consists of smaller mesa-top watersheds that drain into the tributary canyons of Spring Canyon, which then flow into Mexico via the Spring Canyon concentration point. Detention basins were recommended in this watershed to reduce post-development peak flows to predevelopment levels. Care must be taken if detention basins concentrate flows at the upper edge of canyons so that erosion potential is not increased downstream.

Requirements have already been implemented in the East Watershed for control of peak runoff from development. The August 7, 1987 Notice provided requirements for individual developments to regulate stormwater such that runoff from developed properties did not increase above the runoff rate prior to development. The proposed single Detention Basin at the border would eliminate the need for individual on-site detention basins for subsequent development.

In the North Perimeter watershed, there were no identified peak flow attenuation requirements for the small watersheds that flow into small canyons that flow into the Otay River.

Stormwater Quality Requirements: The City requires Best Management Practices (BMPs) be constructed for all new projects. In 2003, the City published “Storm Water Standards – A Manual for Construction & Permanent Storm Water Best Management Practices Requirements”, a reference document for all stormwater issues encountered in development. Most projects on Otay Mesa will require Priority Project Permanent Storm Water BMPs and High Priority Construction Storm Water BMPs. The manual requires the submission of a “Water Quality Technical Report” for all projects subject to priority permanent BMP requirements.

Most of Otay Mesa drains to the south across the U.S./Mexico border to the Tijuana River, which has been identified as an impaired water body pursuant to section 303(d) of the Clean Water Act. A small portion of the drainage flows north into the Otay River and the far western part of the Mesa flows to the west through San Ysidiro and then into the Tijuana River.

April 2007. Drainage Study for the Otay Mesa Community Plan Update

The 2007 report was identical to the 2005 report, except for the addition of a section regarding the proposed drainage alternatives. This additional section is summarized below.

No Project Alternative: The alternative of doing nothing to improve drainage along the main creek channel would prevent future development from taking place along portions of La Media Road. The intersection of Airway Road and La Media Road floods during significant precipitation. The existing creek would not be deep enough to allow adjacent properties to drain effectively. To provide continued access along the truck route during storms the roads would need to be raised to allow flow to pass under them, or an alternative route would need to be identified.

Concrete Channel: The 1999 Otay Mesa Drainage Study identified a concrete channel as a recommended plan from Otay Mesa Road to the Border Detention Basin. The concrete channel would follow the east side of La Media Road until intersecting at Siempre Viva Road, where it crossed under La Media and followed on the north side of Siempre Viva to box culverts under Siempre Viva that connected to the Border Detention Basin. The concrete channel plan assumed that the existing creek with its habitat would continue to carry low flows. The 1999 cost for this project was $10.6 million dollars, without including land acquisition costs, which corresponds to a 2005 cost of $14.9 million.

La Media Channel and Border Detention Basin: The East Watershed is the largest watershed on the Mesa. All flows from the watershed collect at a concentration point at a large culvert where flows cross the U.S./Mexico border. The surrounding area is very flat and adjacent properties cannot drain effectively into the existing creek. To allow for future development, and to accommodate runoff from proposed future projects, a new channel would be required that has an invert of 3 to 5 feet below that of the existing creek channel. The proposed La Media Channel and Border Detention Basin would be built as described in the 2005 report.

C. Impetus of Drainage Studies

Tetra Tech was asked to provide as much detail as possible into the funding and motivation behind the drainage studies completed for Otay Mesa. It is well understood that the first report in 1988 was intended to provide drainage opportunities in the developing Otay Mesa area. The 1999, 2005, and 2007 reports all indicate the need for drainage planning in the rapidly developing Mesa area but also point to the need for water quality considerations and regulations, as well. Meeting regulatory requirements for flood and drainage control (1988) as well as water quality and environmental considerations (1999, 2005, and 2007) seem to be the initial motivation behind the reports.

The drainage reports provided little insight into the funding mechanisms supporting these studies. There were suggestions in several of the studies for funding mechanisms to implement the recommendations

within the studies including general obligation bonds, Mello-Roos Community Facilities Districts tax, special assessment bonds, and certificates of participation. Based on the direction of recommendations, the development community might have initiated the request for drainage control and improved drainage within the public right of way to accommodate drainage from developing areas. However, it is also quite possible that the motivation was also a part of a plan to design the public portion of the drainage system to fully accommodate a built out Otay Mesa that would provide the necessary public safety and flood control needs that a future fully developed scenario might require.

III. Data Compilation and Review

Plans and data including GIS data relevant to Otay Mesa study have been compiled for this report. Relevant drainage requirements and existing drainage plans for Otay Mesa area are summarized in the previous section. Using GIS data, drainage areas for the project site were defined and relevant spatial analyses have been conducted for each drainage area. Potential areas for restoring or improving vernal pools were identified using soil suitability, land uses, and site availability.

A. Data Compilation

The following data were compiled for this Otay Mesa study. Most of the data were downloaded from two websites, SanGIS (http://files.sangis.org/) and SANDAG (http://www.sandag.org/). Vernal pools data were supplied directly from the City.

- Otay Mesa community boundary (SanGIS)
- Zoning (SanGIS)
- Land use (SANDAG)
- Soils (SanGIS)
- Topography: 20-m DEM and 2-ft contours (SanGIS)
- Streams (SanGIS)
- Roads / Streets (SanGIS)
- Parcel boundaries (SanGIS)
- Watershed / Subwatershed boundaries (SanGIS)
- Vegetation (SanGIS)
- Existing vernal pools (City)

B. Drainage Areas

From the existing watershed/subwatershed data, three drainage areas were found in the Otay Mesa study area, which are Otay Valley, San Ysidro, and Water Tanks. Otay Valley covers north of Otay Mesa around the Otay River, San Ysidro covers west, and Water Tanks covers south of Otay Mesa. Otay Valley and Water Tanks were sub-divided into east and west areas respectively. As a result, the Otay Mesa area was divided into five drainages as shown in Figure 2. The sizes of drainage areas are presented in Table 1.

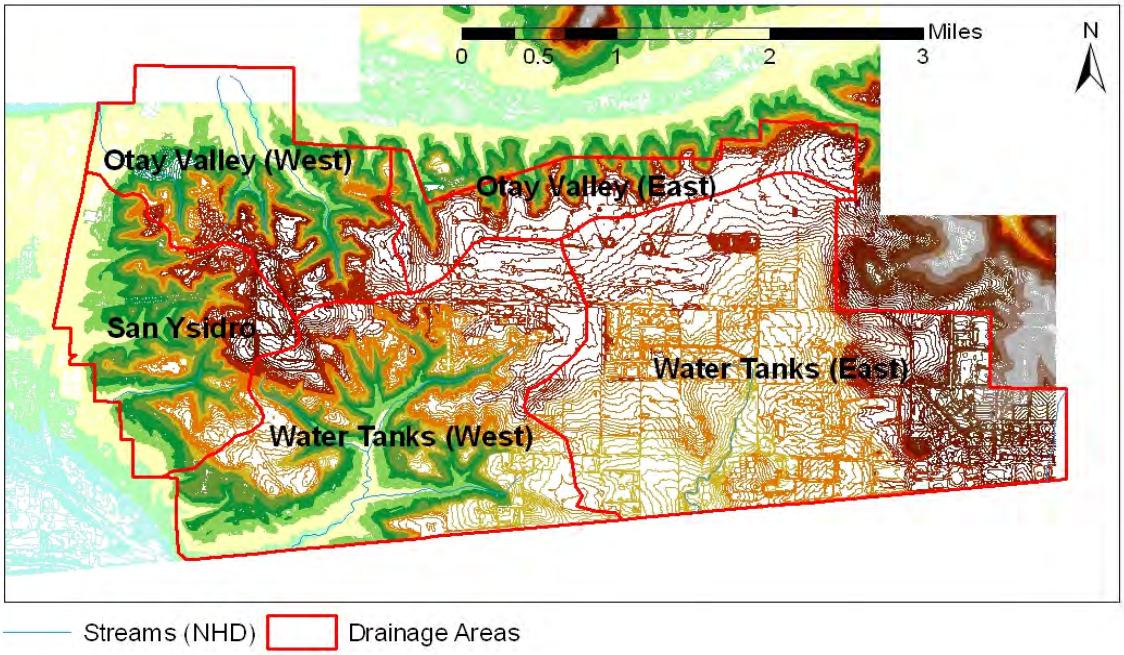

Figure 2. Defined Drainage Areas

Table 1. Drainage Area Sizes

Drainage Areas	Acres
Otay Valley (East)	827.5
Otay Valley (West)	1,378.4
San Ysidro	1,226.1
Water Tanks (East)	3,380.2
Water Tanks (West)	2,488.0
Total	9,300.2

C. Zoning Status

Existing zoning for the Otay Mesa is presented in Figure 3. Otay Mesa zoning consists of Industrial (41.2%), Agricultural (25.4%), Residential (12.2%), Commercial (4.8%), Open Space (0.2%), Other (4.8%), and Unzoned (11.4%) areas. The individual drainage area of each zone and total area is summarized in Table 2.

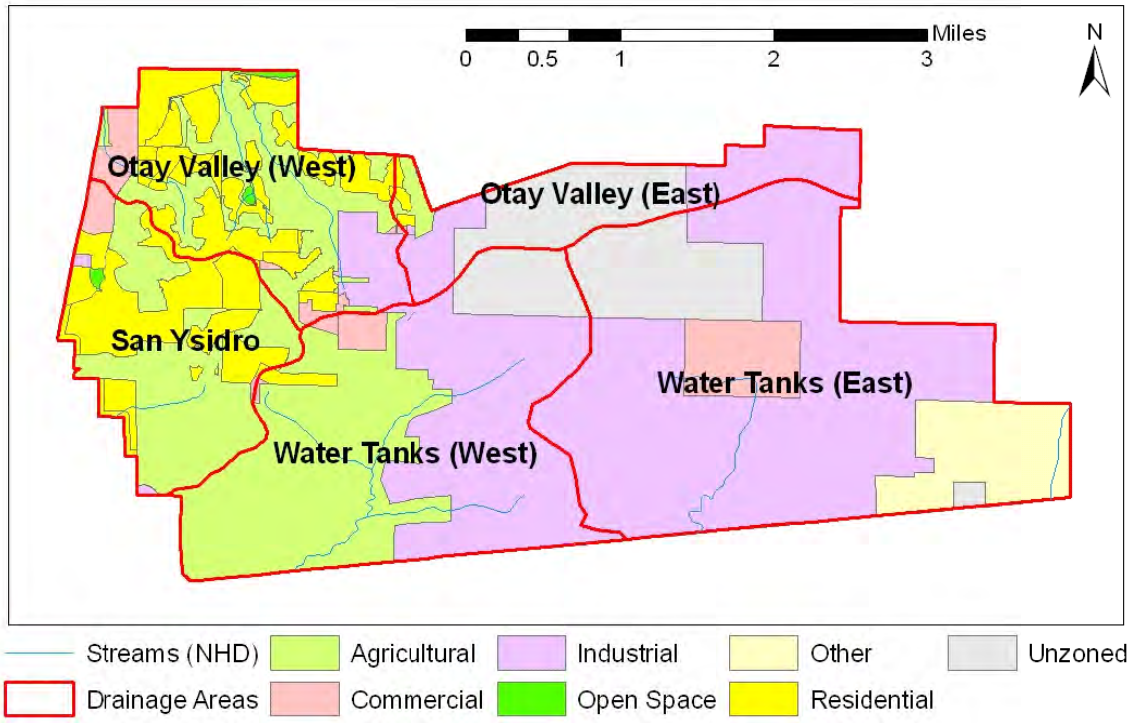

Figure 3. Zoning Status

Table 2. Zoning Status for Drainage Areas

Zoning	Drainage Areas					
	Otay Valley (East)	Otay Valley (West)	San Ysidro	Water Tanks (East)	Water Tanks (West)	Total
Agricultural	46.3	543.2	643.0	0.0	1,127.3	2,359.8
Commercial	0.7	100.2	43.2	241.5	61.5	447.0
Industrial	378.4	149.3	10.6	2,227.9	1,062.6	3,828.7
Open Space	0.0	15.1	5.9	0.0	0.0	21.0
Other	0.0	0.0	0.0	445.3	0.0	445.3
Residential	18.8	570.7	523.3	0.0	25.8	1,138.6
Unzoned	383.3	0.0	0.0	465.7	210.8	1,059.8
Total	827.5	1,378.4	1,226.1	3,380.3	2,488.0	9,300.2

D. Land Uses

Land use status for Otay Mesa is presented in Figure 4 using the 2009 SANDAG land use data set. The detailed land use status for each drainage area is summarized in Table 3. The Otay Mesa land uses consist of Open Space (28.8%), Undeveloped (25.4%), Transportation (21.5%), Industrial (12.1%), Residential (5.6%), Agricultural (3.3%), Commercial (2.1%), Education (1.0%), and Park (0.1%). Land use status appears quite different from the Otay Mesa zoning status. This might be because some areas within a particular zone are not fully developed or because the land use data have more detailed spatial descriptions, which consider topography that can impact land use, than the zoning data.

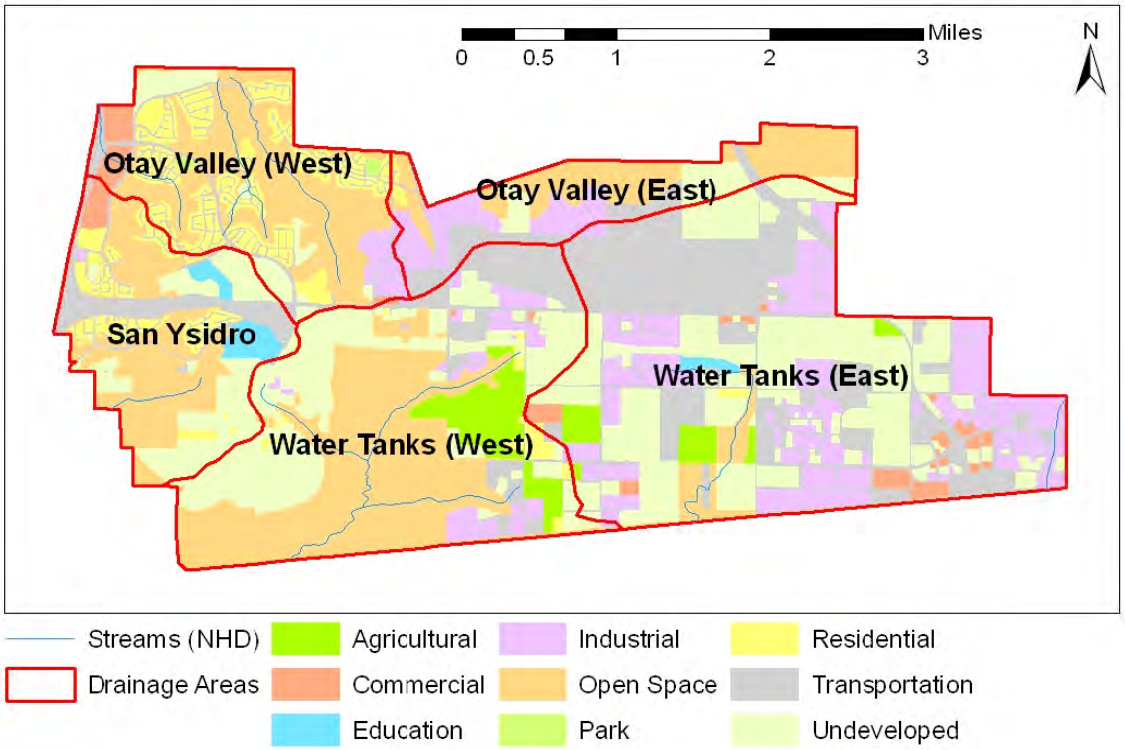

Figure 4. Land Uses

Table 3. Land uses for Drainage Areas

Land Use	Drainage Areas					
	Otay Valley (East)	Otay Valley (West)	San Ysidro	Water Tanks (East)	Water Tanks (West)	Total
Agricultural	0.0	0.0	0.0	101.6	204.3	305.9
Commercial	0.0	60.7	30.6	101.3	5.4	197.9
Education	0.0	0.0	70.1	17.6	0.7	88.4
Industrial	181.6	59.8	2.9	740.5	137.6	1,122.6
Open Space	377.3	629.0	461.2	133.1	1,081.3	2,681.9
Park	0.0	12.9	0.0	0.0	0.0	12.9
Residential	10.7	316.8	136.0	9.9	49.7	523.1
Transportation	146.5	190.0	227.0	1,148.0	290.1	2,001.7
Undeveloped	111.4	109.2	298.1	1,128.2	719.0	2,366.0
Total	827.5	1,378.4	1,226.1	3,380.2	2,488.0	9,300.2

E. Soils

Soil properties for the Otay Mesa are presented in Figure 5. Soil coverage for each drainage area is summarized in Table 4. Otay Mesa is covered mainly by loam (81.2%) and clay (18.0%) type soils.

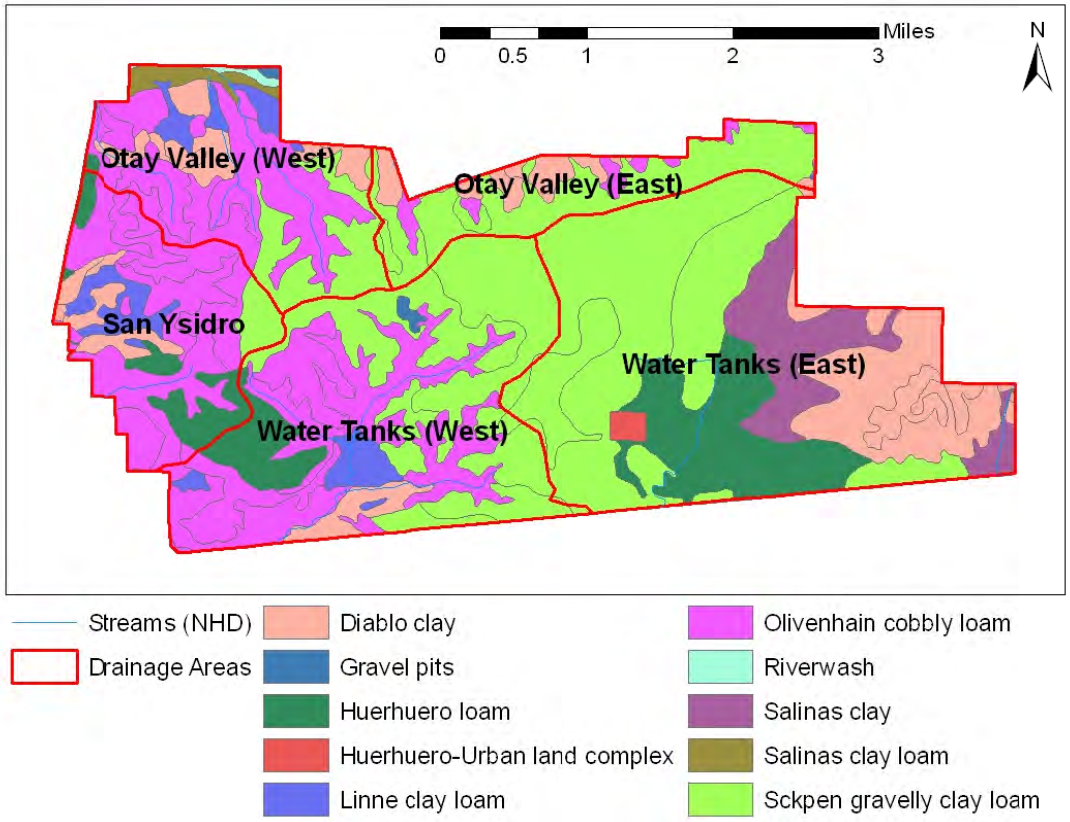

Figure 5. Soils

Table 4. Soils for Drainage Areas

Soils	Drainage Areas					
	Otay Valley (East)	Otay Valley (West)	San Ysidro	Water Tanks (East)	Water Tanks (West)	Total
Diablo clay	149.8	196.0	121.3	635.1	98.0	1,200.1
Gravel pits	0.0	8.6	0.0	0.0	15.7	24.3
Huerhuero loam	0.0	6.9	174.7	606.4	182.4	970.4
Huerhuero-Urban land complex	0.0	0.0	0.0	31.4	0.0	31.4
Linne clay loam	1.5	93.2	111.1	0.0	105.9	311.7
Olivenhain cobbly loam	83.0	714.0	742.3	0.0	989.7	2,529.1
Riverwash	0.0	17.8	0.0	0.0	0.0	17.8
Salinas clay	0.0	0.0	0.0	474.1	0.0	474.1
Salinas clay loam	0.0	71.3	0.0	0.0	0.0	71.3
Stockpen gravelly clay loam	593.1	270.7	76.7	1,633.2	1,096.2	3,670.1
Total	827.5	1,378.4	1,226.1	3,380.2	2,488.0	9,300.2

F. Vegetation

Vegetation coverage for Otay Mesa is presented in Figure 6. The size of vegetation coverage for each drainage area is summarized in Table 5. Otay Mesa vegetation consists mostly of non-native vegetation or developed/unvegetated areas (70.6%), scrub and chaparral (18.9%), grasslands and meadows (10.2%), and other areas (0.4%).

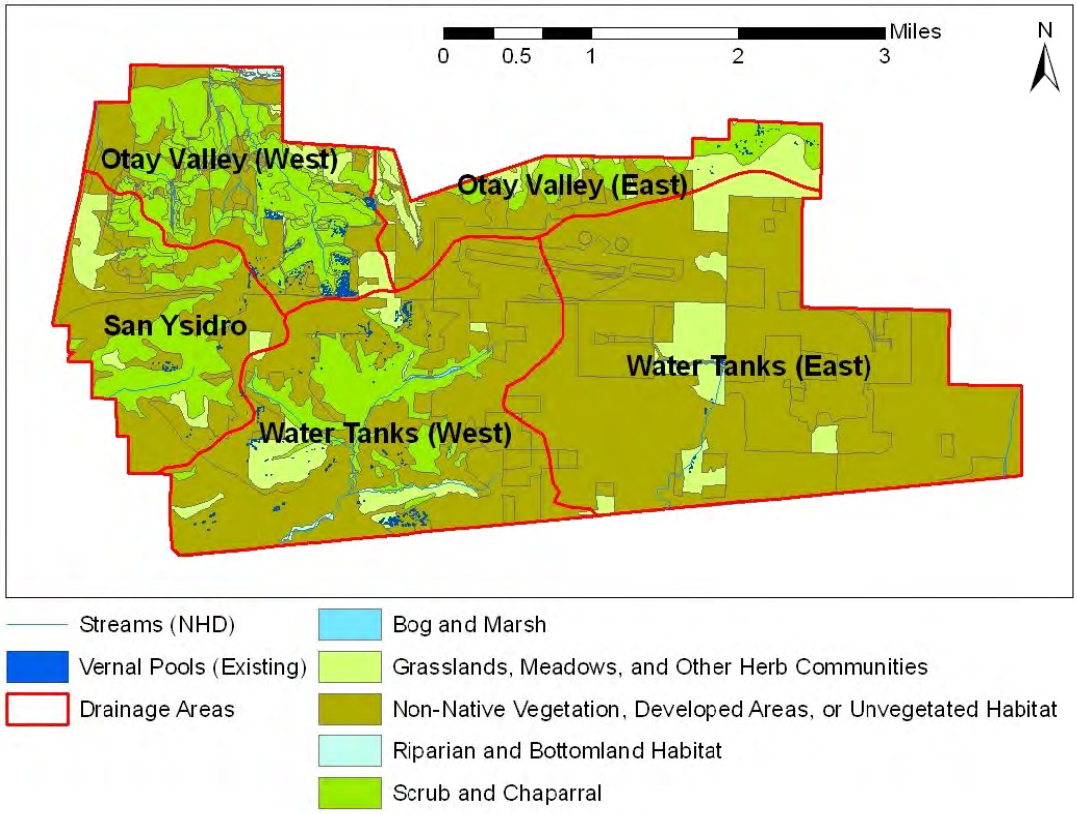

Figure 6. Vegetation of Otay Mesa

Table 5. Vegetation Coverage for Drainage Areas

Vegetation	Drainage Areas					
	Otay Valley (East)	Otay Valley (West)	San Ysidro	Water Tanks (East)	Water Tanks (West)	Total
Bog and Marsh	0.0	0.8	0.0	0.0	4.0	4.8
Grasslands, Meadows, and Other Herb Communities	205.1	88.6	112.0	341.0	201.8	948.5
Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	394.2	528.9	720.2	3,039.2	1,883.4	6,565.9
Riparian and Bottomland Habitat	0.0	17.6	0.2	0.0	8.6	26.4
Scrub and Chaparral	228.2	742.5	393.7	0.0	390.2	1,754.7
Total	827.5	1,378.4	1,226.1	3,380.2	2,488.0	9,300.2

IV. Environmentally Sensitive Lands

A. Vernal Pool Background

Vernal pools are unique seasonal and ephemeral wetlands that result from specific depression-type geomorphic regions. (City of San Diego Vernal Pool Inventory, 2004) Vernal pools form when small, shallow depressions collect precipitation, and by nature are dry basins in the dry months followed by variable lengths of saturation and inundation. [Draft City of San Diego Multiple Species Conservation Program (MSCP) Vernal Pool Management Plan, 2008] The variability in moisture conditions separates these pools from other wetland ecosystems, which is a characteristic of the Mediterranean –type climate that exists in southern California.

Within the City of San Diego, groups or series of vernal pools are found in Del Mar Mesa, Mire Mesa, Carmel Mountain, Kearny Mesa, Mission Trails Regional Park, Otay Mesa, Otay Lakes, and Marron Valley. The pools are often associated with small hills known as Mima mounds, and form in the inter-mound swales. The vernal pools located in these areas have been found to be associated with the particular soil types in these areas. (Bauder and McMillan, 1998) In Otay Mesa, Stockpen, a gravelly clay, is the dominant type of pool-supporting soil, as identified from the county's 1973 Soil Survey maps, with the type of vernal pools associated with this soil called Coastal Mesa pools. Coastal mesa pools are found almost exclusively on the mesas but sustain different flora and fauna depending on the dominant soil series.

Vernal pools support a specific biological ecosystem. Research has found that 47 plant species from 20 families are restricted to vernal pool habitat. (Draft San Diego MSCP Vernal Pool Management Plan, 2008) Vernal pool habitat also supports animals from insect larvae to amphibians, birds, and mammals. San Diego vernal pools provide habitat for two federally listed endangered invertebrates, San Diego and Riverside fairy shrimp; five federally listed endangered plants, spreading navarretia, San Diego and Otay mesa mint, San Diego button celery, and California Orcutt grass; and an unprotected, although rare, plant, little mousetail. *Pogogyne nudiuscula* is a mesa mint species endemic to the coastal mesa pool type of Otay Mesa.

Ecological processes that occur within vernal pools are complex, and not fully understood. Local processes are affected by the relatively short period of wet conditions and relatively small affected area (Leidy and White, 1998). The ecology of the vernal pool is also influenced by larger-scale effects of the watershed including landscape processes of stormwater run-off and native and invasive vegetation. Vernal pools and their associated wetland functions may be indirectly impacted by changes in the watershed, especially changes in hydrologic conditions which need to be considered when development or other landscape changes occur.

B. Otay Mesa Vernal Pools

Within Otay Mesa, the number and quality of vernal pools has been impacted historically by farming and grazing, and more recently, by rapid development in the area. Vernal pool surveys in the San Diego area have been conducted since the late 1970s. In 1988, the California Department of Parks and Recreation estimated that approximately 905 of the Otay Mesa vernal pools had been lost to urban development, agriculture and mining (Leidy and White, 1998). The most recent survey was conducted by the City of San Diego in 2002 – 2003 (City of San Diego Vernal Pool Inventory 2002 – 2003, 2004). This survey identified 29 series, or clusters, of vernal pool basins within the Otay Mesa area, and a total of 983

basins. The survey also identified a total of 12.89 acres of pools that were under creation, enhancement or restoration activities.

The Draft San Diego MSCP Vernal Pool Management Plan identified several factors that should be considered in management and preservation of vernal pools, with urban development identified as the primary threat to these ecosystems. Border Patrol activities along the U.S./Mexico border have caused impacts to Otay Mesa vernal pools because of foot traffic of illegal immigrants and Border Patrol agents. Recreational off-road vehicle users, illegal dumping and littering have also lead to vernal pool impacts. Disturbance and fragmentation of native habitat have resulted in vernal pool ecosystem impacts.

Recommendations for management of vernal pool resources have been implemented at the City and federal level. The 2008 draft San Diego MSCP Vernal Pool Management Plan includes site-specific management requirements and general recommendations for multiple vernal pool complex locations in Otay Mesa. These recommendations include conservation, enhancement or restoration of degraded basins through government implementation, project mitigation requirements, and/or interested non-governmental organizations. The document also recommended research on vernal pool plant genetics, native pollination and dispersal mechanisms to better understanding of vernal pool functions. Also, public education efforts are recommended to increase awareness of vernal pools. The City prioritized the following recommendations:

1. Conservation of land comprising the vernal pool site(s) through government or private land trust acquisition, dedication in fee title, conservation easement, or covenant of easement.
2. Adequate protection of conserved vernal pools from illegal and inadvertent impacts by fencing the site, placing signs, and providing education and/or law enforcement patrol of the sites.
3. Enhancement or restoration of vernal pools to reinstate historic ecosystem functions and values.
4. Solicit and fund, if possible, research on vernal pool ecosystems.

The recommendations provided by the Vernal Pool Management Plan may be enforceable by regulatory agencies through permit conditions, approved mitigation, monitoring and reporting programs, a Biological Opinion resulting from a Section 7 consultation with the U.S. Fish and Wildlife Service (FWS), and development agreement(s).

The U.S. FWS first provided a vernal pool recovery plan for southern California in 1998, and again in 2005. The more recent plan addressed 33 species of plants and animals that occur exclusively or primarily within a vernal pool ecosystem in California, with the ultimate goal of achieving and protecting self-sustaining populations of each species, through stabilizing and protecting populations to prevent further decline. (U.S. FWS, 2005) The key elements included in the plan for achieving these goals were habitat protection; adaptive management, restoration and monitoring; status surveys; and research.

U.S. EPA has also provided recommendations for vernal pool compensation and conservation (Leidy and White, 1998). In light of the complex system of processes that occur within vernal pool ecosystems, and the relationship of these niches to the larger watershed, U.S. EPA recommended using an ecosystem approach in assessing vernal pool compensation. The ecosystem approach would base compensation on preservation of vernal pool complexes within *an ecosystem* rather than the current approach of creating or restoring isolated pools. A hydrogeomorphic approach to assessing wetland function was

recommended to provide the most efficient method to determine mitigation requirements for impacted vernal pools (Leidy and White, 1998).

V. Review of Stormwater Regulations

A. Federal Regulations and Permits

CWA Section 404 Permits

Most projects conducted in or adjacent to streams or wetlands will require a U.S. Army Corp of Engineers (US ACE) Clean Water Act (CWA) Section 404 Permit. A Section 404 Permit is required if materials, including dirt, rocks, geotextiles, concrete, or culverts, are moved or placed into or within US ACE jurisdictional areas. Permit coverage may be granted if the following are performed: (1) actions are taken to avoid wetland impacts, (2) potential impacts are minimized, and (3) compensation for any unavoidable impacts is provided.

Proposed activities are regulated through a permit review process. An individual permit is required for potentially significant impacts. Individual permits are reviewed by the US ACE and evaluated under a public interest review, as well as the environmental criteria set forth in the CWA Section 404(b)(1) Guidelines. However, for most discharges that will have only minimal adverse effects, a general permit may be suitable. The Section 404 general permit process is more streamlined than the individual permit process due to the elimination of the individual review, provided that the general or specific conditions for general permit coverage are met. General permits are issued on a nationwide, state, or regional basis for particular categories of activities.

- Regional General Permits (RGPs) are issued for common maintenance-type activities with minimal impact to the environment and often include pre-approval from the RWQCB Section 401 Certification and/or from the U.S. Fish and Wildlife Service (FWS) and NOAA Fisheries Service for Endangered Species Act consultations. Permit coverage takes approximately one to six months for existing activity categories or six months to one year for new and unique activity categories.
- Nationwide Permits (NWPs) are written for categories of projects that occur nationwide, such as road crossings, bank stabilization, repairs to existing structures, flood control maintenance, and wetland restoration for wildlife habitat. Permit coverage takes from three to nine months.
- An Individual Permit (IP) may be required if over one-half acre of permanent impacts may occur. Public review is required for an IP, which lengthens the amount of time between permit application and permit coverage (six months to a year under the best circumstances, but can be multiple years).

The 404 Permit process should begin with a consultation with US ACE. Prior to application for a Section 404 Permit, a wetland delineation and estimation of US ACE jurisdictional area should be performed. RWQCB 401 Water Quality Certification must also be obtained when applying for a NWP or IP. After any pre-application steps are completed, the US ACE “Application for Department of the Army Permit” should be prepared and submitted.

The US ACE Section 404 permit also requires that a Section 106 Review be conducted as part of the permit application. Section 106 is a document review of the project site for historical significance. Based on the results, additional studies may be required, such as an additional Historical/Archaeological Report or mitigation to protect the historical significance of the site. The review search and approval duration varies on the project scope.

Endangered Species Act

Impacts to endangered or threatened species are regulated under both the California Endangered Species Act (CESA) administered by CA Department of Fish and Game (DFG) and the federal Endangered Species Act (ESA) administered by US Fish and Wildlife Service (FWS). Species that are protected under these laws are designated on the state and federal endangered and threatened species lists. The term "take" is used to describe the impact to a species. Under Section 2081 of the DFG code, a development project that coincides with the occurrence of a listed species must have an incidental take permit. To obtain this permit, the applicant must meet the following criteria (California Department of Fish and Game, 2009):

1. The authorized take is incidental to an otherwise lawful activity
2. The impacts of the authorized take are minimized and fully mitigated
3. The measures required to minimize and fully mitigate the impacts of the authorized take are roughly proportional in extent to the impact of the taking on the species, maintain the applicant's objectives to the greatest extent possible, and are capable of successful implementation.
4. Adequate funding is provided to implement the required minimization and mitigation measures and to monitor compliance with and the effectiveness of the measures
5. Issuance of the permit will not jeopardize the continued existence of a State-listed species.

A mitigation plan is attached to a permit that outlines how these criteria will be met. Measures for meeting the criteria vary and may include avoidance measures or acquisition and transfer of habitat management lands (including funds for protecting and maintaining land in perpetuity). Applicants must avoid all take for "fully protected" species and "specified birds" as defined in Fish and Game Code Sections 3505, 3511, 4700, 5050, 5515, and 5517 (http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=fgc&codebody=&hits=20). All take of bird species protected under the Migratory Bird Treaty Act must also be avoided, as stated in Section 3515 of the DFG code.

An applicant determines whether an incidental take permit and a Habitat Conservation Plan (HCP) are required by contacting the nearest DFG. The potential need for a permit can be assessed by using the DFG's online mapping resources. If a listed species is present on the property and the project will result in a take of that species, then a permit is required. Permit processing is likely to take between 3 and 12 months or longer depending on the project circumstances and whether a federal permit is required.

To meet federal ESA requirements for a take of federally listed species, an incidental take permit (http://www.dfg.ca.gov/habcon/cesa/incidental/CodeRegT14_783.pdf) must also be obtained by developing a HCP that outlines plans to offset impacts to the species listed as threatened or endangered (http://www.fws.gov/Endangered/wildlife.html). HCP must meet the following criteria:

1. Taking will be incidental
2. The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of the taking
3. The applicant will ensure that adequate funding for the plan will be provided
4. Taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild
5. Other measures, as required by the Secretary, will be met.

Mitigation measures for ESA, like measures for CESA, vary by the project and may include the following:

- Payment into an established conservation fund or bank
- Preservation (via acquisition or conservation easement) of existing habitat
- Enhancement or restoration of degraded or a former habitat
- Establishment of buffer areas around existing habitats
- Modifications of land use practices and restrictions on access.

An applicant determines whether an incidental take permit and HCP are required by contacting the nearest DFG or FWS office. If a listed species is present on the property and the project will result in a take of that species, then a permit is required.

Under ESA, an incidental take permit is not required for plant species. However, if a permit is required for other endangered or threatened species and an HCP must be prepared, then the HCP must analyze the effects of the action on any endangered or threatened plant species. Accordingly, if a plant is on the California threatened or endangered list, then a permit must be obtained through DFG.

The timeline for federal incidental permit processing varies by project complexity and whether FWS must require National Environmental Policy Act (NEPA) documentation. Minor, or "Low Effect," HCPs do not require FWS to prepare NEPA documentation, and the target processing time for these HCPs is three months. HCPs that require an Environmental Assessment (EA) under NEPA have a target processing time of four to six months, and for HCPs requiring an Environmental Impact Statement (EIS), processing may take up to 12 months or longer (U.S. Fish and Wildlife Service, 2005).

A Section 7 Consultation may also be required under the ESA if the project has a "federal nexus," usually in the form of another federal permit or federal funding, at some stage of the project and with any federal agency. The type of consultation will be either informal or formal, depending on whether the project affects listed or protected species. If the project has a federal nexus, it will also require NEPA documentation, which is described under the federal requirements section of this report.

Data on endangered and threatened species observations are available from the California Natural Diversity Database, which is developed by the Biogeographic Data Branch of DFG, and these data estimate the approximate spatial range of the species.

B. State Regulations and Permits

California Endangered Species Act (CESA)

CESA states that all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation, will be protected or preserved (California Department of Fish and Game, no date). Sections 2081(b) and (c) of CESA allow the California DFG to issue an incidental take permit for a State listed threatened and endangered species only if specific criteria are met. These criteria are as follows:

- The authorized take is incidental to an otherwise lawful activity;
- The impacts of the authorized take are minimized and fully mitigated;
- The measures required to minimize and fully mitigate the impacts of the authorized take are roughly proportional in extent to the impact of the taking on the species, maintain the applicant's objectives to the greatest extent possible, and are capable of successful implementation;
- Adequate funding is provided to implement the required minimization and mitigation measures and to monitor compliance with and the effectiveness of the measures; and
- Issuance of the permit will not jeopardize the continued existence of a State-listed species.

Measures to minimize the take of species covered by the permit and to mitigate the impacts caused by the take will be set forth in one or more attachments to the permit. Incidental Take Permit Applications include the following (California Department of Fish and Game, 2008):

1. Applicant's full name, mailing address, and telephone number(s).
2. The common and scientific names of the species to be covered by the permit and the species' status under CESA, including whether the species is the subject of rules and guidelines pursuant to Section 2112 and Section 2114 of the Fish and Game Code.
3. A complete description of the project or activity for which the permit is sought.
4. The location where the project or activity is to occur or to be conducted.
5. An analysis of whether and to what extent the project or activity for which the permit is sought could result in the taking of species to be covered by the permit.
6. An analysis of the impacts of the proposed taking on the species.
7. An analysis of whether issuance of the Incidental Take Permit would jeopardize the continued existence of a species. This analysis includes consideration of the species' capability to survive and reproduce, and any adverse impacts of the taking on those abilities in light of (a) known population trends; (b) known threats to the species; and (c) reasonably foreseeable impacts on the species from other related projects and activities.
8. Proposed measures to minimize and fully mitigate the impacts of the proposed taking.
9. A proposed plan to monitor compliance with the minimization and mitigation measures and the effectiveness of the measures.
10. A description of the funding source and the level of funding available for implementation of the minimization and mitigation measures.
11. Certification of accuracy.

California Environmental Quality Act (CEQA)

CEQA requires environmental impact assessment and mitigation for non-exempt projects occurring within the State of California. As unique ecosystems associated with endangered and threatened species, vernal pools are considered rare biological resources in CEQA review. CEQA applies to projects proposed to be undertaken or requiring approval by State and local government agencies. The lead agency is responsible for completing an environmental review process defined by CEQA. The review process includes

1. Determining if the activity is a project subject to CEQA,
2. Determining if the project is exempt from CEQA, and
3. Performing an Initial Study to identify the environmental impacts of the project and determine whether the identified impacts are "significant." Based on the findings of significance, one of the following documents must be prepared:

    - Negative Declaration if the review finds no "significant" impacts;
    - Mitigated Negative Declaration if the review finds "significant" impacts but the project can be altered to avoid or mitigate those significant impacts;
    - Environmental Impact Report (EIR) if the review finds "significant" impacts.

Some projects may be determined to be exempt from CEQA by law because the project may fall under a category of projects that have already been determined to generally not have significant environmental impacts. Examples include resource and environmental protection actions by regulatory agencies, wildlife habitat acquisition, habitat restoration on five acres of less, maintenance activities, or emergencies. Retrofits to existing structures may be considered an exception. Articles 18 (http://ceres.ca.gov/ceqa/guidelines/art18.html) and Article 19 (http://ceres.ca.gov/ceqa/guidelines/art19.html) of the Act contain details on exemptions and exceptions to CEQA.

This project may require consideration of cultural resources as part of CEQA documentation. The purpose of a cultural resources study is to identify significant impacts and potentially significant impacts of a proposed project to cultural resources, and to provide mitigation measures to reduce impacts to a level less than significant.

401 Certification

Under CWA Section 401, every applicant for a federal permit or license for any activity which may result in a discharge to a water body must obtain State Water Quality Certification (401 Certification) to ensure the proposed activity will comply with state water quality standards. In general, a 401 Certification is required for all projects in which a US ACE CWA Section 404 Permit (described above) is obtained or that will discharge dredged or fill material to waters of the U.S., including removing vegetation or channel materials for flood control, constructing levees, and filling wetlands. If the Regional Water Quality Control Board (RWQCB) deems a project exempt from the provisions of Section 401, it may regulate the dredge and fill activity under State authority in the form of Waste Discharge Requirements or Certification of Waste Discharge Requirements.

To initiate the 401 Certification process, a Biological Assessment is typically performed in which any potential impact to waters of the U.S., adjacent wetlands, and receiving waters is determined. Coordination between the City and the RWQCB is recommended before the application is submitted. A *Section 401 Water Quality Certification Application Form* should then be prepared and submitted to the RWQCB. On average, the 401 Certification application process takes three to four months to complete from the time of application to the time of approval.

C. Local Regulations and Permits

Post-Construction Stormwater Management

For typical development projects, the City requires project proponents to use a checklist to determine whether standard stormwater requirements (low impact development and source controls) or priority stormwater requirements (for development that meets certain size or land use thresholds or that might impact sensitive areas) are applicable. The Stormwater Standards Manual describes the steps that then need to be taken (i.e., Best Management Practices, or BMPs) to meet the applicable requirements. These stormwater requirements are not likely to apply to a drainage project.

Project proponents are required to submit Urban Stormwater Mitigation Plans consistent with the region's Standard Urban Stormwater Mitigation Plan (http://www.sdcounty.ca.gov/dpw/watersheds/susmp/susmp.html) to meet the following objectives:

- Reduce Priority Development Project discharges of pollutants from the MS4 to the maximum extent practicable
- Prevent Priority Development Project runoff discharges from the MS4 from causing or contributing to a violation of water quality standards
- Manage increases in runoff discharge rates and durations from Priority Development Projects that are likely to cause increased erosion of stream beds and banks, silt pollutant generation, or other impacts to beneficial uses and stream habitat due to increased erosive force.

Some areas within Otay Mesa could be considered a Priority Development Project Areas if they were to discharge runoff from any development or redevelopment directly into or directly adjacent to receiving waters within an Environmentally Sensitive Area (ESA; includes vernal pools). Other conditions that would trigger the application of a priority development project area include either the creation of 2,500 square feet of impervious surface on a proposed project site or an increase in the area of imperviousness of a proposed project site to 10 percent or more of its naturally occurring condition (San Diego Regional Water Board Order R9-2007-0001 (Section D.1.d.(2)(g)). Within these definitions, "directly adjacent" is defined as project sites situated within 200 feet of the ESA. "Discharging directly to" is defined as outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.

Provision D.1.g of San Diego Regional Water Board Order R9-2007-0001 requires the San Diego Stormwater Copermittees to implement a Hydromodification Management Plan (HMP) "…to manage increases in runoff discharge rates and durations from all Priority Development Projects, where such increased rates and durations are likely to cause increased erosion of channel beds and banks, sediment pollutant generation, or other impacts to beneficial uses and stream habitat due to

increased erosive force." To comply with this requirement, the San Diego Copermittees developed an HMP (http://www.projectcleanwater.org/pdf/susmp/hmp_final_12-29-09_clean.pdf, December 29, 2009), which is subject to Regional Water Quality Control Board approval. The HMP specifies that Priority Development Projects are required to implement hydromodification mitigation measures so that post-project runoff flow rates and durations do not exceed pre-project flow rates and durations where such increases would result in an increased potential for erosion or significant impacts to beneficial uses. Hydromodification mitigation can be provided as follows:

- Demonstrate no post-project increase in impervious area and resultant peak flow rates as compared to pre-project conditions
- Installation of LID BMPs, such as bioretention facilities, to control runoff flows and durations from new impervious areas
- Mitigation of flow and durations through implementation of extended detention flow duration control basins
- Preparation of continuous simulation hydrologic models and comparison of the pre-project and mitigated post-project runoff peaks and durations (with hydromodification flow controls) until compliance is achieved
- Implementation of in-stream rehabilitation controls to demonstrate that projected increases in runoff peaks and/or durations would not accelerate erosion to the rehabilitated receiving stream reach.

Chapter 6 of the HMP Guidance provides guidance on applicability, hydromodification mitigation criteria and implementation options, and a framework for in-stream rehabilitation options.

Construction Stormwater Management

In California, discharges from construction sites one acre or larger are regulated under the State-wide General Permit for Waste Discharge Requirements for Discharges of Storm Water Associated with Construction Activity (NPDES General Permit CAS000002) Water Quality Order 98-08-DWQ (General Permit). The General Permit requires a Storm Water Pollution Prevention Plan (SWPPP) that describes BMPs to prevent pollutant and sediment discharges from the construction site, as well as an inspection and monitoring program. A Notice of Intent (Attachment 2 of the General Permit) is to be submitted to the State Water Resources Control Board (SWRCB) along with a project site map and fee at least two weeks prior to construction initiation.

The SWPPP must remain onsite at all times and regular self-inspections must be performed to assess the effectiveness of the BMPs. Stormwater samples must be collected if there is reason to suspect that non-visible pollutants have come into contact with stormwater or the site discharges to a water body listed on the 2006 CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs. If permit coverage is not terminated within a year, an annual report must be completed and submitted to the LARWQCB. To terminate permit coverage, a Notice of Termination is to be completed and submitted to the SWRCB. The Construction Storm Water General Permit is currently under revision and is available online at: http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

Biological Resources

Multi-Species Conservation Program

The Multi-Species Conservation Program (MSCP) applies to the Otay Mesa area. The MSCP is designed to preserve native habitat for multiple species by identifying areas for directed development and areas to be conserved in perpetuity (referred to as Multi-Habitat Planning Area or MHPA) to achieve a workable balance between smart growth and species protection. The project area falls within portions of the City's MHPA and includes areas directly adjacent to the MHPA. These two categories have different requirements as follows:

- For **premises that are located within or adjacent the City's MHPA**, the project must demonstrate compliance with the MHPA land use adjacency guidelines (see the City's MSCP Subarea Plan, March 1997, http://www.sandiego.gov/planning/mscp/pdf/subarea.pdf) to address potential indirect effects to the MHPA through features incorporated into the project and/or permit conditions. The following issue areas are addressed:

    1. Drainage;
    2. Toxics;
    3. Lighting;
    4. Noise;
    5. Barriers;
    6. Invasive species;
    7. Brush management; and,
    8. Grading/land development.

- For **sites partially within the MHPA**, the allowable development area under the MSCP includes all the land outside the MHPA. If less than 25 percent is outside the MHPA, the project would be allowed the required area to achieve a 25 percent development area. In defining the 25 percent developable area, the least sensitive portion of the site must be used and would include avoidance/minimization of wetlands and MSCP narrow endemics.

The MHPA can be altered on a site to accommodate a project, subject to approval by the City and wildlife agencies in accordance with meeting the six MHPA boundary line adjustment functional criteria (see Section 5.4.2 of the Regional MSCP Plan, August 1998, http://www.co.san-diego.ca.us/dplu/mscp/docs/SCMSCP/FinalMSCPProgramPlan.pdf). These criteria include:

- Effects on significantly and sufficiently conserved habitats;
- Effects to covered species;
- Effects on habitat linkages and function of preserve areas;
- Effects on preserve configuration and management;
- Effects on ecotones of other conditions affecting species diversity; and
- Effects to species of concern not on the covered species list.

The analysis for any proposed MHPA adjustment should be included in the project biology report[1] (if required, see below), and include:

1. An exhibit clearly showing the proposed removal and addition areas with the proposed grading;
2. A table showing, by habitat type, area within the existing MHPA, area to be removed, area to be added, and the proposed net change to the preserve; and
3. A written analysis of how the proposed MHPA adjustment meets the six required functional equivalency criteria.

Environmentally Sensitive Lands (ESL) Regulations
The City oversees development that may impact listed species through the ESL Regulations (San Diego Municipal Code, Land Development Code, and Biology Guidelines, currently pending amendment). City public projects do not need a grading permit, however these projects will still be required to obtain all necessary City, State, and Federal permits prior to the preconstruction meeting or any clearing or grading of the project site.

Land Development Code Biology Guidelines (City of San Diego, 2001) lists *Eryngium aristulatum* var. *parishii* (Parish's eryngo, San Diego button celery), *Navarretia fossalis* (spreading navarretia, vernal pool pincushionplant), *Orcuttia californica* (California Orcutt grass), *Pogogyne abramsii* (San Diego mesa mint), and *P. nudiuscula* (Otay Mesa mint) as narrow endemic species. Narrow endemics are included in the definition of Environmentally Sensitive Lands, which requires a discretionary review of the project permit including biological surveys and species specific mitigation requirements. These species are associated with vernal pool habitats, which are found within the project area (see Section Vernal Pool Management Plan, below, for more information about vernal pool management).

A biological survey report is required for all proposed development projects that are subject to the ESL Regulations, and/or where CEQA review has determined that there may be a significant impact on other biological resources considered sensitive under CEQA. Table 6 summarizes survey requirements for various biological resources inside and outside the MHPA. Note that the proposed project site includes areas that are inside, adjacent to, and outside of the MHPA area.

The Biological Survey Report must identify all potential impacts from the development (both on-site impacts and off-site impacts such as roads, water and sewer lines) to sensitive biological resources and to other significant biological resources as determined by the CEQA process. The report should evaluate the significance of these impacts. Impact assessments need to include analysis of direct impacts (e.g. grading, Zone 1 brush management), indirect impacts (e.g. lighting, noise) and cumulative impacts. The City of San Diego (1994) Significance Determination Guidelines under the CEQA should be used as a reference.

The ESL regulations require that impacts to wetlands be avoided, and all unavoidable wetlands impacts (both temporary and permanent) will need to be analyzed and mitigated via wetland creation, restoration, enhancement, and/or acquisition. Acquisition and/or enhancement of existing wetlands

[1] Three full sets of the MHPA adjustment materials will be required for any proposed MHPA adjustment.

may be considered as partial mitigation only. The mitigation ratio for vernal pools ranges from 2:1 when no endangered species are present, up to 4:1 when endangered species with very limited distributions (e.g., *P. abramsii*) are present.

Table 6. Summary of biological survey requirements

Resource	Survey Requirements	
	Inside MHPA	Outside MHPA
Vegetation		
Uplands	Confirm/Revise MSCP mapping	Confirm/Revise MSCP mapping
Wetlands	Delineate wetlands per City definition	Delineate wetlands per City definition
Covered species[1]		
Listed species	Focused survey per protocol	Per MSCP conditions of coverage[2]
Narrow endemic	Focused survey per protocol	Focused survey per protocol
Other	Survey as necessary to comply with requirements as outlined in Section II.A.2 of Biology Guidelines	Per MSCP conditions of coverage[2]
Non-covered species		
Listed species	Focused survey per protocol	Focused survey per protocol
"Other sensitive species" [3]	Case-by-case determination depending on the species	Case-by-case determination depending on the species

1. Based upon the MSCP mapping, site specific surveys, the NDDB records, previous EIRs and biological surveys and/or discussion with the Wildlife Agencies, the potential for listed species, narrow endemic and CEQA sensitive species will be determined. Where there is a reasonable likelihood that one of these species exists, surveys will follow the above requirements.
2. Survey as necessary to conform with to Appendix A of the City of San Diego MSCP Subarea Plan (March 1997).
3. "Other Sensitive Species". Those other species that are not listed by federal and/or state agencies and/or not covered by the MSCP and to which any impacts may be considered significant under CEQA.

Vernal Pool Management Plan

To protect vernal pools, site-specific management recommendations were developed for ten Otay Mesa locations (http://www.sandiego.gov/planning/mscp/vpmp/index.shtml), two of which occur in the project area: "J28 East" and "J21." J 28 East is a 20-acre site located southwest of the intersection of La Media Road and Avenida de la Fuente with five mapped vernal pools that are located within the MHPA. J21 is a 49-acre site located southwest of Siempre Viva Road and La Media Road with seven vernal pools that are located outside of the MHPA. Both sites' vernal pools were identified by the adopted Recovery Plan for Vernal Pools of Southern California (USFWS, 1998) as necessary to stabilize populations of the following endangered and threatened species: *E. aristulatum*, *P. nudiuscula*, *N. fossalis*, *O. californica*, *B. sandiegonensis* and *S. woottoni*.

Both sites are subject to the same threats: development (both sites are privately owned and not conserved); invasive species (particularly grasses); trespass from foot traffic and off-road vehicles; litter, wind-blown debris, and illegal dumping; and fire and fire suppression activities. Both sites are recommended for conservation through public acquisition or private mitigation, and restoration or

enhancement of the vernal pools is appropriate given the high species diversity recorded historically at those sites. Restoration at J28 East should focus on creating stable populations of the aforementioned species, particularly on *E. aristulatum*, *M. minimus*, and *P. nudiuscula*, and restoration at J21 should focus particularly on *E. aristulatum*, *N. fossalis*, *O. californica*, and *P. nudiuscula*.

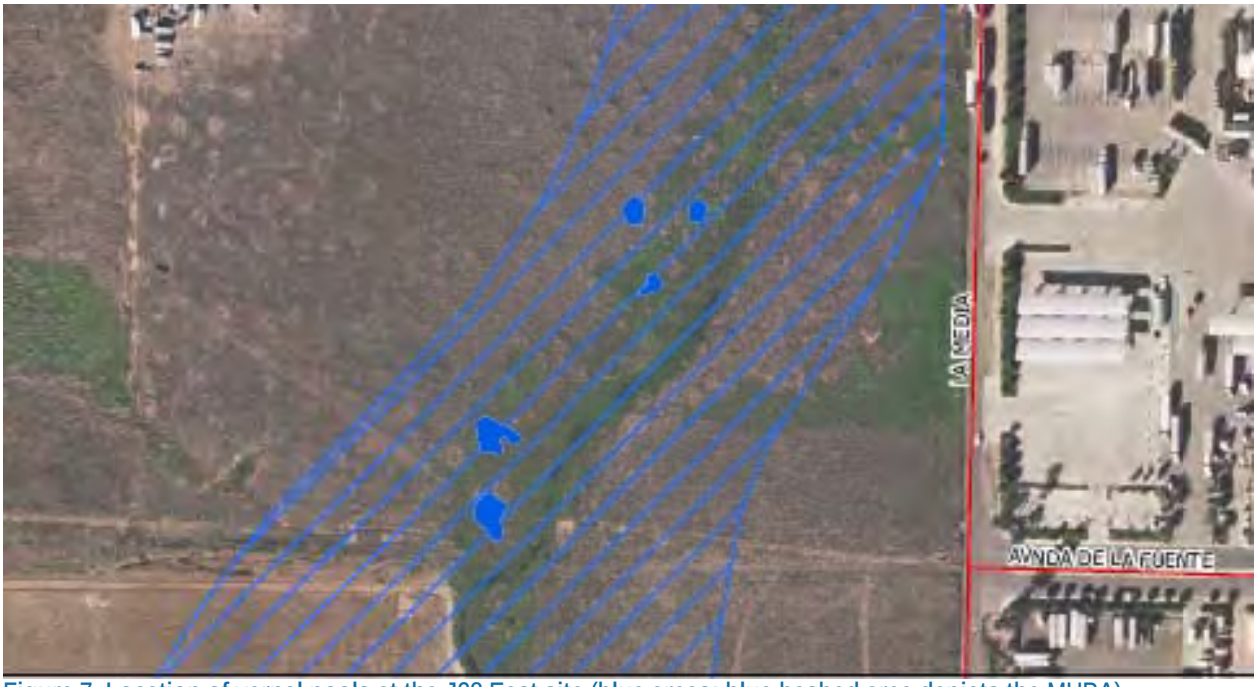

Figure 7. Location of vernal pools at the J28 East site (blue areas; blue hashed area depicts the MHPA).

Figure 8. Location of vernal pools at the J21 site (blue areas; blue hashed area depicts the MHPA).

Geologic Hazards

Unstable slopes, slide-prone geologic formations, faults and liquefaction-prone soils occur in many parts of the City. The relative risk of these geologic hazards has been mapped as part of the City of San Diego Seismic Safety Study (SSS) (City of San Diego Development Services, 2009). The maps indicate where potentially adverse geological conditions may exist, as defined by Geologic Hazard Category (http://www.sandiego.gov/development-services/hazards/hazardsmaps.shtml).

Evaluation of the SSS maps for the project area show the presence of Geologic Hazard Category 53, defined as level or sloping terrain with unfavorable geologic structure, which presents a low to moderate geologic risk.

The proposed project can be categorized as a minor public structure, which can be considered Building Type/Land Use Category IV, defined as "residential (single-family residences, apartments, etc.) and most commercial and *minor public structures*" (emphasis added). Group III, the next more stringent group, specifies places normally attracting large concentrations of people, and this project should not fall into that category.

Based on the presence of Geologic Hazard Category 53 and a Category IV project, a soil investigation and geologic investigation are anticipated. The City of San Diego (2008) *Guidelines for Geotechnical Reports* (http://www.sandiego.gov/development-services/industry/pdf/geoguidelines.pdf) describes these investigations in greater detail.

Grading

Not applicable; public works projects do not require a grading permit.

D. County Regulations and Permits

Because the areas in question are located within the City limits, county permits are not anticipated to be needed unless drainage or other infrastructure will connect to or otherwise affect county-owned infrastructure.

E. International Regulations and Permits

The International Boundary and Water Commission (IBWC) issues licenses and permits for activities in the IBWC right-of-way at the border or on IBWC maintained floodways. The *Criteria for Construction Activities within the Limits of USIBWAC Floodways* specifies that a license or permit is required for any proposed activities crossing or encroaching upon the floodplains of the IBWC flood control projects and right-of-way. This project does not affect the floodplains or right-of-way of any IBWC flood control project. Water quality considerations under IBWC jurisdiction focus on Texas rivers only and do not apply to the Otay Mesa area.

VI. Drainage Requirements, Considerations, and Opportunities

This report provides information primarily on the East and West Water Tanks drainage areas as these are the areas covered by the engineering reports. The West Watershed consists of smaller mesa-top watersheds that drain into the tributary canyons of Spring Canyon, which then flow into Mexico via the

Spring Canyon concentration point. While there is a need for some runoff management in these areas to reduce post-development peak flows to predevelopment levels, this area is of fairly low priority.

The engineering reports completed in the Otay Mesa area and summarized above focus primarily on the industrialized areas of the East Water Tanks drainage areas. This East Watershed is the largest watershed on the Mesa. All flows from the watershed collect at a concentration point at a large culvert where flows cross the U.S./Mexico border. The surrounding area is fairly flat and adjacent properties have difficulty draining effectively into the existing creek during larger storm events. The existing drainage is a combination of storm drains, improved channels, and detention basins, which discharge in many areas to natural drainage paths that do not have adequate hydraulic capacity. As projects have been developed in this area, portions of the private properties have been dedicated to the city as drainage easements or flood water storage easements (not verified as a part of this report).

Collectively, the engineering reports have recommended in one way or another that for this area to accommodate future development, the construction of a drainage channel along the east side of La Media crossing from the northeast corner to the northwest corner of the intersection of La Media with Siempre Viva Road would be required. The proposed channel would continue along the north side of Siempre Viva at La Media to the current culvert crossing along Siempre Viva to connect to the existing stream channel. This plan was selected because an existing drainage ditch located on the east side of La Media Road could be expanded to intercept flows from the east without creating potential conflicts from utilities in La Media Road; and flows from the west would continue to flow in the old drainage path. Additionally, this plan may reduce impacts to properties by following the property boundaries and could minimize potential utilities conflicts along Siempre Viva Road.

In this area, drainage alternatives should be given substantial thought by the City of San Diego. The next section presents several considerations that highlight key practical issues that might impinge on future drainage and development decisions.

A. Consideration 1: Drainage and Runoff Management Responsibilities

One of the first considerations is who has the responsibility to provide drainage the East Water tanks Drainage Area. The City of San Diego is responsible for public land including runoff from public roads and right of ways. However, as has been pointed out several times in this document, private property owners or developers are required to provide adequate storage and conveyance for 50-year flows in areas in the watershed that are above major (four lane) road crossings (City of San Diego Development Services, 2004). This is typical for most developments in the East Water Tanks drainage area. However, below major roadways, the drainage infrastructure must be designed to accommodate 100-year flows. The 100-year floodplain is also significant in that it is a standard used by the National Flood Insurance Program (NFIP) for floodplain management and to determine the need for flood insurance.

Figure 9 shows 100-year floodplain in the Water Tanks (East) drainage area (Kimley-Horn and Associate, 2007).

The interpretation of drainage language is that all public or private properties are required to provide adequate storage and conveyance for up to the 50-year flows, except for those in the natural drainage channel which are exempt. “Major roadways”, that is, those that are four lane or greater and major roadway crossings would require designs that consider conveyance of the 100-year storm either beneath,

along and/or on the roadway as long as not more than one lane of the four is used for conveyance and the conveyance does not encroach onto private property outside of the road right-of-way. None of the areas shown in Figure 9 are considered to be below major roadways.

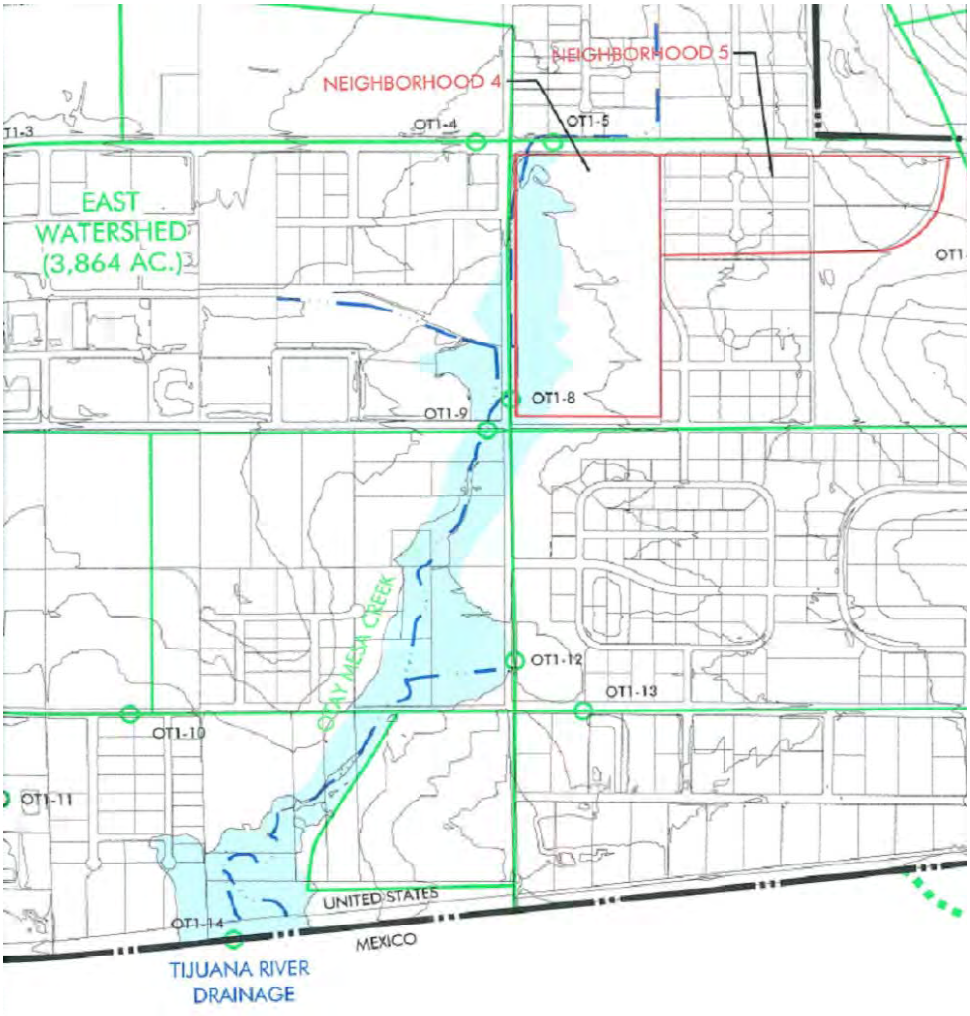

Figure 9. 100-year Floodplain in the Water Tanks (East) drainage area (Kimley-Horn and Associate, 2007).

B. Consideration 2: Potential for BMPs

The potential for stormwater BMPs is another consideration in the decision making process. If, in the future, conveyance along with water quality systems like BMPs are required in the Water Tanks East Drainage, current policies state that all BMPs be constructed for Priority Project Permanent Storm Water BMPs and High Priority Construction Storm Water BMPs. Most projects in the East Water Tanks watershed then would require the submission of a "Water Quality Technical Report" which follows the guidance "Storm Water Standards – A Manual for Construction & Permanent Storm Water Best Management Practices Requirements."

Several factors must be considered when including BMPs in this area. The suitability and types of BMPs that may be selected are highly dependent on the existing conditions, including slope, soils, adequate area, and other natural resource considerations such as destruction of natural vernal pools. However,

this may potentially be an opportunity as well. As has previously been noted, this area is endemic to vernal pools. Projects within this area may provide a very good opportunity to include vernal pool restoration or creation and habitat improvements to support this unique ecosystem natural to Otay Mesa.

Potential Areas for Vernal Pools

Potential areas for restoring and/or improving vernal pools were identified using soil suitability, land use, and site availability. Bauder and McMillan (1998) describe suitable areas for vernal pools with slopes 9% or less and a substance layer with permeability of 0.06 inches/hour or less. Suitable areas using the criteria are shown in Figure 10.

The downstream areas of the Water Tanks (East) drainage area are mainly covered by two types of soils as shown in Figure 5. Major characteristics of the soils are summarized below (Bauder and McMillan 1998).

Huerhuero loam:

- Slopes: 2 to 9 percent
- Impervious sub-surface layer: 12 to 55 inches of clay and clay loam
- Permeability of sub-surface layer: <0.06 inches/hour
- pH: 5.3- for surface and 8.2 for sub-surface

Sckpen (Stockpen) gravelly clay loam:

- Slopes: 0 to 2 percent
- Impervious sub-surface layer: 21 to 60 inches of gravelly clay or clay
- Permeability of sub-surface layer: <0.06 inches/hour
- pH: 6.5 for surface and 8.0 for sub-surface

The characteristics of these soils make them ideal for creating vernal pools.

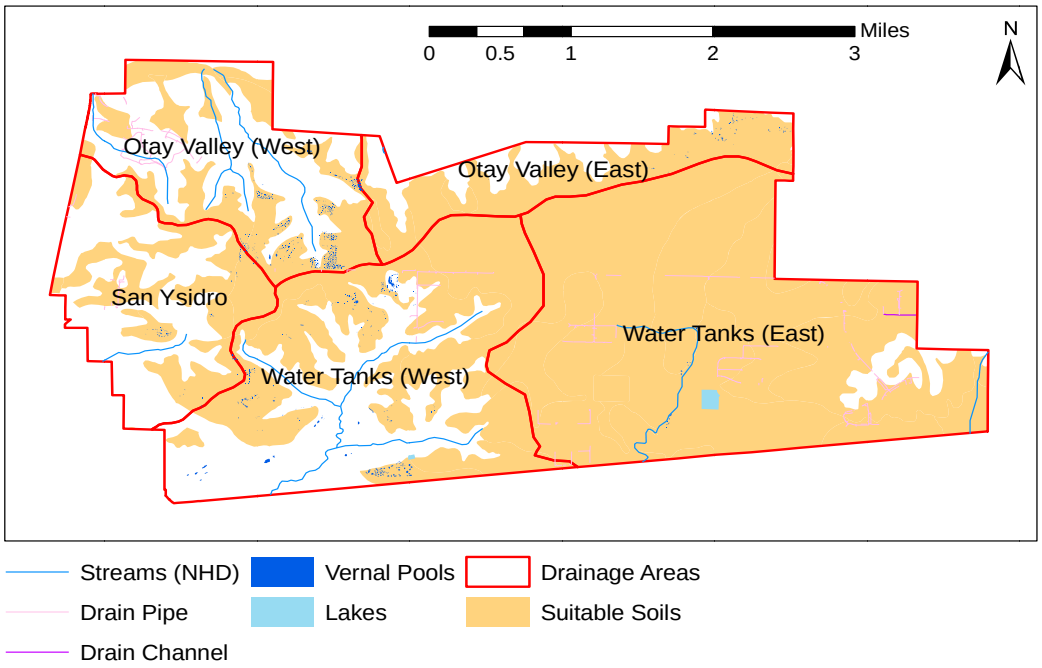

Figure 10. Suitable Areas for Vernal Pools with 9% or less Slope and 0.06 inches/hour or less Permeability

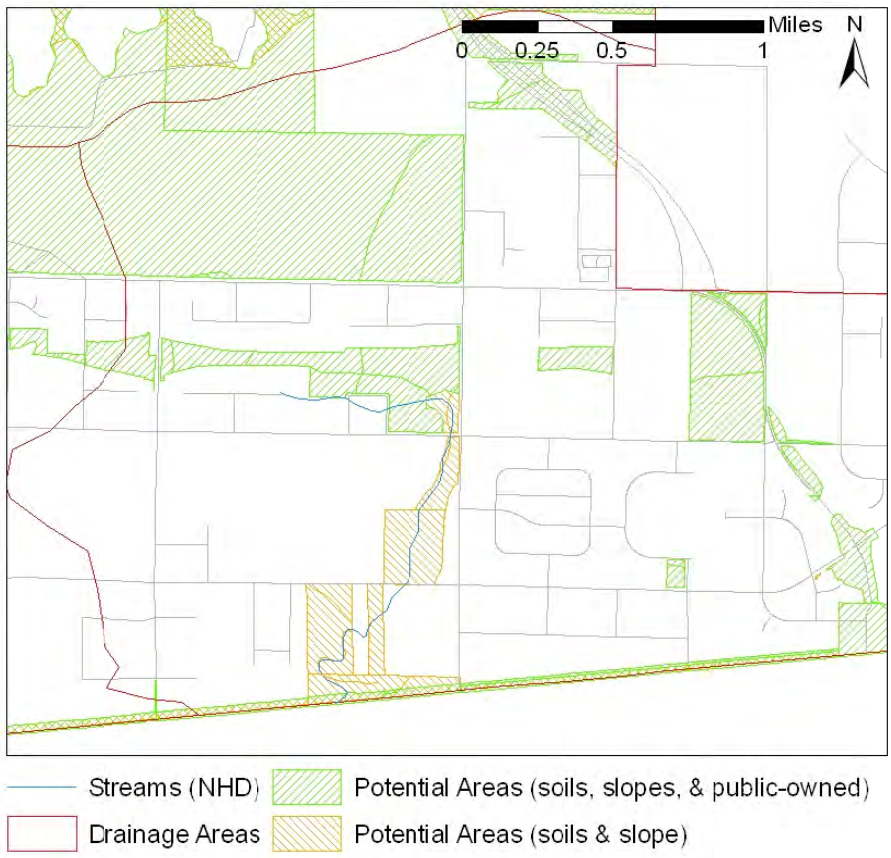

Figure 11. Potential Areas for Vernal Pools within the Water Tanks (East) drainage area

There are a number of parcels that could serve as potential areas for vernal pool creation as supplemental stormwater BMPs beyond the canal and detention system highlighted in the engineering reports.

C. Consideration 3: Estimated Annualized Costs for Planning, Permitting, Land Acquisition, Design, Construction, and Maintenance of Stormwater and Drainage Infrastructure

Another consideration is the cost of future maintenance of stormwater and drainage facilities if these were to be put in place.

Planning

Costs for planning include the effort required to further develop the project concept which, depending on the complexity of the project, could result in preparing a Project Concept Report. Additional administrative costs could be required to administer, manage and coordinate the project's implementation and are included with the planning costs. Administrative costs can vary widely with the complexity of the project, but for purposes of comparison, a value of 5 percent of the capital costs is assumed for planning.

Permitting

Regulatory requirements have to be met and environmental permits are required to implement most BMPs. The applicability of many regulations for a specific project depends on its site or design characteristics. Because the requirements imposed by regulatory agencies often have an effect on the project cost, the associated costs were included in the analysis for centralized BMPs: Because the opportunities identified for distributed structural BMPs are for areas of impervious cover and not applied to vacant or open spaces, the permitting effort anticipated for such projects is minimal, if any. Therefore, no separate costs are identified in the analysis for permitting. It is assumed that any permitting costs associated with the construction phase, such as erosion and sedimentation control, are included in the construction costs.

Land Acquisition

Cost estimates for any acquisition of private lands in Otay Mesa would be generated at the time when the City has determined to move forward with a public drainage facility. The cost estimates would be based on market value at that time, and would include BMP's as necessary.

Design

Designing structural BMPs requires collecting data, analyzing it, and preparing documents that can be used for constructing a project. Data collection could include geotechnical investigations, field investigation of existing utilities (potholing), and a topographic survey for mapping. The design deliverables are project plans and specifications that can be bid by a contractor for construction. Engineering costs can vary widely depending on the complexity of the project. For the purposes of the cost estimates, fixed rates of 5 and 10 percent were applied to the distributed and centralized BMP construction costs, respectively, to estimate the design/engineering cost. A lower percent was used for distributed BMP design costs because these BMPs are expected to have less time-intensive designs compared to centralized BMPs.

Construction

The typical levels of construction cost estimates are:

- Preliminary/Order of Magnitude—provide a range of costs at the planning level for a conceptually defined project
- Budget—cost estimates based on layouts and specific quantities
- Final/Definitive—prepared after the design documents are complete

The estimates for centralized BMPs on public and private property are not site-specific and are in the preliminary/order of magnitude category. To the extent possible, construction costs are based on approximate quantifications of the major components of the BMP.

Mobilization: Mobilization costs are highly variable depending on the magnitude of the project. A mobilization factor of 5% was included.

Excavation and removal: Excavation and removal costs include the cost of excavating the volume of soil required to provide the required storage, hauling the removed dirt offsite, and disposal to an appropriate facility.

Reinforced Concrete Pipe: Costs were derived from R.S. Means (2007) and are included to estimate the costs for constructing a storm drain extension of or to bypass an existing storm drain system.
Landscaping: One of the benefits of distributed BMPs is that they can be integrated into the site plan and often incorporated into the landscaping. Landscaping costs were estimated based on regional data.

Native Landscaping: Native landscaping should be used for any BMP because native landscaping is more adapted to the natural conditions which increase plant survivability.

Contingency: Because some of the project components have not been fully defined at this preliminary stage, a contingency factor of 25 percent should be applied to the construction costs to estimate the total construction costs and capture expected but as yet unidentified additional costs. The costs could arise from site-specific field conditions such as those associated with utility relocations, dewatering, and erosion and sedimentation control. At this stage of project development, the contingency also includes an allowance for such items as field facilities and construction scheduling, which might be required but are not specifically itemized. The contingency factor has **not** been applied to any of the cost functions or component cost estimates itemized in Table 7.

Table 7: Per Unit Cost Estimates for Construction Components

Construction Component	Cost
Mobilization	5% of construction total
Excavation and Removal	$25.00/yd^3
Asphalt/Base Removal	$8.00/yd^3
Site Preparation	$20.00/ft^2
Reinforced Concrete Pipe	$8.00 per diameter (inch) per length (ft)
Landscaping (includes mulch/sod and vegetation)	$5.00/ft^2
Native Landscaping	$25.00/ft^2
Planning	5% of total

Construction Component	Cost
	construction costs
Permits/Studies	Included in design
Design (Centralized)	10% of total construction costs
Design (Distributed)	5% of total construction costs
Contingency for Planning Estimate (Centralized)	25% of total construction costs
Contingency for Planning Estimate (Distributed)	15% of total construction costs

This costing information can be used by the City of San Diego to evaluate costs of planning, permitting, operating and maintaining the proposed drainage facilities and BMPs.

D. Consideration 4: Risk-Based Analyses

On method of assessing the level of service to provide to some drainage areas is to evaluate the risk to private citizens and the economic losses due to flooding. Risk costs are those cost items incurred due to the unexpected failure in the drainage system due to flooding and can broadly be categorized as tangible and intangible costs. Tangible costs are those measured as direct monetary losses including damage to properties and structures, loss of business, cost of repair, etc. Intangible costs include psychological trauma, damage to the environment, and other costs that do not have a direct, agreed upon, or known value.

Economic risks and flood loss costs were considered began to take hold in the early 1960's. One of the early applications was risk based concept to hydraulic design of highway culverts. Pritchett used four actual locations, calculating the investment costs with the expected flood damage costs on an annual basis for several design alternatives. The results indicated that a more economical solution would be reached by selecting smaller culvert sizes compared to the traditional return method typically used.

The basic concept of risk based design is shown schematically in Figure 13. The risk function can account for the potential undesirable consequence associated with the failure of hydraulic structures on the damage and costs related to flooding costs. However, it must be recognized that the risk costs associated with the failure of hydraulic structures cannot be precisely predicted from year to year

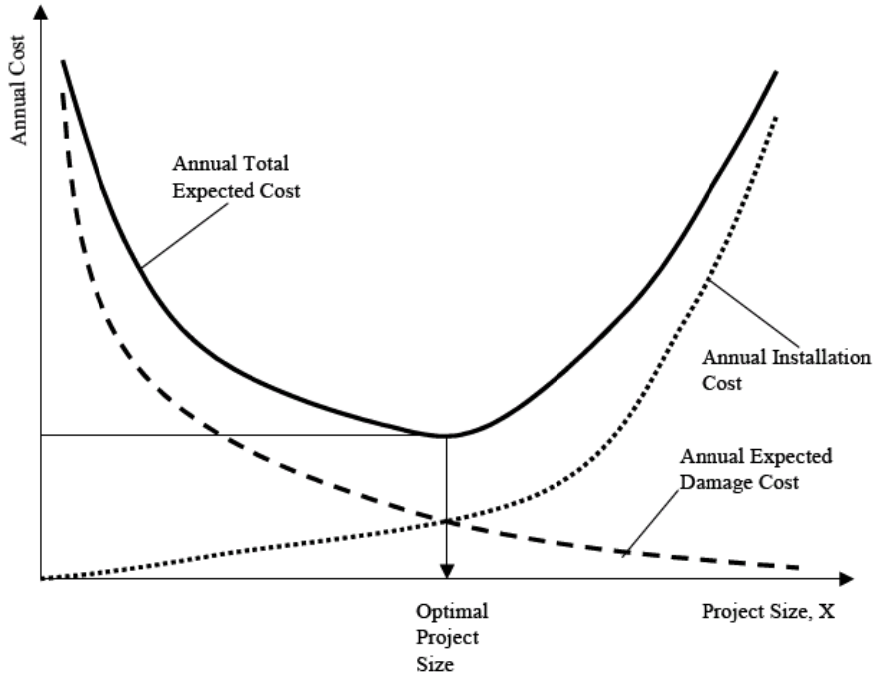

Figure 12. Risk-Based Design Costs Analyses Concepts

The Annual Total Expected Cost is the sum of the annual expected installation and maintenance costs and the annual expected damage and flooding costs. The sum of cost that makes up the intersection between the individual cost curves is the estimated optimal project size. Using this risk-based approach projects can more efficiently determine the estimated costs to inform project design.

For Otay Mesa, the engineering reports summarized potential drainage designs but do not consider the design based on a risk-based approach. These reports use the 100-year return interval for their recommended designs. It should be noted that the land uses where the drainage upgrades are suggested are primarily industrial in nature. This may impact tangible economic costs (e.g., transportation/delivery, vehicle and employee access, etc.), but other intangible costs such as loss of life and threat to personal safety are likely to be minimal because of very little if any residential land uses in this area.

A risk-based approach may be well suited for decision making in the Otay Mesa area. To adequately determine the size of a project to be designed, the annual total expected costs should be evaluated to assist in determining the optimal project size most appropriate for the drainage area. While risk based analyses is not as commonly used by engineers and planners, it is recommended that this task include economists from the City to consider risk-based costs when evaluating engineering designs such as those planned for the Otay Mesa drainage areas.

E. Consideration 5: Border Issues

There are some transboundary considerations beyond what was covered in the regulatory section of this report. The International Boundary and Water Commission (IBWC) is the lead agency for transboundary water management and settlement of bilateral disputes relating to managing shared water resources. An

international pollution abatement board makes recommendations to the EPA administrator for the abatement of international water pollution.

In August 1983, the U.S.-Mexico Border Environment Cooperation Agreement, better known as the La Paz Agreement, initiated a new era of formal multinational consultation and heightened attention to environmental issues within the border region. The La Paz process was strengthened by the 1992-1994 Integrated Border Environmental Program, the 1995-2000 Border XXI Program, and most recently by EPA's Border 2012 Program. These programs broadened the scope of border water management to include pollution prevention, water quality management, a concern for ecological processes, and a concern for advancing sustainable development of water resources along the border. Although these programs acknowledge IBWC's historic treaty role in binational water planning, they favor more regionalized and local workgroups and task forces to de-centralize decision making and to mobilize local resources for local solutions to water issues.

Even with these layers of bureaucracy, it is understood that Governments may be liable when mismanagement of reservoirs or other storage systems result in major flooding of downstream areas. For example, The U.S. Court of Claims [Gasser v United States, 14 Cl. Ct 476 (1988)] has held that the U.S. may be liable for flood damages in Mexico caused by operation of an upstream government reservoir. However, catastrophic natural events do not seem to apply to flood control requirements. Similarly, there is no standard set for the control of flows from the U.S. into Mexico, especially for intermittent or ephemeral streams such as the drainage of the Water Tanks (East) catchment. If a canal and detention system were built in this area, consideration of this area as a "hydrocommons", hydraulically linked basins connected through man-made engineered systems, may be necessary (Michel, 2000). The changing of current drainage patterns and timing of flow across the border in the Water Tanks (East) watershed of Otay Mesa could significantly alter downstream (Mexico) hydrologic functions such as water quality, aquatic habitat, riparian ecosystems, and land use. These issues are weakly addresses with federal, state, and international laws with the implications of constructing the proposed drainage and flood control systems unclear. Further investigation into the legal responsibilities and ramifications should be further reviewed if the drainage and detention projects proceed.

VII. Conclusions

This report has provided a review of previously developed engineering drainage reports with the report recommendations summarized. An inventory of current land use and drainage patterns, as well as regulations regarding storm water were provided as background to support up-to-date considerations for the placement of stormwater management facilities including the possibility of vernal pool restoration. This type of restoration may be required to mitigate impacts to sensitive areas (e.g.,vernal pools) associated with the implementation of the previously recommended drainage reports. The five considerations that were forwarded in this report are:

- Drainage and Runoff Management Responsibilities
- Potential for BMPs
- Estimated Annualized Costs for Planning, Permitting, Land Acquisition, Design, Construction, and Maintenance of Stormwater and Drainage Infrastructure
- Risk-Based Analyses
- Border issues

Through the consideration of these issues, the many regulatory layers, background on environmental sensitive areas of Otay Mesa, data compilation and description, and the summary and evaluation of the engineering reports the City of San Diego will have the necessary information for decision analysis for the Otay Mesa drainage area.

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APPENDIX G-3

Water Quality Technical Report

Water Quality Technical Report

Otay Mesa Community Plan Update

January, 2007

Prepared for:
MNA Consulting
427 C Street, Suite 308
San Diego, CA 92101

Prepared by:
Kimley-Horn and Associates, Inc.
517 Fourth Ave., Suite 301
San Diego, CA 92101

Kimley-Horn
and Associates, Inc.

WATER QUALITY TECHNICAL REPORT

Otay Mesa Community Plan

January, 2007

Prepared for:
MNA Consulting
427 C Street, Suite 308
San Diego, CA 92101

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APPENDICES

1. Introduction

The Otay Mesa Community is quickly developing in the City of San Diego. This area consists of approximately 7,000 acres bounded by the City of Chula Vista and the Otay River Valley on the north, the International Border on the south, Interstate 805 on the west, and the County of San Diego on the east. The far northwest arm of the Mesa is fully developed and all other areas are envisioned for residential, industrial, and commercial development in the Otay Mesa Community Plan.

The Mesa consists of flat terrain and shallow swales for drainage paths. Most of the Mesa slopes north to south resulting in runoff entering Mexico at several points. Increased development has caused concentrated flows in culverts under roads, redefined some of the historical drainage paths, and increased runoff into Mexico. For the most part, the existing drainage facilities have been constructed by private development causing non-continuous facilities and difficulty for subsequent developers to tie into the existing facilities. The Otay Mesa Creek is the only significant creek on the Mesa which lies in the East Watershed (see **Appendix A** for watersheds). The Drainage Study prepared for the Otay Mesa Community Plan Update proposes improvements to the Otay Mesa Creek with the La Media Channel and Border Detention Basin in the East Watershed to be constructed to convey flow and prevent downstream flooding. From the hydraulic analysis in the Drainage Study, Otay Mesa Creek crosses the border into Mexico just north of the Tijuana Airport and eventually to the Tijuana River. The West Perimeter Watershed and West Watershed also flow into the Tijuana River. The Tijuana River Watershed is a water quality impacted watershed, therefore, the water quality must be addressed for additional development. The Tijuana River is included in the 2002 Clean Water Act Section 303(d) List of Water Quality Limited Segments approved by the U.S. Environmental Protection Agency (EPA) and by the State Water Resources Control Board (SWRCB) on February 4, 2003.

The proposed detention basins in the West Perimeter Watershed and West Watershed will be constructed as part of development in the immediate vicinity of future projects. These detention basins are recommended to also function as treatment BMPs for runoff caused by new development. The La Media Channel and Border Detention Basin will be constructed before new development along the creek takes place (see **Appendix A** for locations). These BMPs target sediment, nutrients, trash, metals, oil & grease, and organics from existing and future development prior to crossing the border and into the Tijuana River.

This document complies with the City of San Diego's Standard Urban Storm Water Mitigation Plan and Storm Water Standards Manual.

2. Pollutants that May Affect Storm Water Quality

Future use of the undeveloped land may consist of residential, industrial, and commercial projects. From Table 2 of the City of San Diego's Storm Water Standards Manual, the anticipated and potential pollutants can be identified based on project category. For a residential development, the anticipated pollutants of concern are sediments, nutrients, trash and debris, and pesticides. The potential pollutants of concern include oxygen demanding substances, oil & grease, and bacteria & viruses. The anticipated pollutants for commercial developments include trash & debris and oil & grease. Potential pollutants are sediments, nutrients, organic compounds, oxygen demanding substances, bacteria &

viruses, and pesticides.

The Tijuana River is listed on the 303(d) list for impaired water bodies for bacteria, nutrients, oxygen demanding substances, low dissolved oxygen, pesticides, synthetic organics, and trash. This project proposes the La Media Channel and Border Detention Basin to improve existing drainage. Since residential, industrial, and commercial developments are planned uses of the site, this water quality technical report will not address additional pollutants (associated with the planned uses). Permanent storm water BMPs must be incorporated into future project where necessary to mitigate the impacts of urban runoff as a result of the development. For this project, the proposed channel and detention basin will contribute to filtering of pollutants prior to crossing the border. Heavy riparian vegetation will be allowed to grow in the channel, which traps pollutants. The channel slowly conveys runoff into a detention basin where runoff will be held for some minimum time allowing pollutants to settle prior to discharge.

3. Proposed Control Measures

The Water Quality Technical Report or the Storm Water Management Plan for future projects in the Otay Mesa Community rely on implementation of site design BMPs, source control BMPs, and treatment control BMPs. This project, Otay Mesa Community Plan Update, will only implement treatment control BMPs for the region. Future developers must address site design BMPs, source control BMPs, and additional treatment control BMPs based on anticipated and potential pollutants for the corresponding planned use. The main objective is to ensure that pollutants do not come in contact with storm water by reducing or eliminating the pollutants. These objectives are achieved by implementing the required source, site, priority project and treatment BMPs set forth in the City of San Diego Storm Water Standards.

Site Design

The following Site design BMPs are identified for future development (City Storm Water Standards-Section III.2.A and Appendix C):

1. Minimize impervious footprint. (1) Increase building density (number of stories above or below ground); (2) construct walkways, trails, patios, overflow parking lots and alleys and other low-traffic area with permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials; (3) construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised; and (4) minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.
2. Conserve natural areas and provide buffer zones between natural water bodies and the project footprint. (1) Concentrate or cluster development on the least environmentally sensitive portions of a site while leaving the remaining land in a natural, undisturbed condition; and (2) use natural drainage systems to the maximum extent practicable (natural drainages and vegetated swales are preferred over using lined channels or underground storm drains.
3. Minimize directly connect impervious areas. (1) Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm water conveyance system; and (2) where landscaping is proposed, drain impervious parking lots, sidewalks, walkways, trails, and patios into adjacent landscaping.

4. Maximize canopy interception and water conservation. (1) Preserve existing native trees and shrubs; and (2) plant additional native or drought tolerant trees and large shrubs in place of non-drought tolerant exotics.
5. Convey runoff safely from the tops of slopes.
6. Vegetate slopes with native or drought tolerant vegetation
7. Stabilize permanent channel crossings.
8. Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.

Source Control

The following source control BMPs are identified for future development (City Storm Water Standards – Section III.2.B and Appendix C):

1. Outdoor material storage areas will be designed to reduce pollution introduction. Any hazardous materials with the potential to contaminate urban runoff shall be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with rain, runoff or spillage to the storm water conveyance system; and (2) protected by secondary containment structures such as berms, dikes or curbs. The storage area shall be paved and sufficiently impervious to contain leaks and spills and have a roof or awning to minimize direct precipitation within the secondary containment area.
2. Trash storage areas shall be: (1) paved with an impervious surface, designed not to allow run-on from adjoining areas, and screened or walled to prevent off site transport of trash; and, (2) contain attached lids on all trash containers that exclude rain; or (3) contain a roof or awning to minimize direct precipitation.
3. Integrated pest management principles shall be employed including planting pest-resistant or well-adapted varieties such as native plants and using pesticides as a last line of defense. These principles shall be extended through the distribution of IPM educational materials to future site tenants.
4. Efficient irrigation systems and landscape design should employ rain shutoff devices to prevent irrigation during and after precipitation, irrigation design according to specific water requirements, and flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
5. All inlets should contain prohibitive illegal dumping language.

Priority Project

The following Priority Project design BMPs are identified for applicable future developments (City Storm Water Standards – Section III.2.C)

1. The design of private roadways shall use at least one of the following: (1) rural swale system; (2) urban curb/swale system; or (3) dual drainage system.
2. Residential driveways shall have one of the following: (1) shared access; (2) flared entrance; (3) wheelstrips (paving under tires); (4) porous paving; or (5) designed to drain into landscaping prior to discharging to the storm water conveyance system. Uncovered temporary

or guest parking on private residential lots shall be: (1) paved with permeable surfaces or (2) designed to drain into landscaping prior to discharging to the storm water conveyance system.

3. Loading/unloading dock areas shall include the following: (1) cover loading dock areas, or design drainage to preclude urban run-on and runoff; and (2) an acceptable method of containment and pollutant removal, such as a shut-off valve and containment area.
4. Maintenance bays shall include at least one of the following: (1) repair/maintenance bays shall be indoors; or, (2) designed to preclude urban run-on and runoff. Maintenance bays shall include a repair/maintenance bay drainage system to capture all wash water, leaks, and spills.
5. Outdoor areas for vehicle & equipment washing shall be: (1) self contained to preclude run-on and run-off, covered with a roof or overhang, and equipped with a clarifier or other pre-treatment facility; and (2) properly connected to a sanitary sewer.
6. Outdoor processing areas shall: (1) cover or enclose areas that would be the most significant source of pollutants; or, (2) slope the area toward a dead-end sump; or, (3) discharge to the sanitary sewer system. Grade or berm processing area to prevent run-on from surrounding areas.
7. Where landscaping is proposed in surface parking areas, incorporate landscape areas into the drainage system. Overflow parking may be constructed with permeable paving
8. Non-Retail fueling areas should be designed with the following: (1) paved with Portland cement concrete or equivalent; (2) designed to extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less; (3) sloped to prevent ponding; (4) separated from the rest of the site by a grade break, and (5) designed to drain to the project's treatment control BMP. Must have overhanging roof structure or canopy that is equal to or greater than the area within the fuel dispensing area's grade break and designed not to drain onto or across the fuel dispensing area.
9. Steep hillside areas shall be landscaped with deep-rooted, drought tolerant plant species.

Treatment Control

Treatment control BMPs are designed to filter or treat runoff prior to discharging into an on-site or off-site storm drain system. The largest watershed of the Mesa is the East Watershed encompassing approximately 4,000 acres. This watershed flows into Mexico at a single point between Britannia and La Media roads. The La Media Channel and Border Detention Basin will function as a treatment design BMP (See Exhibit A for locations). Runoff drains to the La Media Channel where runoff is slowly conveyed through heavy riparian vegetation. The channel slopes at 0.25% for approximately 3,500 feet and behaves similar to a vegetated swale. Runoff is then discharged into the Border Detention Basin where storm water flow is slowed in order for pollutants to settle. The basin is approximately 58 acres with a maximum water depth of 6ft. These BMPs were chosen on the basis of site design feasibility and the City Storm Water Standards- Section B.2.1.D. Additional site treatment control BMPs may be necessary and addressed for future developments.

4. Operation and Maintenance Procedures

Grass Lined Channel

1) Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris. See BMP detail TC-30 in **Appendix B** for preferred schedule
2) Regularly inspect swales for pools of standing water to prevent mosquito breeding.
3) Every few years maintenance of dead or fallen trees may be required.

Detention Basin

An effective maintenance program should include the following key components

1. Weather-triggered inspections – Inspect after several storm events for bank stability and to determine if the desired residence time has been achieved.
2. Regular inspections – Inspect semi-annually and after significant storm events. Inspect for the issues as described in BMP detail TC-22 in **Appendix B**.
3. Sediment Removal – Remove accumulated sediment when accumulated sediment volume exceeds 10-20% of the basin volume or when accumulation reaches 6 inches or if re-suspension is observed. Significant sediment deposition is not expected after development on The Mesa is completed.
4. Water Removal – Basin will be designed with a "low-flow" outlet; however, if water remains remove standing water by clearing drainage path within 72 hours after accumulation
5. General Maintenance Activities – see BMP detail TC-22 in **Appendix B** for maintenance activities and suggested frequency.

5. Operation and Maintenance Responsibility

A Maintenance District will be created for maintaining the channel and regional detention basin. Project detention/water quality basins and BMP's will be maintained by the project owners.

6. Installation Costs

La Media Channel and Border Detention Basin

Preliminary Opinion of Probable Construction Cost
2/8/2005
Kimley Horn and Associates
Construction Items

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Excavation	822,500	CY	$2	$1,645,000
2	Airway Road culvert (8-6'wx5'h)	300	CY	$1,500	$450,000
3	La Media/Airway Road culvert (6-10'wx6'h)	1,500	CY	$1,500	$2,250,000
4	Siempre Viva Road culvert (8-10'wx6'h)	1,490	CY	$1,500	$2,235,000
5	Detention Basin Outlet Structure	1	LS	$100,000	$100,000
6	Traffic Control	1	LS	$100,000	$100,000
7	Utility Relocation	1	LS	$150,000	$150,000
8	Street Repair	1	LS	$50,000	$50,000
9	Erosion Control	1	LS	$50,000	$50,000
10	Revegetation	1	LS	$600,000	$600,000
		Subtotal			$7,630,000
		Contingency	20%		$1,526,000
		Total			$9,156,000

Land Acquisition

1	Land Acquisition (outside MHPA)*	2,610,000	SF	$4	$10,440,000
2	Land Acquisition (inside MHPA)**	1,820,000	SF	$1	$1,820,000
		Subtotal			$12,260,000
		Contingency	20%		$2,452,000
		Total			$14,712,000

Total Cost (Construction and Land Acquisition) $23,868,000

Notes: * Includes area of detention basin and channel south of Siempre Viva
** Includes entire area within MHPA boundary
*** Estimate does not include engineering, environmental, geotechnical, surveying, etc.

8. Conclusion

The future developments on the Mesa will include source, site, priority project, and treatment control BMPs consistent with the City of San Diego Storm Water Standards. This project consists of treatment control which will be in place before adjacent development is completed. The treatment control consist of a detention basin and a grass lined channel for the watershed to minimize downstream flooding and to treat and filter runoff prior to discharge across border. Use of these control measures complies with the Municipal Storm Water National Pollutant Discharge Elimination System (NPDES) Permit and the City of San Diego's Storm Water Standards.

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Vegetated Swale TC-30

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas
- Swales are more susceptible to failure if not properly maintained than other treatment BMPs

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles, stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data

	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-110	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2-16	25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	25	46–73	-25	grassed channel
Wang et al., 1981	80	-		-	70–80	-	dry swale
Dorman et al., 1989	98	16		47	37–81	-	dry swale
Harper, 1988	87	83	84	80	88-91	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988	81	17	40	52	37-69		wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research on the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998), consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select firm, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick, if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.
- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft². This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft², which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost Low	Unit Cost Moderate	Unit Cost High	Total Cost Low	Total Cost Moderate	Total Cost High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--		--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total			--			$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = (top width + 8(swale depth²)/3(top width)) x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SLWRPC, 1991)

Component	Unit Cost	Swale Size: (Depth and Top Width)		Comment
		1.5-Foot Depth, One-Foot Bottom Width 10-Foot Top Width	1-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	$0.05 / 1000 ft²/mowing	$0.14 / linear foot	$0.21 / linear foot	Lawn width = swale side slope + top width + 10 feet; length = linear feet; eight times per year
General Lawn Care	$300 / 1000 ft²/year	$0.18 / linear foot	$0.26 / linear foot	Lawn maintenance area = top width + 10 feet; length
Swale Debris and Litter Removal	$0.10 / linear foot / year	$0.10 / linear foot	$0.10 / linear foot	-
Grass Reseeding with Mulch and Fertilizer	$0.03 / yd²	$0.01 / linear foot	$0.01 / linear foot	Area to be reseeded equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	$0.10 / linear foot / year, plus $25 / inspection	$0.75 / linear foot	$0.10 / linear foot	Assumes four inspections per year
Total	-	$0.38 / linear foot	$0.75 / linear foot	-

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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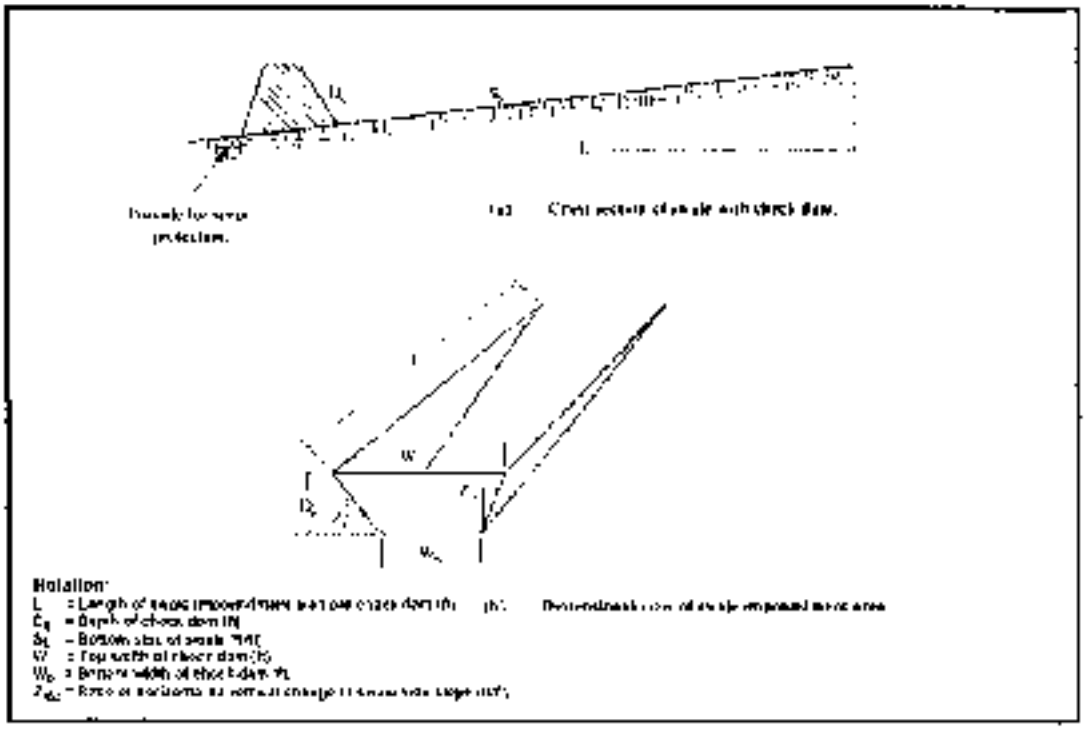

Extended Detention Basin TC-22

Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 7 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economics of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996)

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

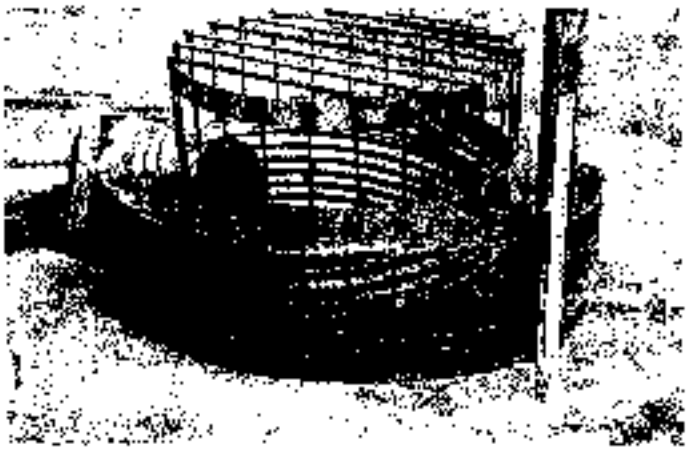

Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_o))^{0.5}$$

where: Q = discharge (ft³/s)
C = orifice coefficient
A = area of the orifice (ft²)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_o = orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation

management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.66}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the

perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	193
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

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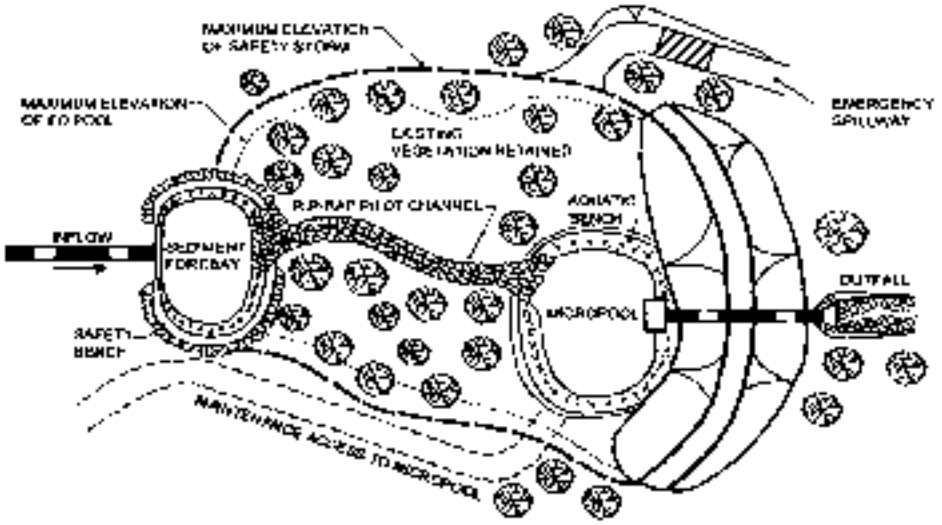
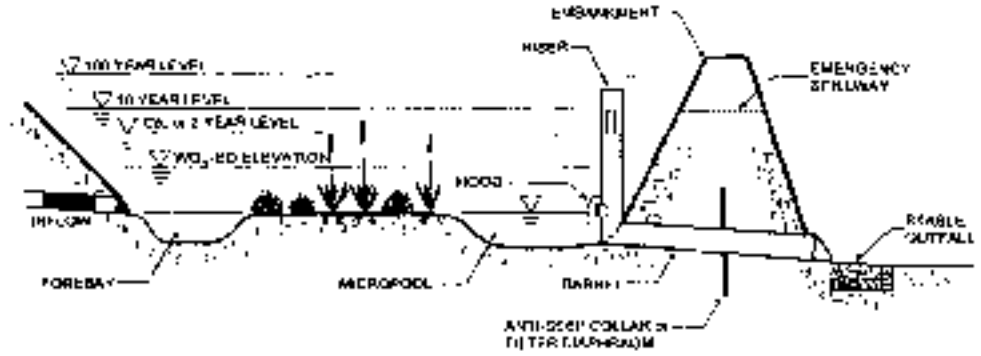


PLAN VIEW



PROFILE

Schematic of an Extended Detention Basin (MDE, 2000)

Drainage Study for the Otay Mesa Community Plan Update

June, 2006

Prepared for:
MNA Consulting
427 C Street, Suite 308
San Diego CA 92101

Prepared by:
Kimley-Horn and Associates, Inc.
517 Fourth Avenue, Suite 301
San Diego CA 92101

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APPENDICES

I. BACKGROUND

This report has been prepared as an appendix to the Otay Mesa Community Plan update EIR. Its purpose is to provide a summary of the existing drainage situation and facilities and proposed future facilities, including alternatives for draining the large central watershed. In addition, this report presents recommendations for drainage design criteria and storm water quality requirements for each of the watersheds on the Mesa.

For most of its early history, Otay Mesa was used for agriculture and farming was the primary land use. As industrial and commercial development started taking place in the 1960s, the City of San Diego recognized the need for a comprehensive drainage Master Plan for the Mesa. Because most of the Mesa drains to the South into Mexico, there was concern that the new development would increase the runoff crossing the border. The City needed to establish criteria for the new development such that there was no increase in runoff as a result of the new construction.

In May of 1987, the City Council approved a contract to prepare the Otay Mesa Drainage Master Plan. In August of 1987, the City published a Notice to "All Private Engineers" that established "Drainage Requirements for Development in Otay Mesa" (attached). The Master Plan was published in January, 1988, and included a proposed concrete Channel from Airway Road to Siempre Viva Road that followed the existing drainage channel.

The Master plan was updated with the "Otay Mesa Drainage Study" published in August, 1999. The most significant recommendation change was moving the proposed new channel from the creek alignment to a new location directly adjacent to La Media Road and Siempre Viva Road.

Reproduction of 1987 NOTICE from Engineering and Development Department

NOTICE

Date: August 7, 1987

To: All Private Engineers

From: Subdivision Engineer

Subject: Drainage requirements for development in Otay Mesa

In order to minimize the effects of increased storm water runoff in Mexico, due to development of property in Otay Mesa, all property in Otay Mesa that is within the water shed that drains into Mexico, shall be developed with the following requirements:

1. Each property owner shall provide storm water detention facilities so that there will be no increase in the rate of runoff due to development of the property.

2. The detention facilities shall be designed so that the rate of runoff from the property will not be greater after development than it was before development for a 5 year, 10 year, 25 year and 50 year storm.

3. All drainage facilities crossing four-lane major or higher classification streets shall be designed for a Q100 (existing). Other facilities, except the major channel referred to in paragraph 5, may be designed for Q50 (existing).

4. The Drainage Design Manual shall be used as guidelines for design of drainage facilities and computing design discharges.

5. The City Engineer's Office, Flood Control Section, is preparing a preliminary plan for the main north-south channel from Otay Mesa Road near La Media to the Mexican Border. The preliminary design will include the design "Q" (Q100 existing), the invert grade, and the water surface elevation at the major road crossings.

C.R. Lockhead
Subdivision Engineer

II. EXISTING DRAINAGE FACILITIES

Information was collected for existing drainage and flood control facilities on Otay Mesa through as-built plans, SanGIS maps, and site visits. Most of the existing drainage facilities were constructed as part of the private development that is taking place on the Mesa. Many of these facilities are not continuous because of the piecemeal nature of the development. This creates challenges for the subsequent developers that need to tie into the existing facilities. Many of the existing facilities are temporary.

Most of the development to-date has occurred in the East Watershed, which therefore includes most of the existing drainage facilities on the Mesa. The existing system is a combination of storm drains, improved channels, and detention basins, which in many areas discharge to natural drainage paths that do not have adequate hydraulic capacity.

The "Existing Drainage Facilities" drawing shows the facilities as-of the date of this report. The area is developing rapidly, and therefore new facilities are continuously being constructed. There are currently no dedicated drainage rights-of-way on the Mesa. Many of the projects, as they were mapped and constructed, dedicated portions of the properties to the city as drainage easements or flood water storage easements. Eventually, the systems and their easements will be continuous.

III. HYDROLOGIC ANALYSIS

The Otay Mesa Study area is shown on the Watershed Map, and includes all of the Mesa area within the City of San Diego divided into five watersheds (with the exception of the far northwest arm of the Mesa, which is fully developed).

Watersheds	Acres	mi²
West Perimeter Watershed	258	0.40
West Watershed	2,190	3.42
North Perimeter Watershed	590	0.92
East Watershed	3,864	6.04
Border Crossing Watershed	223	0.35
TOTAL	7,125	11.13

Most of the Mesa slopes from North to South, with the flow entering Mexico at several points. The northern and western perimeters of the Mesa flow into the adjacent Canyons. These perimeter watersheds are divided into several independent smaller watersheds. The watershed boundaries on the Mesa are not well defined because the Mesa is so flat. There are very few defined natural drainage paths, with much of the runoff sheet-flowing across the Mesa. The watershed boundaries shown are based on field investigations and best available mapping, but the actual drainage boundaries may be very different.

The only watershed that has been studied significantly from a drainage perspective is the East Watershed. Hydrologic models have been prepared for both of the previous drainage studies. The peak flows calculated in the two studies are different, primarily because of different assumptions relative to developed area, proposed drainage facilities, and watershed areas. The East Watershed includes a large area of unincorporated County property. The hydrologic model assumed the same industrial development for the unincorporated area. If land uses change in the County area, it may change the runoff rates. The differences for the concentration point at the border are shown below.

Q100 at Border East Watershed		
	Area (mi²)	Q100(cfs)
1988 Study	5.72	5,050
1999 Study	6.53	3,529
2004 CPU	6.75	3,673

As part of this study, new hydrologic models have been prepared for the main watersheds which flow into the Tijuana River. For the East Watershed, HEC-1 has been used, since both previous studies used this model. For the other watersheds, the standard City of San Diego Modified Rational Method (AES) has been used. The results of these analyses are shown in the table below.

Hydrologic Analysis Summary

	Area (mi²)	Q50(cfs)	Q100(cfs)
West Perimeter Watershed	0.40	170	444
West Watershed	3.42	672	1,676
East Watershed	6.78	1,280	3,673
	10.60	2,122	5,793

In addition to the above flows, the Spring Canyon open space area contributes 109 cfs (Q50) and 257 cfs (Q100) from 1.2 mi². Since the Tijuana River Watershed is a water-quality impacted watershed, the quality and quantity of flow will need to be addressed before additional development takes place.

IV. HYDRAULIC ANALYSIS

Most of the Mesa is very flat, resulting in local flooding during storms at the low points and along some drainage ditches. The only significant creek on the Mesa is the main channel in the East Watershed, Otay Mesa Creek, which flows from North to South along La Media Road and crosses the border into Mexico just north of the Tijuana Airport.

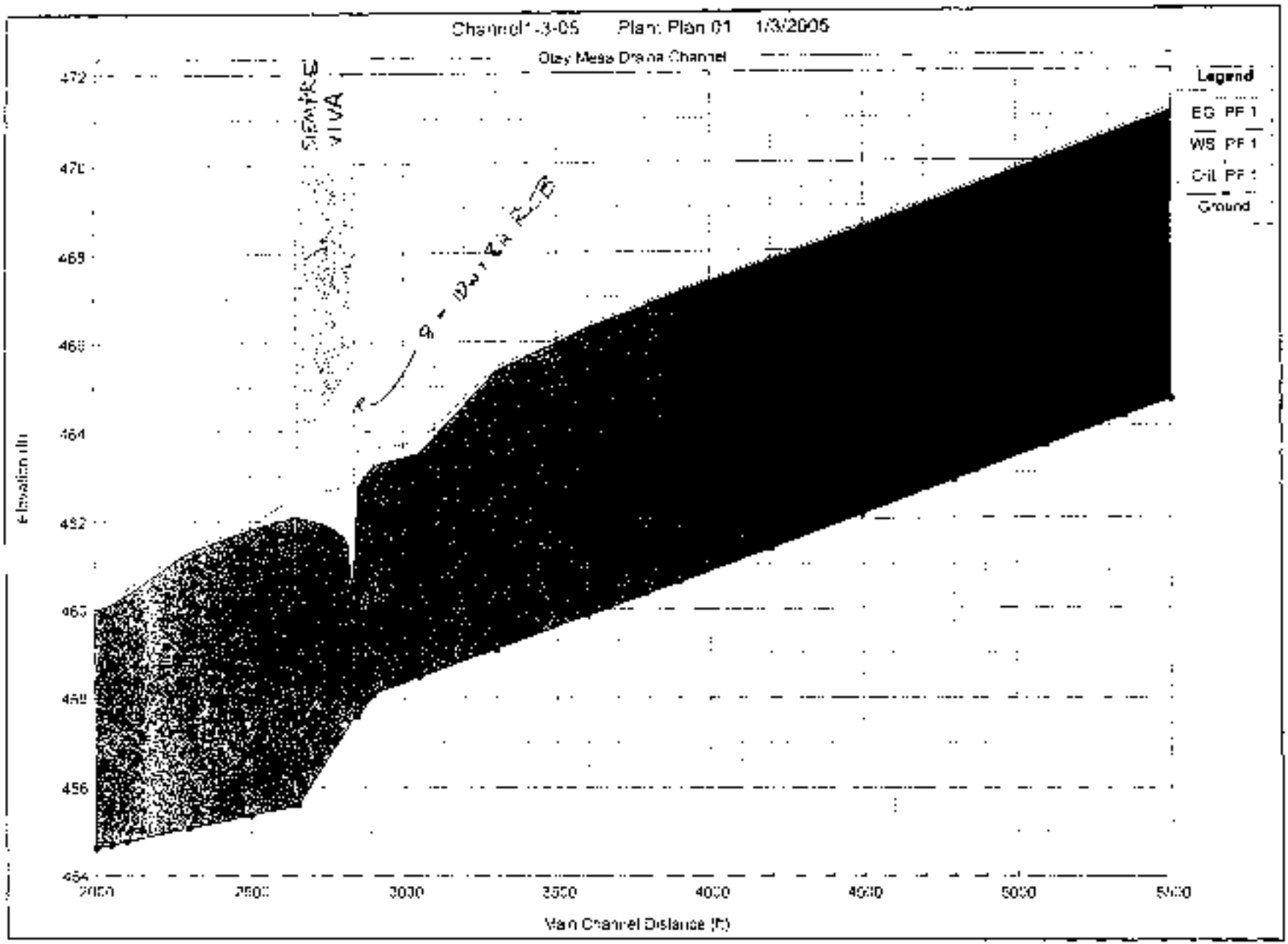
A HEC-RAS hydraulic model was prepared for this channel from the border north to Otay Mesa Road. The purpose of this model was to identify the 100-year floodplain for this reach for present conditions. The proposed future drainage project along this alignment will be designed to contain the 100-year flow, reducing or eliminating flooding impacts to adjacent properties.

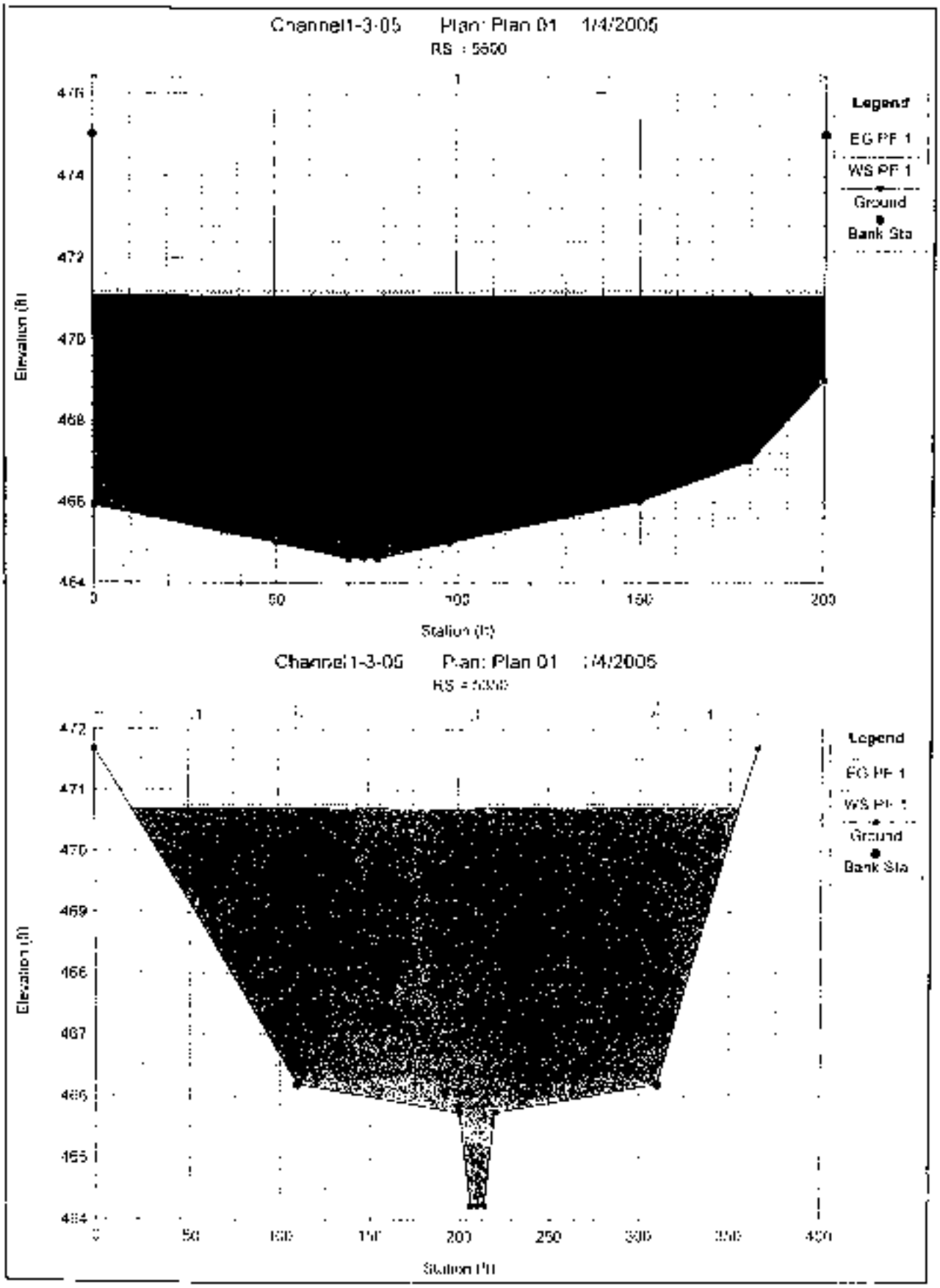
The HEC-RAS model was also used to size the proposed new channel from Airway Road to just south of Siempre Viva Road. Several alternative cross-sections were modeled to reflect input on the environmental aspects of the channel.

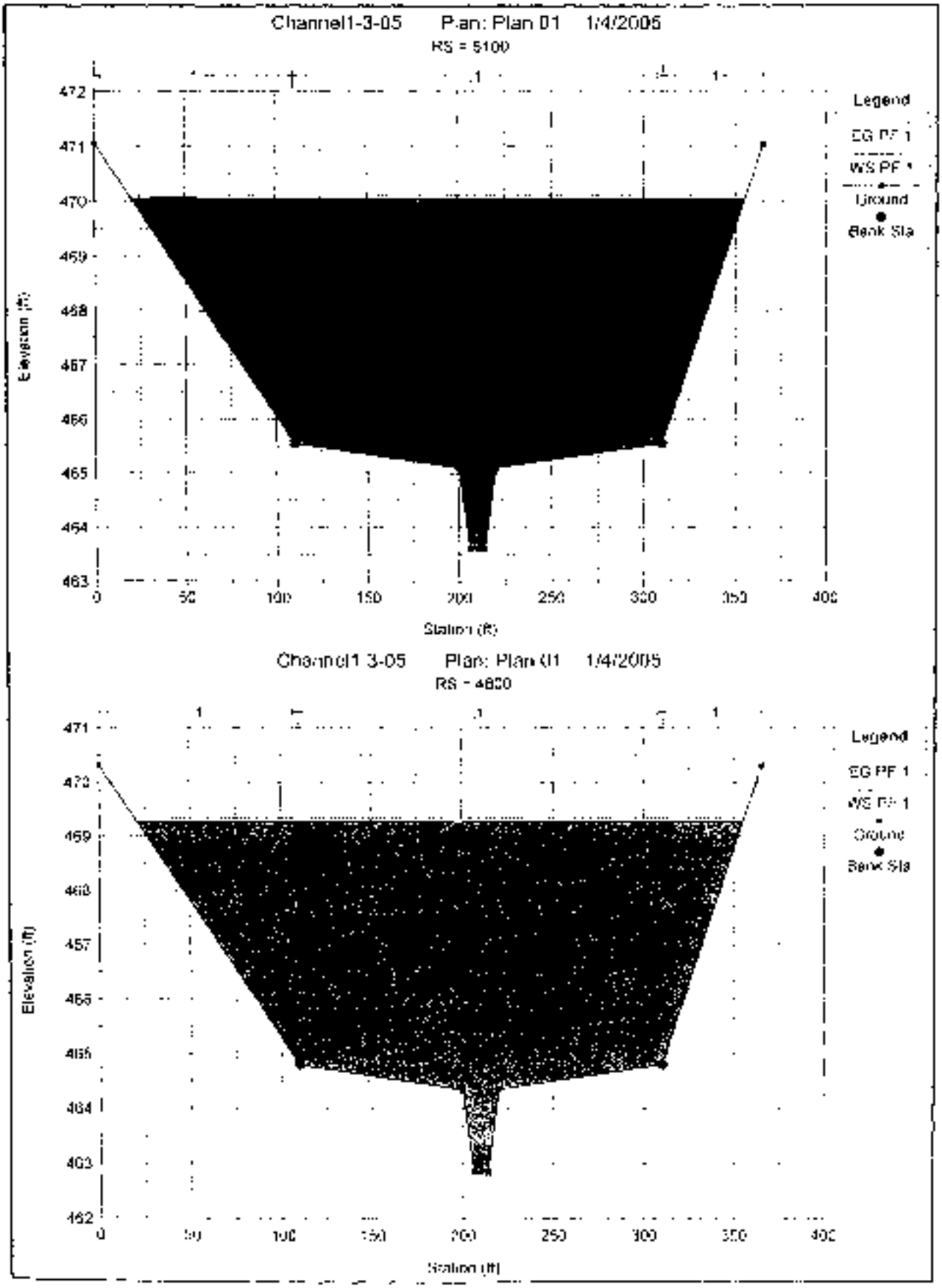
A significant tributary to the main channel enters just upstream of the Siempre Viva Road crossing. This tributary conveys flow from the De La Fuente Business Park and the Siempre Viva Business Park. The existing channel from La Media Road to the proposed main channel is approximately 15 feet wide and 4 feet deep, with a hydraulic capacity of approximately 120 cfs. The 100 year flow in this channel is 1116 cfs. A proposed new channel has a 50 ft bottom width with 1.5:1.0 side slopes and will convey the 100 year flow. A double 10' x 4.5' RCB will also be required for the flow under La Media Road. The cost estimate does not include these facilities.

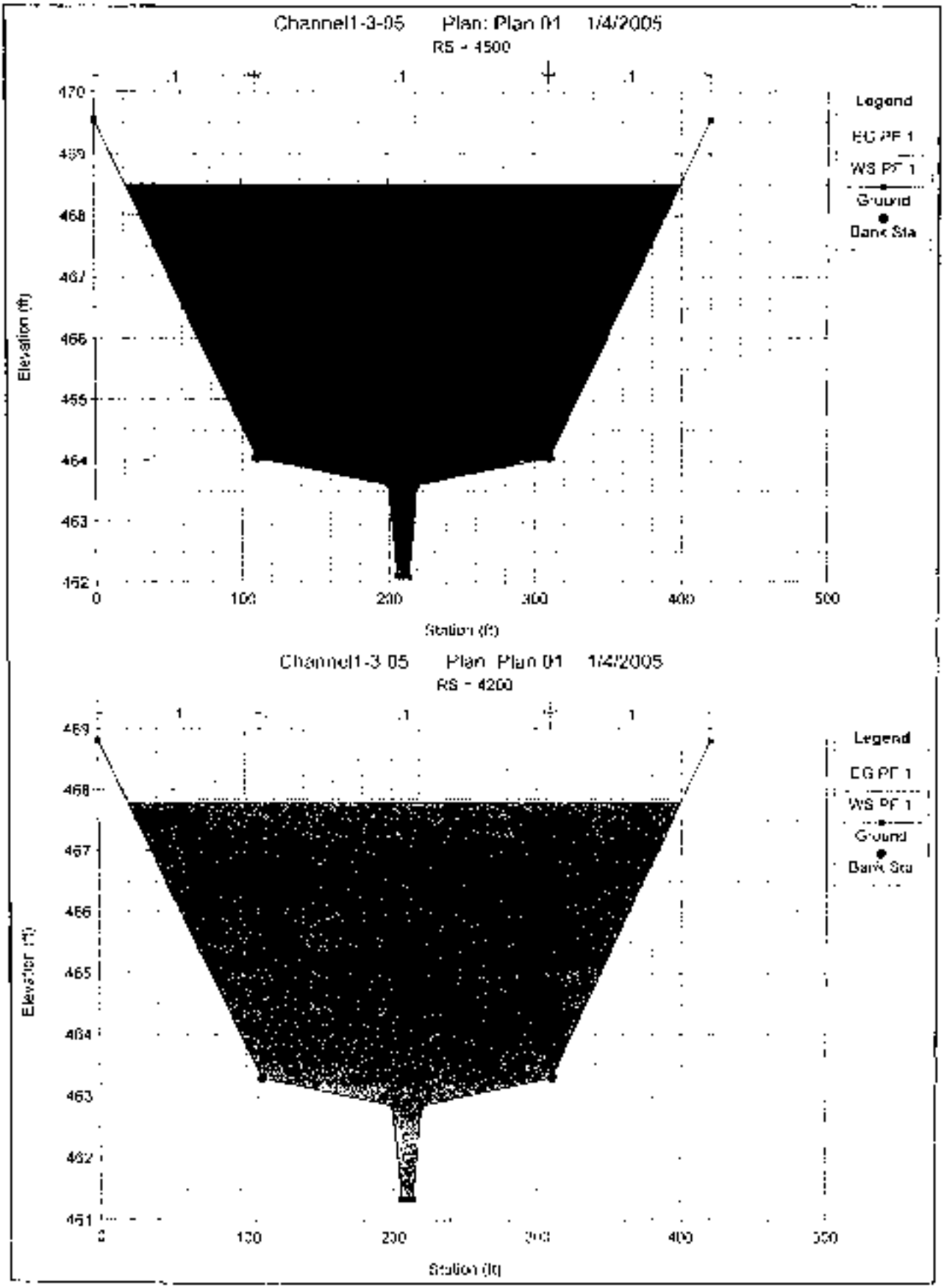
HEC-RAS Plan: Plan 01 River: Clay Mesa Drains Reach: Channel Profile: PF 1

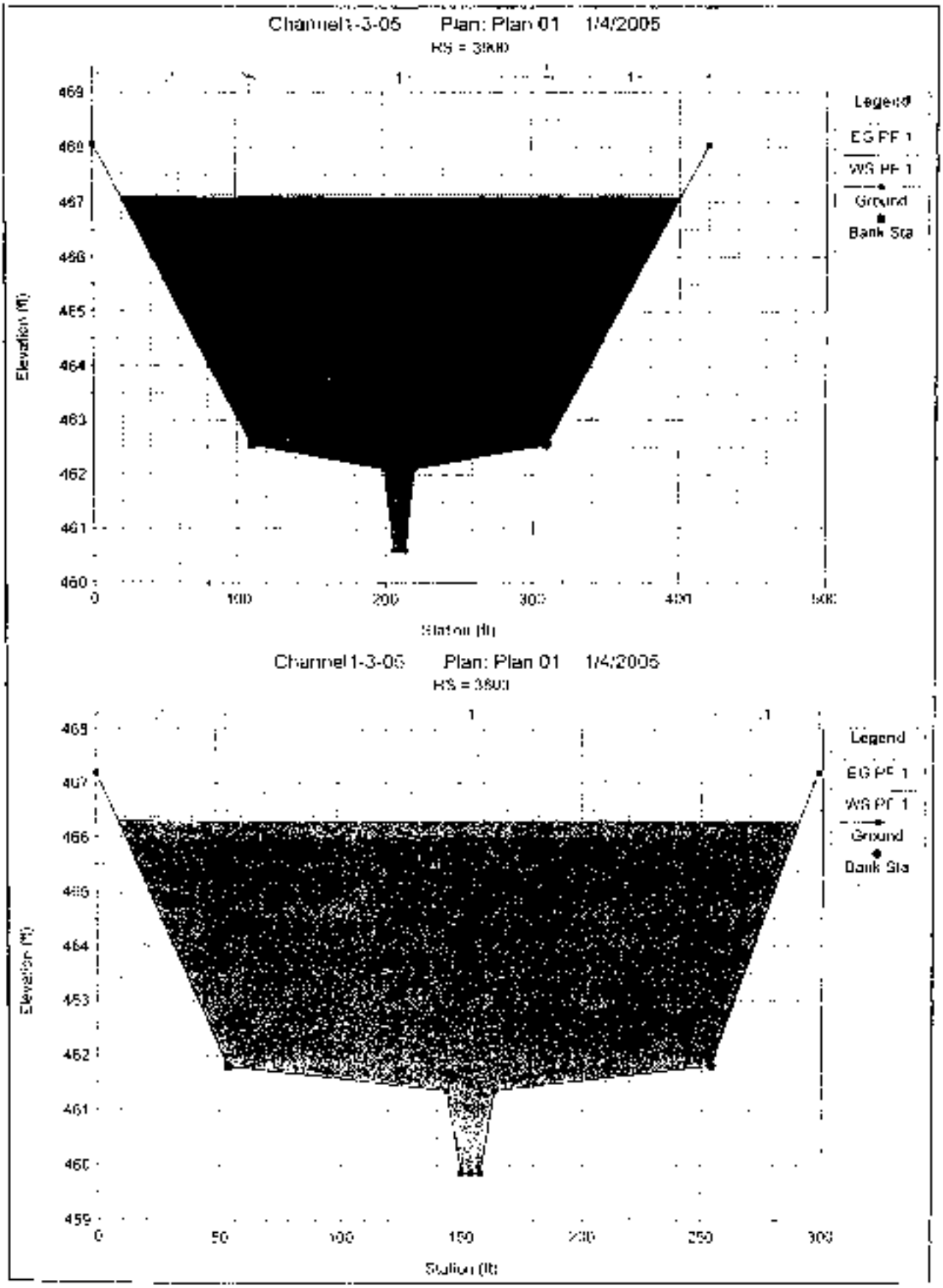
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Channel	5500	PF 1	2500.00	464.50	471.08		471.16	0.002743	2.33	1073.59	200.30	0.18
Channel	5060	PF 1	2500.00	464.23	470.69		470.76	0.002572	2.16	1279.19	335.44	0.17
Channel	5100	PF 1	2500.00	463.60	470.06		470.13	0.002591	2.17	1275.95	335.19	0.17
Channel	4900	PF 1	2500.00	462.85	469.27		469.33	0.002656	2.19	1253.55	334.04	0.18
Channel	4500	PF 1	2500.00	462.10	468.51		468.58	0.002431	2.08	1358.84	378.24	0.17
Channel	4230	PF 1	2500.00	461.35	467.79		467.85	0.002365	2.07	1371.79	379.61	0.17
Channel	3930	PF 1	2500.00	460.60	467.09		467.15	0.002265	2.04	1392.50	381.79	0.16
Channel	3600	PF 1	2500.00	459.85	466.38		466.37	0.002869	2.32	1153.04	261.59	0.19
Channel	3300	PF 1	2500.00	459.10	465.33		465.42	0.003473	2.41	1109.99	285.62	0.20
Channel	3050	PF 1	3000.00	458.46	463.50		462.74	0.016532	4.06	777.90	261.33	0.39
Channel	2900	PF 1	3000.00	458.10	463.23	461.14	463.61	0.003245	4.97	603.31	222.92	0.41
Channel	2850	PF 1	3000.00	457.50	462.74	461.24	463.55	0.003521	7.22	415.32	168.05	0.58
Channel	2750		Culvert									
Channel	2540	PF 1	3000.00	455.59	462.07	458.55	462.52	0.011957	5.38	557.46	163.64	0.37
Channel	2500	PF 1	3000.00	455.38	461.81		461.87	0.001846	2.07	1492.27	277.64	0.15
Channel	2300	PF 1	3000.00	455.08	461.31		461.40	0.003272	2.45	1261.91	277.56	0.19
Channel	2100	PF 1	3000.00	454.78	460.34		460.48	0.006864	3.05	1006.36	275.43	0.27
Channel	2050	PF 1	3000.00	454.70	460.11		460.21	0.003838	2.56	1181.75	275.37	0.21
Channel	2000	PF 1	3000.00	454.63	460.00	456.55	460.06	0.002195	2.06	1582.35	378.00	0.16

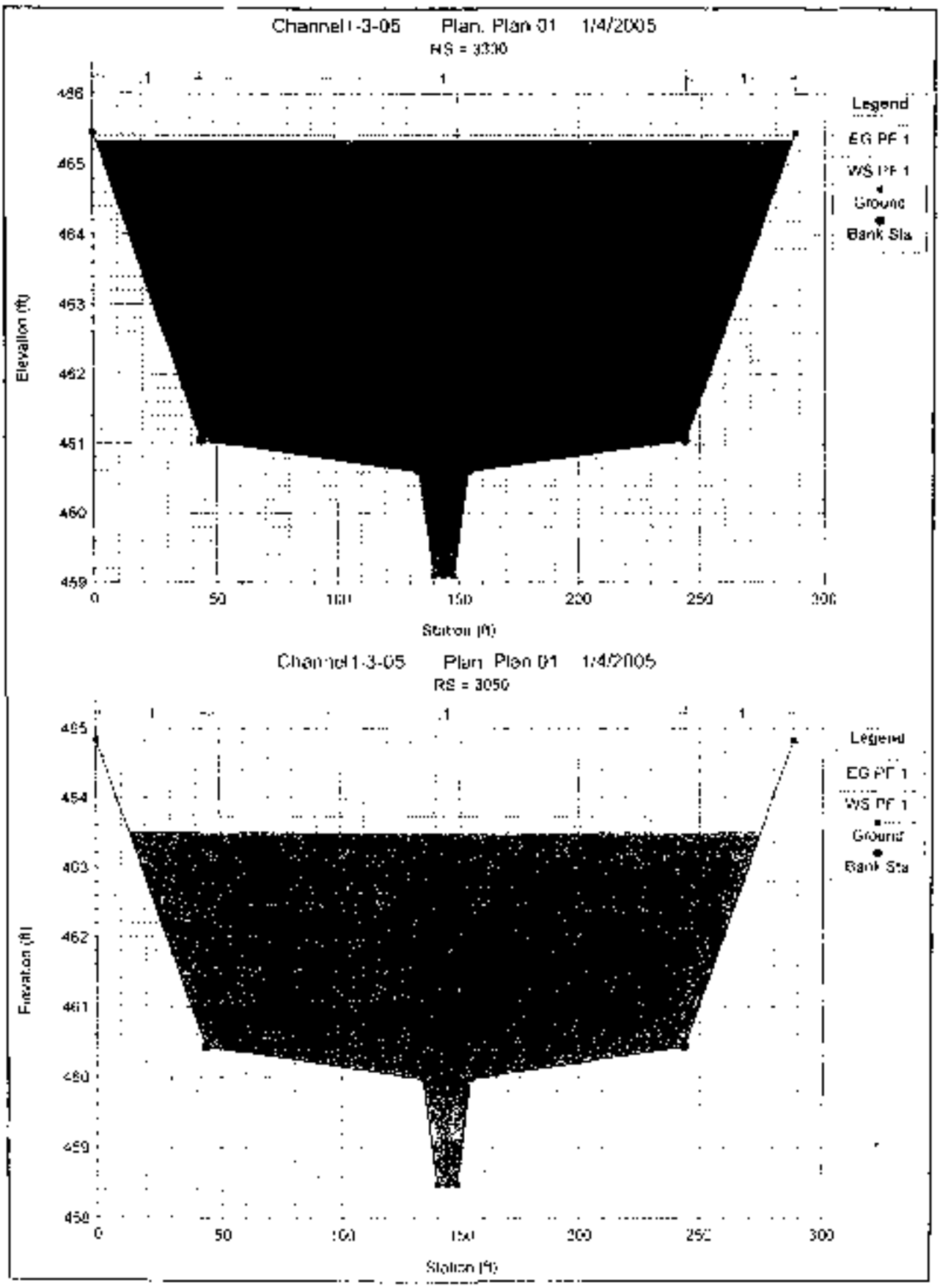

Otay Mesa Drainage Channel
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
SIEMPRE VIVA
Main Channel Distance (ft)

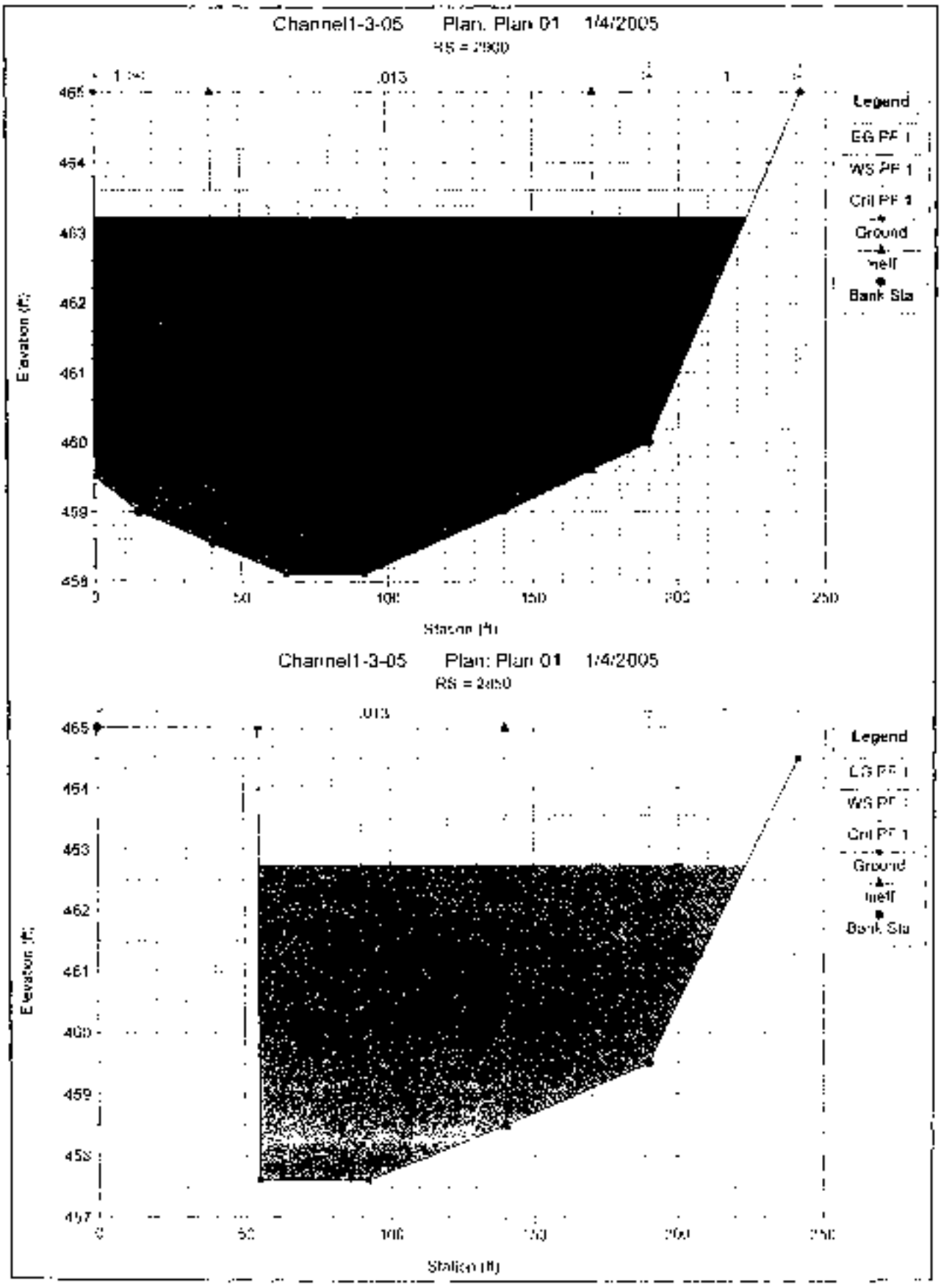

Channel1-3-05 Plan: Plan 01 1/4/2005
RS : 5650
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
Legend
EG PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

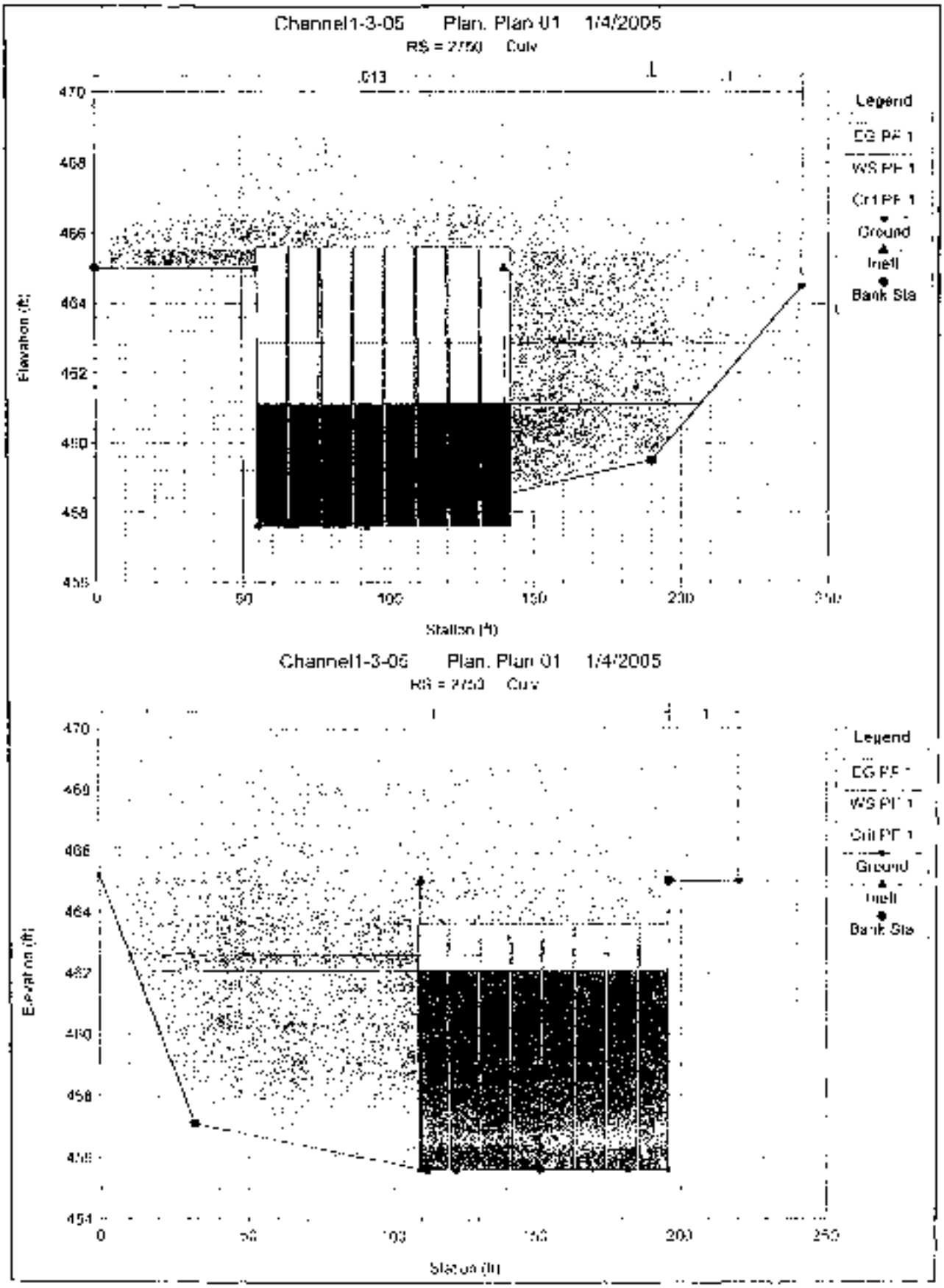

Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 5100
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1 3-05 Plan: Plan 01 1/4/2005
RS = 4800
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

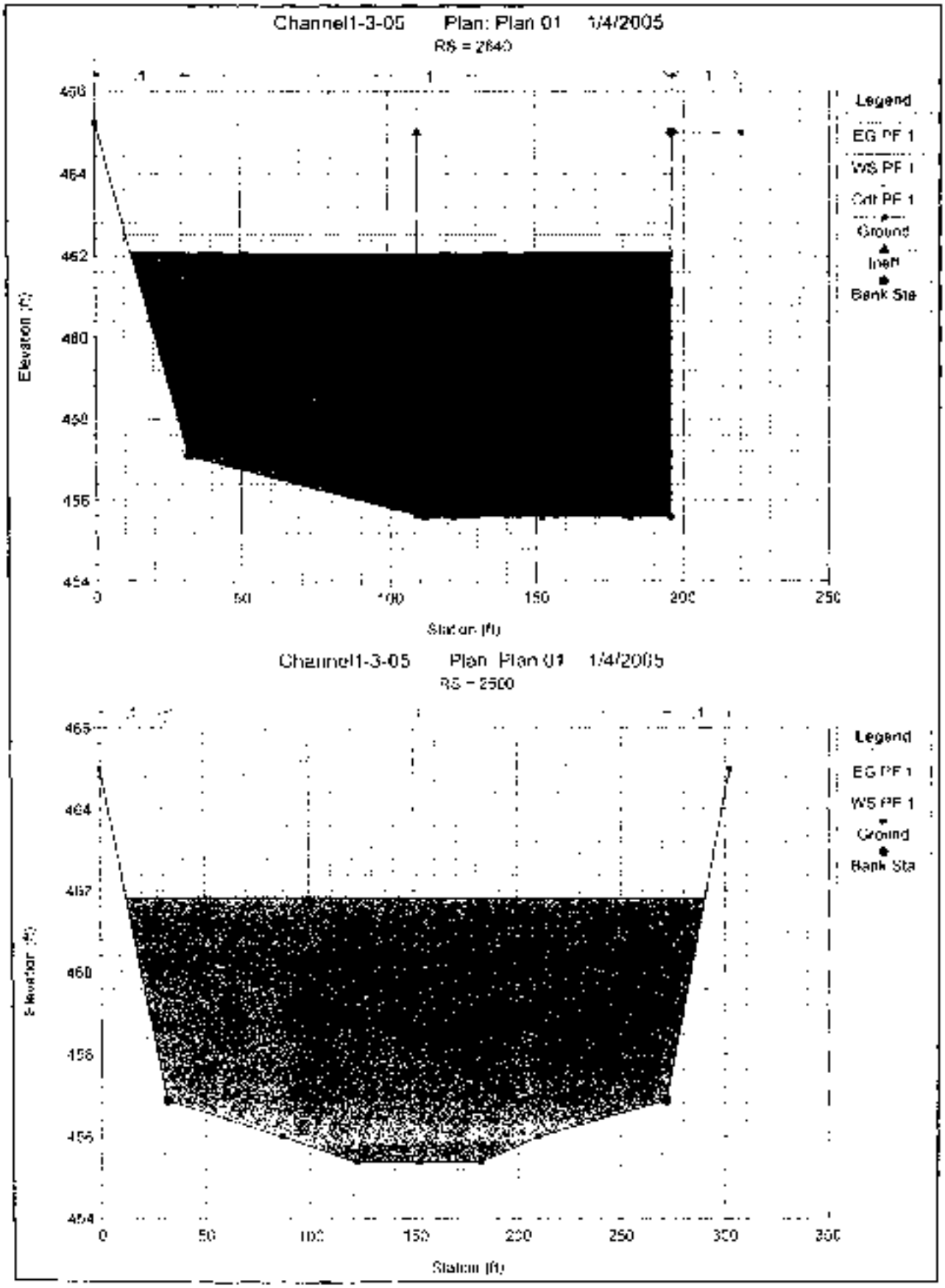

Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 4500
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 4200
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

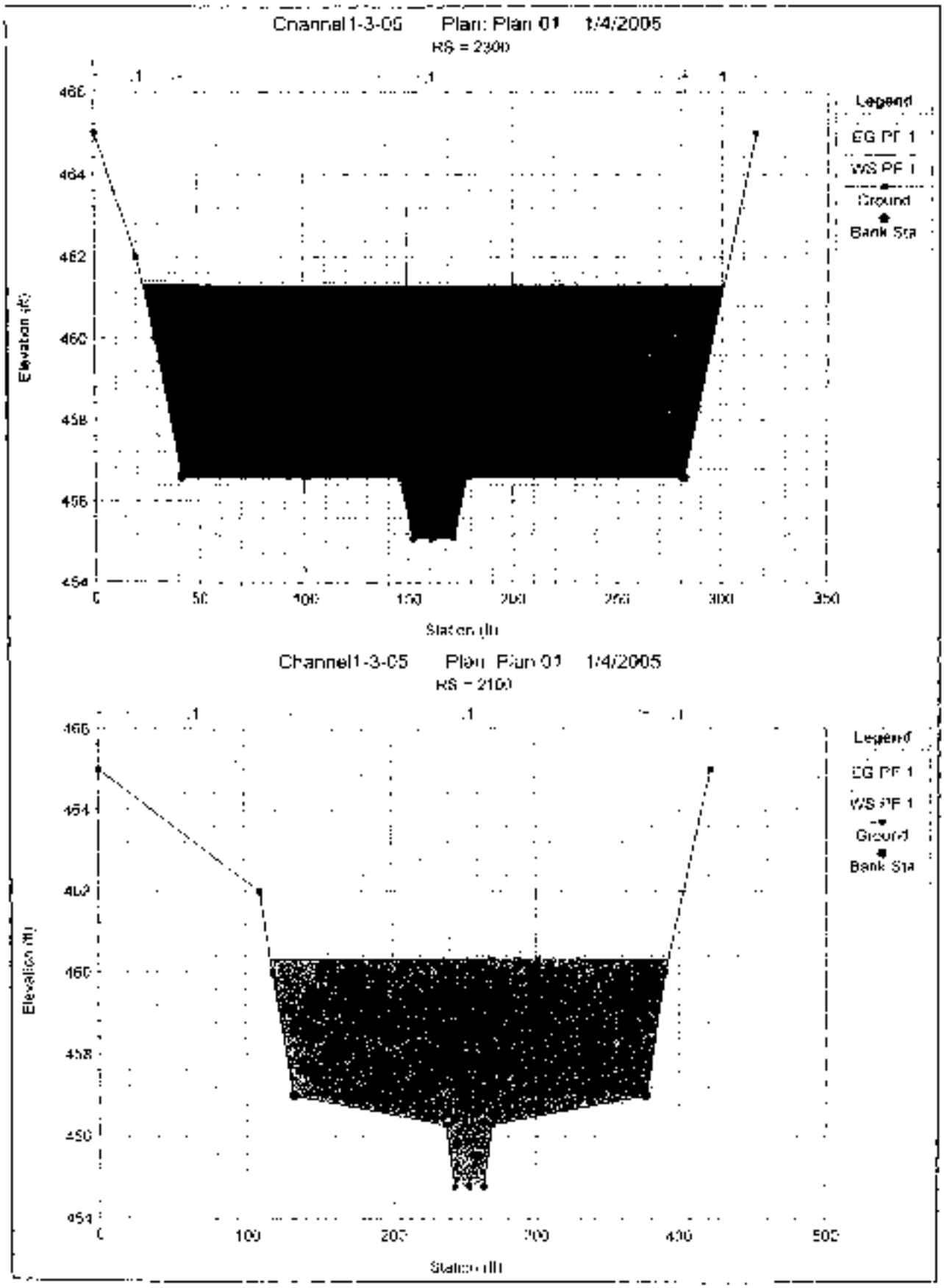

Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 3800
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 3800
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

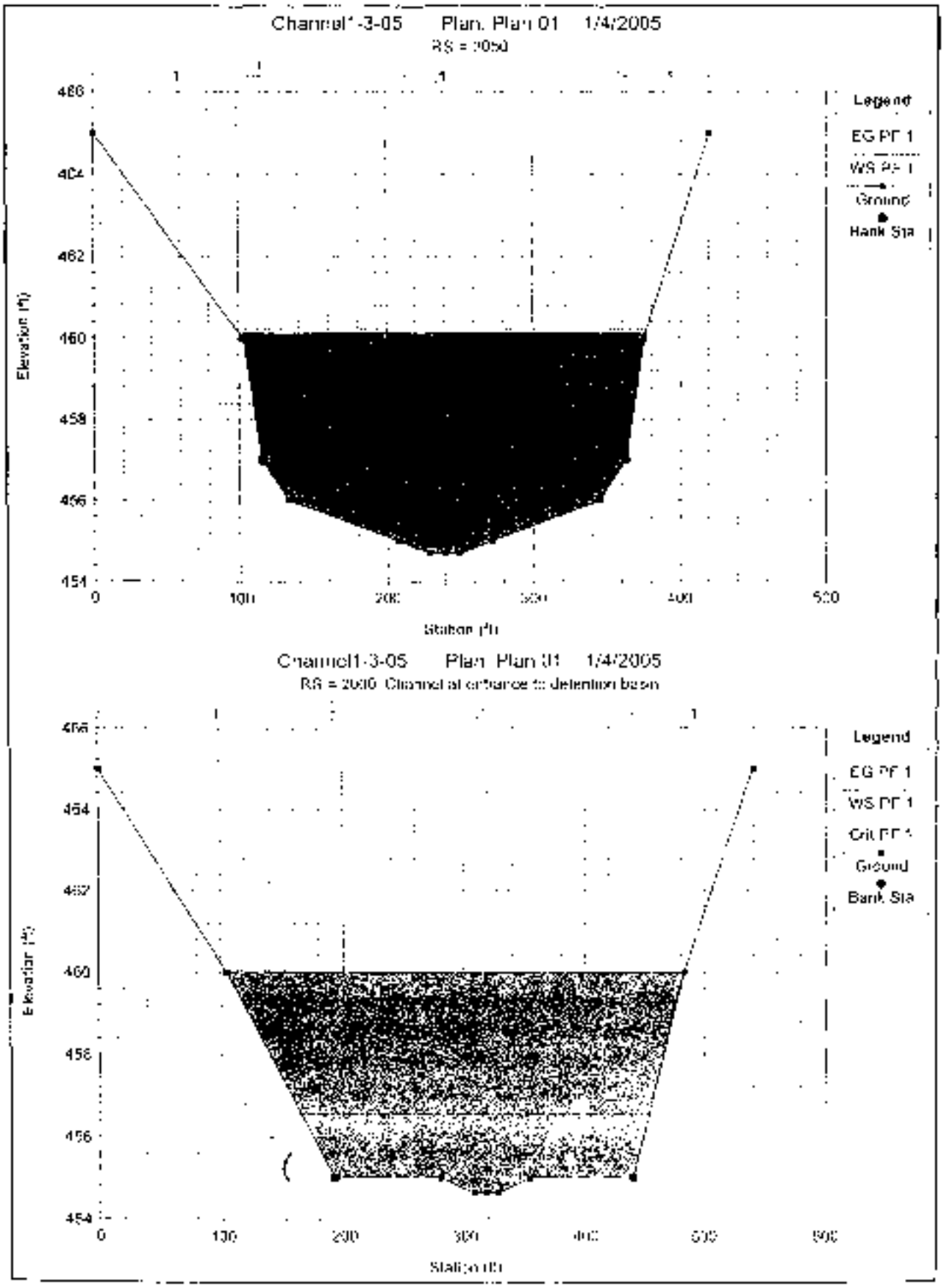

Channel 1-3-05 Plan: Plan 01 1/4/2005
RS = 3300
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel 1-3-05 Plan: Plan 01 1/4/2005
RS = 3050
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2950
.013
1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2850
.013
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2750 Culv
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Inelf
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2750 Culv
Legend
Ground
Inelf
Bank Sta
Elevation (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2640
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Inef
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2500
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2300
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2100
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2050
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2000 Channel at entrance to detention basin
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

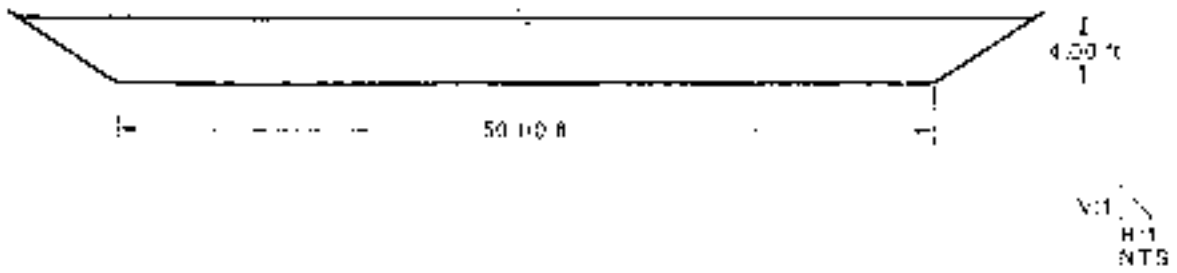
Input Data		
Mannings Coefficient	0.045	
Slope	0.006150	ft/ft
Depth	4.00	ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	50.00	ft

Results		
Discharge	1,331.30	cfs
Flow Area	224.0	ft²
Wetted Perimeter	64.42	ft
Top Width	62.00	ft
Critical Depth	2.73	ft
Critical Slope	0.022466	ft/ft
Velocity	5.94	ft/s
Velocity Head	0.55	ft
Specific Energy	4.55	ft
Froude Number	0.55	
Flow Type	Subcritical	

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Mannings Coefficient	0.045	
Slope	0.036150	ft/ft
Depth	4.00	ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	50.00	ft
Discharge	1,331.30	cfs



V. PROPOSED DRAINAGE FACILITIES

For most of the Mesa, drainage facilities are constructed as part of development or road projects, and include only facilities in the immediate vicinity of the projects. For the proposed future private development, no designs are available to show these future facilities. Caltrans has prepared plans for their SR-905 project, and those facilities are shown on the attached map

The only Master Planned facility which needs to be constructed before development takes place is the Main Channel and Detention basin in the East Watershed. Details of this system are presented in Section VI.

VI. PROPOSED DRAINAGE ALTERNATIVES

The historical drainage on the Mesa, with its flat terrain and shallow swales for drainage paths, did not become a problem until development started taking place in the 1960s. This development started concentrating flows in culverts under roads and redefined some of the historical drainage paths. Some of the development solved problems in some areas, but impacted other areas by moving the problem downstream. One of these areas is the existing creek that parallels La Media Road and eventually crosses the border into Mexico. The frequent flooding along portions of this channel is a constraint to future development for some of the areas along the creek.

1. NO PROJECT

The alternative of doing nothing to improve the drainage along the main creek channel would prevent future development from taking place along portions of La Media Road. The existing creek is not deep enough to allow the adjacent properties to drain effectively. To provide continued access along the truck route during storms, if the channel is not constructed, the roads will need to be raised or alternative routes identified. The existing intersection of Airway Road and La Media Road floods after any significant precipitation. The adjacent roads are too low to allow significant flows to pass under them, so they flood frequently. If the roads are raised to allow more flow to pass under them, they will impact the already-developed adjacent property, parts of which would now be lower than the roads, creating even more difficult drainage issues for the properties.

2. CONCRETE CHANNEL

The 1999 Otay Mesa Drainage Study recommended a concrete channel from Otay Mesa Road to the Border Detention Basin. The recommended plan was a concrete channel along the east side of La Media Road until reaching Siempre Viva Road, where it crossed under La Media and followed on the north side of Siempre Viva to box culverts under Siempre Viva that connected to the Border Detention Basin. All of the concrete channel alternatives assumed that the existing creek with its habitat would continue to carry low flows. The 1999 cost for this alternative was $10.6 million, which would be approximately $14.9 million in 2005 dollars without land acquisition.

3. LA MEDIA CHANNEL AND BORDER DETENTION BASIN

The largest watershed on the Mesa is the East Watershed, which covers an area at 6.78 square miles (4,340 Acres). All of the flow from this watershed collects at a concentration point at a large culvert where it crosses the border with Mexico and flows under the airport access road and airport runway before flowing into the Tijuana River.

This portion at the Mesa is extremely flat, and the adjacent properties can not effectively drain into the existing small creek channel without raising the elevations of the roads and developments near the creek. To allow for future development and to accommodate runoff from proposed future projects, a new channel is required with inverts from 3 to 5 feet below the existing creek channel.

The proposed channel has a bottom width that varies from 240 feet at the new border detention basin to 200 feet from north of Siempre Viva Road to the Airway Road/La Media Road intersection. The side slopes will vary between 4:1 to 10:1. Heavy riparian vegetation will be allowed to grow in the channel and no annual maintenance will be required. Once the vegetation has matured, maintenance of dead or fallen trees may be required every few years. There will be a 12 foot wide access road on each bank. The Channel will contain the 100 year flood flow with mature vegetation growth.

From the Airway Road/La Media Road intersection, a 35 foot wide concrete channel along the east side of La Media Road will connect with the proposed Caltrans culverts which will be constructed with SR 905. The RCB culverts under the intersection will need to accommodate existing utilities in both roads, which may impact the intersection and the utilities.

The Border Detention Basin will be designed to attenuate peak flows from 5 year to 100 year storms. The outlet structure will be less than six feet high, and will not be under the jurisdiction of the State of California DSOD. The design of the outlet structure will be prepared with final plans for the project. The Detention Basin will be approximately 1700' by 1500' and cover an area of approximately 58 acres.

Border Detention Basin

Area:	58 Acres
Max. Water Depth:	6.0 Feet
Max. Storage Volume:	308 AF

The basin will be graded to appear natural. Natural vegetation will be allowed to grow in the basin and no annual maintenance will be required. A low-flow stream will be created through the basin. A Maintenance Assessment District may be created for maintaining the channel and detention basin.

The basin and channel will require the removal of approximately 915,000 CY of soil. It is assumed that this export will be used on adjacent properties to raise the building pad grades thereby limiting the haul distance. A preliminary cost estimate was prepared which reflects both the construction costs and the land acquisition costs. A Property Ownership Map which shows the ownership within the East Watershed is attached.

La Media Channel and Border Detention Basin

Preliminary Opinion of Probable Construction Cost

2/8/2005

Kimley-Horn and Associates

Construction Items

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Excavation	822,500	CY	$2	$1,645,000
2	Airway Road culvert (6-5'wx5'h)	300	CY	$1,500	$450,000
3	La Media/Airway Road intersection culvert (6-10'wx6'h)	1,500	CY	$1,500	$2,250,000
4	Siempre Viva Road culvert (8-10'wx8'h)	1,490	CY	$1,500	$2,235,000
5	Detention Basin Outlet Structure	1	LS	$100,000	$100,000
6	Traffic Control	1	LS	$100,000	$100,000
7	Utility Relocation	1	LS	$150,000	$150,000
8	Street Repair	1	LS	$50,000	$50,000
9	Erosion Control	1	LS	$50,000	$50,000
10	Revegetation	1	LS	$600,000	$600,000
		Subtotal			$7,630,000
		Contingency	20%		$1,526,000
		Total			$9,156,000

Land Acquisition

1	Land Acquisition (outside MHPA)*	2,610,000	SF	$4	$10,440,000
2	Land Acquisition (inside MHPA)**	1,820,000	SF	$1	$1,820,000
		Subtotal			$12,260,000
		Contingency	20%		$2,452,000
		Total			$14,712,000

Total Cost (Construction and Land Acquisition) $23,868,000

Notes. * Includes area of detention basin and channel south of Siempre Viva

** Includes entire area within MHPA boundary

*** Estimate does not include engineering, environmental, geotechnical, surveying, etc

K:\09540\000\Excel\[cost estimate.xls]Sheet1

VII. RECOMMENDED DRAINAGE DESIGN CRITERIA

Since the five watershed areas on the Mesa flow in every direction except east, they flow into different watersheds with different constraints and impacts. The runoff from the five watersheds will have different criteria for design of drainage facilities.

West Perimeter Watershed

This watershed consists of smaller Mesa-top watersheds with a total area of approximately 254 acres that drain to the west to three separate creeks in canyons and gullies. These creeks are carried under the SD&AE and Trolley tracks and through San Ysidro in buried storm drain systems. The storm drains under the tracks have hydraulic capacities of 30 cfs (18" RCP) and 125 cfs (36" RCP) based on the San Ysidro Boulevard Area Master Drainage plan prepared by BSJ Consultants, February 15, 1996. Sub-basins OT1-7 and OT3-8 combine downstream into a single creek that flows to the 36" RCP. The current study estimates 140 cfs (Q100) will flow off of the Mesa into this sub-basin. This study does not address the capacity of the downstream system or include the hydrologic analysis for areas to the west of the Mesa, but clearly the 125 cfs capacity of the existing system will be exceeded. This area will need to be addressed in more detail during design of the upstream tributary development. Detention Basins are recommended which will reduce peak flows in the sub-basin to minimize impacts on the downstream system. These detention basins will reduce the peak, 50-year, and 100-year flow to predevelopment levels. Because of the unstable soils in this area, care should be taken that the proposed detention basins and relocated drainage facilities do not contribute to an increase in the risk of slides through increased saturation of the soil.

West Watershed

The West Watershed consists of smaller Mesa-top watersheds that drain into the tributary canyons of Spring Canyon. All of the flow from the watershed flows into Mexico at the Spring Canyon concentration point. Detention basins will be required to reduce the post-development peak flows to predevelopment levels for the 50-year and 100-year storm. If the detention basins concentrate flows at the upper edge of canyons, care must be taken to ensure that erosion potential is not increased downstream.

East Watershed

The East Watershed flows to Mexico at a single concentration point between Britannia and La Media roads. Requirements for the control of peak runoff from development in this watershed already exist. The "Notice" dated August 7, 1987 (page 2), sets criteria for detention basins and for storm drain sizing. As part of the future storm drain project in this watershed, a single detention basin will be constructed at the border. The construction of this basin will eliminate the need for individual on-site detention basins for subsequent development.

North Perimeter Watershed

These small watersheds along the northern edge of the Mesa flow into small canyons that flow into the Otay River. There are no peak flow attenuation requirements for flows from these watersheds. There may be water quality issues with the Otay River, and there may be erosion issues from storm drains on the Mesa. Only approximately 14 acres of Neighborhood 6 are in this watershed.

VIII. STORM WATER QUALITY REQUIREMENTS

Because of problems related to the poor water quality of storm water runoff from urban conveyance systems, the City requires that storm water Best Management Practices (BMPs) be constructed for all new projects. The storm water discharge contains pollution such as chemicals, trash, sediment, bacteria, metals, oil and grease. Construction projects which add impervious areas and change drainage patterns increase the discharge of these pollutants.

The Municipal Storm Water National Pollutant Discharge Elimination System Permit (NPDES Municipal Permit), approved February 21, 2001 by the San Diego Regional Water Quality Control Board (RWQCB), requires the City to implement regulations for constructing storm water BMPs for development projects.

In 2003, as part of the San Diego Municipal Code, the City published "Storm Water Standards A Manual for Construction & Permanent Storm Water Best Management Practices Requirements." This manual is the reference document for all of the storm water issues encountered in development, including BMPs. Included in this report are Appendix C -- Example Permanent Storm Water Best Management Practices, and the Storm Water Requirements Applicability Checklist from the City's Manual. Before preparing a drainage study, the "Storm Water Requirements Applicability Checklist" is completed. This checklist is used to determine the priority level of the project. Most of the projects on the Mesa will require Priority Project Permanent Storm Water BMPs and High Priority Construction Storm Water BMPs.

All projects subject to the priority permanent BMP requirements must include a "Water Quality Technical Report." From the manual, the report will include:

1. A drainage study report prepared by a civil engineer, hydrologist, or hydrogeologist registered in the State of California, with experience in the science of stream and river generated surface features (i.e., fluvial geomorphology) and water resources management, satisfactory to the City Engineer. The report shall consider the project area's location (from the larger watershed perspective), topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors to be protected specific to the project area's watershed.
2. A field reconnaissance to observe and report on downstream conditions, including undercutting erosion, slope stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies) and the area's susceptibility to erosion or habitat alteration as a result of any future upstream development.
3. A hydrologic analysis to include rainfall runoff characteristics from the project area including at a minimum, peak runoff, time of concentration, and detention volume (if appropriate). These characteristics shall be developed for the two year and ten-year frequency, six-hour or 24-hour, type B storm for the coastal areas of San Diego County. The largest peak flow should be included in the report. The report shall also report the project's conditions of concern based on the hydrologic and downstream conditions discussed above. Where downstream conditions of concern have been identified, the drainage study shall establish that pre-project hydrologic conditions that minimize impacts on those downstream conditions of concern would be either improved or maintained by the proposed project, satisfactory to the City Engineer, by incorporating the permanent BMP requirements.

Appendix D of the Manual includes detailed guidelines for the Water Quality Technical Report.

There are numerous alternative permanent BMPs that can be used for each project. The alternatives include Site Design BMPs, Source Control BMPs, and Treatment Control BMPs. The Site Design BMPs are primary ways to reduce storm water runoff through means such as increased pervious areas, increased infiltration, use of natural channels, and appropriate landscaping. All of these except dry wells are applicable to the Mesa. Source Control BMPs are meant to control pollutants at their source before they enter storm water, and are all applicable to the Mesa. Treatment Control BMPs treat the storm water before it leaves the property, and include natural methods such as biofilters, detention basins, wetlands, and porous pavement, and mechanical methods such as filters and separators. The one Treatment Control BMP that is not applicable to the Mesa is infiltration, which is not very effective on the Mesa because of the clay soils.

Most of Otay Mesa drains to the south across the border with Mexico and eventually into the Tijuana River. A small portion flows north into the Otay River, and the far western part of the Mesa flows to the west through San Ysidro and then into the Tijuana River. The Tijuana River has been identified by the 2002 Clean Water Act as a "Section 303(d) Water Quality Limited" river. The pollutants of concern which are included in the attached pages from the USEPA, need to be listed, and the new development project's potential impacts on these pollutants need to be included in the project's drainage report.

Recommended Storm Water Policies

1. **Apply water quality protection measures to land development projects during project design, permitting, construction, and operations in order to minimize the quantity of runoff generated on-site, the disruption of natural water flows and the contamination of storm water runoff.**

    a. Increase on-site infiltration, and preserve, restore or incorporate natural drainage systems into site design
    b. Reduce the amount of impervious surfaces through selection of materials, site planning, and narrowing street widths where possible.
    c. Increase the use of natural vegetation and landscaping in drainage design
    d. Avoid conversion of areas particularly susceptible to erosion and sediment loss (e.g., steep slopes), and where unavoidable, enforce regulations that minimize these impacts.
    e. Avoid land use, site development, and zoning regulations that limit impacts on, and protect the natural integrity of topography, drainage systems, and water bodies.
    f. Maintain landscape design standards that minimize the use of pesticides and herbicides
    g. Enforce maintenance requirements in development permit conditions.

2. **Require construction contractors to comply with accepted storm water pollution prevention planning practices for all projects.**

    a. Minimize the amount of graded land surface exposed to erosion and enforce control ordinances
    b. Continue routine inspection practices to check for proper erosion control methods and housekeeping practices during construction.
    c. Ensure that contractors are aware of and implement urban runoff control programs.

3. **Encourage measures to promote the proper collection and disposal of pollutants at the source, rather than allowing them to enter the storm drain system.**

    a. Promote the provision of used oil recycling and/or hazardous waste recycling facilities and drop-off locations.
    b. Follow up on complaints of illegal discharges and accidental spills to storm drains, waterways, and canyons.

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REFERENCES

This Water Quality Technical Report incorporates, by reference, the appropriate elements of the following documents and plans required by local, State or Federal agencies:

1. Municipal Storm Water National Pollutant Discharge Elimination System (NPDES) Permit

2. City of San Diego Storm Water Standards

3. Drainage Study for the Otay Mesa Community Plan

4. California Stormwater BMP Handbook, "Extended Detention Basin – TC-22" New Development and Redevelopment, January 2003

5. California Stormwater BMP Handbook, "Vegetated Swale – TC-30" New Development and Redevelopment, January 2003