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EL CERRITO STORM DRAIN MASTER PLAN

Prepared for:
THE CITY OF EL CERRITO

Prepared by:
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in association with
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INTRODUCTION

This Storm Drain Master Plan being prepared in order to address the City's concern for the increasing problems caused by deteriorating and inadequate storm drain facilities. This Master Plan Study consists of three major tasks: (1) research and mapping of the existing storm drain facilities; (2) evaluation of the existing facilities based on capacity, location, and condition; and (3) identification of storm drain improvements and related construction costs to correct major deficiencies.

El Cerrito is located in West Contra Costa County approximately two thirds of a mile east of the San Francisco Bay. The City is bordered by the City of Richmond to the west and east, unincorporated Kensington to the southeast, unincorporated Richmond Heights to the north, and the City of Albany to the south. The City of El Cerrito is a residential community of approximately 23,000 people and covers an area of approximately 3.7 square miles. The City varies in elevation between 3 feet and 1007 feet above sea level.

The City of El Cerrito was incorporated in 1917; however, most of the residential area was developed during the late 1940's and the 1950's. During that era, it was common practice to drain public streets into the nearest natural drainage way rather than constructing a separate drainage system within the street right-of-way to convey storm water to the nearest creek. Accordingly, the City's original storm drainage system was not installed in a systematic manner, and many drains were installed on private property without obtaining public easements. In some cases, structures have been constructed over these storm drain facilities.

Most of the City's storm drain system is currently 40 to 50 years old, and, therefore, deterioration is evident in many locations. The main concern is that the deterioration may lead to collapsed pipes, eroded soil, or flooding. In addition, there are many areas where the capacity of the existing storm drains is inadequate, causing frequent overflows and flooding problems. Structural and capacity problems on storm drainage facilities traversing private property has exposed the City to liability claims. During the last ten years, the City has received 23 claims of which 13 have been settled at a cost of $307,000.

DATA COLLECTION

Existing information was assimilated into this master plan report. This information included the following:

1. Existing Storm Drain Inventory Maps Prepared by the City

2. Storm Drain Maps from the City of Richmond

3. Contra Costa County Storm Drain Maps

4. Flood Insurance Rate Maps (FIRM) by FEMA

5. Flood Insurance Study Prepared by U.S. Soil Conservation Service

6. Storm water Flow Analysis, Drainage Basins Northwest from Manila Avenue

7. Hydrology and Hydraulic Calculations Prepared by the City

8. Resident Interviews

The entire City of El Cerrito was field reviewed to inspect accessible storm drain facilities. In addition, a few key storm drain facilities downstream of El Cerrito were inspected and areas upstream of El Cerrito were inspected to determine the tributary area.

A storm drain information data base was created for El Cerrito in order to provide a systematic list of information about the existing storm drain system. The data base also facilitates the analysis procedure in determining the existing deficiencies in the system and provides a standardized procedure to objectively ascertain a priority listing of proposed storm drain improvement projects.

WATERSHED & EXISTING FACILITIES DESCRIPTION

The City of El Cerrito consists of eight major drainage basins which generally drain from the Berkeley Hills, westerly towards the City of Richmond and eventually to the San Francisco Bay. Most of the El Cerrito watersheds originate within the City limits, except for the Contra Costa County Richmond Heights area northeast of the City and the Contra Costa County Kensington area and Berkeley to the southeast which all drain into El Cerrito. The easterly drainage boundary (Berkeley Hills ridge line) generally coincides with the City limits. A small acreage within the City of El Cerrito drains from the Berkeley Hills Ridge easterly over natural hillside to Wildcat Canyon Regional Park.

Each of the eight major watersheds are almost fully developed with residential areas generally located in the hills/foothills, and commercial and multi-family residential generally located in the westerly portion of the City surrounding San Pablo Avenue.

STORM DRAIN MAPPING

Storm drain utility maps were prepared to reflect the existing storm drain facilities which includes up-dated information, corrections, and clarifications revealed during the research and data collection of this project. The utility maps show location of storm drains, manholes, catch basins, easements, facility sizes, invert elevations, facility material, and slopes, where such information was available.

Information shown on the storm drain maps is intended for determining the general location of storm drain facilities, estimating storm drain deficiencies, and general planning of storm drain improvements. The information provided is primarily based on existing information sources. The original source, elevation datum, and the accuracy of the information shown is generally not known. Field surveys should be performed to verify the location of existing storm drain facilities prior to design or further analysis of proposed storm drain improvements.

HISTORIC DRAINAGE PROBLEMS

There have been a number of large storms in El Cerrito that have caused drainage problems and flooding in the past. Identifying the location and severity of the problem is helpful in developing the storm drain master plan in order to confirm the deficient areas and plan future improvement to help prevent these problems from recurring.

Data sources utilized to identify historical drainage problems included: (1) documentation of the 1969 flood; (2) the City files which were researched for records of staff reports and citizen complaints on flooding problems; (3) discussions with City staff members regarding known drainage problems; (4) the drainage questionnaire that was distributed to citizens; (5) FEMA Flood Insurance maps for the City of El Cerrito; and (6) Soil Conservation Service Flood Insurance Study of 1971.

The only portion of El Cerrito located in a FEMA Flood Insurance zone is an area called Bayview, located west of San Pablo Avenue and south of Central Avenue. Flooding is generally caused by the relatively low ground elevations in this area, coupled with hydraulic restrictions in the existing downstream channels in Richmond between El Cerrito and the San Francisco Bay.

The hydraulic analysis of Cerrito Creek performed by the Soil Conservation Service in 1971 predicted that the 100-year flood would overtop all downstream crossings, including the culverts at I-80, the railroad, and the culvert at I-580. The existing crossing at I-580 appears to be larger than the culvert that was surveyed for the flood insurance study and may have been improved to pass the 100-year flow.

Over the past ten years, from 1982 through 1991, there have been 23 drainage-related claims filed with the City. Settlement payments totaling about $307,000 have been made on 13 of these claims for an average of $23,600 per claim. Five claims are still pending. Since these claim payments are generally for damages caused and do not necessarily correct the drainage problem that caused the damage, the City must still expend additional monies to correct the drainage problem before additional damage occurs.

EXISTING STORM DRAIN DEFICIENCY ANALYSIS

An analysis was performed for the City's storm drain facilities in order to determine the deficient segments of the existing system. This deficiency analysis is the basis for the storm drain improvements recommended in this Master Plan Report. The items addressed in this analysis include hydraulic deficiencies, condition deficiencies, and operation and maintenance deficiencies. Any of these deficiencies may result in flow restrictions which may affect the level of flood protection. Although no specific deficiency analysis was performed for the 100-year flood during this study, general observations regarding 100-year flood deficiencies have been included.

Hydraulic Capacity Deficiencies

Hydraulic deficiencies of the storm drain system include those drain segments where there is insufficient capacity to convey the 10-year storm. A 10-year storm is defined as a storm that will be equalled or exceeded on the average once every ten years. The use of the 10-year flow rate is common standard for small urban watersheds. Portions of the storm drain system where the estimated peak 10-year storm runoff flows exceeded the estimated hydraulic capacity are considered to be hydraulically deficient.

Condition Deficiencies

Many of the drainage problems identified in this study relate to the condition of the existing storm drain facilities, separate from the hydraulic capacity deficiencies mentioned above.

During the field inspection portion of the Storm Drain Study, the interior of a number of storm drain facilities were inspected to determine the current condition. These inspections indicated the general condition of typical storm drain facilities in El Cerrito.

No unusual problems were observed in the concrete structures examined. In some cases, a slight misalignment of pipes at joints was observed, but this probably occurred during construction of these drain segments. While there may be additional problems with some concrete storm drain segments, **it is assumed that reinforced concrete pipes are generally in fair to good condition.**

Most of the corrugated metal pipes (CMP) viewed during field inspection had some problems with corrosion and perforation of the invert (bottom) sections of the pipes. The drain segments that were examined appear to still be structurally sound, with no distortion or eminent collapse of the upper portion of the pipe occurring yet. However, these storm drains are candidates for rehabilitation or replacement in the near future before more deterioration occurs. More serious problems may exist in portions of the drainage system that was not accessible, and a more complete inspection program of the CMP drains should be undertaken in order to locate areas where extremely serious problems may be present. Most of the CMP pipe was probably installed in the late 1940's and early 1950's and is now at least 40 years old. Since this exceeds the expected life of this type of pipe, **the condition of CMP drains is assumed in to be poor to fair condition, unless an inspection has shown otherwise.**

Operation and Maintenance Deficiencies

During the field inspection of the storm drain system, a number of maintenance deficiencies were noticed. Many of these deficiencies consisted of relatively minor problems such as debris accumulation in catch basin inlets, and broken grates on catch basins. In addition, there are several more serious maintenance problems observed that may justify structural improvements. These problems are generally related to the collection of sediment and debris in the larger storm drains which threatens to cause flooding problems due to the potential blockage of the storm drain. Regular maintenance and better debris removal facilities may be desirable at several locations in the City, especially downstream of open space areas, where large amounts of debris tend to collect.

100-Year Flooding Deficiencies

The Master Plan Hydrology Analysis included the estimation of the 100-year flows throughout the storm drain system, but no evaluation has been made of flooding problems that would occur during the 100-year flood. In most cases the existing storm drain system would be inadequate to carry these flows, and excess storm water would be carried in the streets. The exact overland flowpath would be difficult to predict.

Since the City's street system conveys storm water drainage whenever the capacity of the local storm drain facilities is exceeded, it is current practice to construct improvements on adjacent properties such that they will not be flooded from these street flows. Some existing properties were developed at elevations lower than the adjacent roadway without providing positive drainage through their property. Although the proposed drainage improvements will reduce street flooding, it is cost prohibitive for the City to construct storm drain facilities such that street flooding will be eliminated. Accordingly, those properties currently impacted by street flooding may continue to experience problems during major flood events.

The area of El Cerrito currently located in the 100-year flood plain as identified by FEMA is described above under "Historic Drainage Problems." Flooding in this area appears to be caused by undercapacity drainage channels and undersized drainage facilities crossing the I-80 freeway and Southern Pacific Railroad located in Richmond.

One barrier to the 100-year flows may be the area along the BART right-of-way. The former railroad grade along this path was slightly elevated in several locations, and streets crossings in these areas may be raised to meet this grade. This may have altered the natural drainage pattern towards the west. Some drainage structures crossing the BART area consist of bridges, channels, or oversize culverts and may provide enough capacity to provide passage of the 100-year flows. In other cases, the existing drainage structures would not provide adequate capacity, and some ponding of water behind the embankment could be expected during high flows.

STORM DRAIN IMPROVEMENTS

Improvement Goals

The improvements recommended for the El Cerrito storm drain system are intended to bring the existing facilities up to an acceptable condition and to provide adequate capacity to allow the drainage system to carry the 10-year storm water runoff through the City without causing flooding damage.

Based on the evaluation of the existing deficiencies in the storm drain system, the following are recommended goals for El Cerrito to utilize in planning future improvements to the drainage system:

1. Replace all storm drains in substandard structural condition.

2. Provide capacity in the storm drain system to convey the 10-year peak flow rate.

3. Convey all public storm water through drainage facilities located within public street right-of-ways or within public drainage easements.

Prioritization of Improvements

Meeting these storm drain improvement goals will require a long term commitment of considerable financial resources. A priority assessment was performed based on the existing storm drain deficiencies in order to allocate resources to those improvements which are most critical and represent the most benefit to the City's storm drain system.

Several factors were considered in developing the priority list of storm drain improvement projects. The general factors included were: (1) Quantity of storm water flow being conveyed; (2) The hydraulic capacity; (3) Deteriorated condition; (4) Location of drainage facility (on public right-of-way or on private property); and (5) whether flood damage has recently occurred. For each of these general conditions, a severity factor was applied. Potential problems that may occur more frequently, affect more people, or cause more damage should have a higher priority to be corrected than less severe problems. The resulting priority ranking of City wide storm drain segments that have deficiencies is contained in the Technical Appendix of the Storm Drain Master Plan.

Improvement Options

There are a number of options available to correct the identified deficiencies in storm drain capacity and condition. The determination of the best option for each site will require a careful evaluation of a number of factors specific to each project and a determination of the cost effectiveness of various options.

For planning purposes at a master plan level, several factors were identified that would most likely influence the options that would be used to correct the deficient conditions. These factors included whether or not there was a condition problem, whether or not there was a capacity problem, and whether or not the drain was located in a public right-of-way.

In determining the likely options, it is assumed that in most cases it is desirable for existing drainage facilities currently on private property to be rerouted to an existing nearby public street. This generally provides better access to the facilities for future maintenance and would reduce liability exposure of the City. If the capacity of the existing drain is adequate and an inspection of the pipe indicates that there is no deterioration then replacement of the drain could reasonably be delayed until a future time even if it is on private property. In some cases, rerouting the flow may not be feasible due to topography constraints which prevent a gravity flow drain from being installed at a reasonable cost. In these cases, obtaining a drainage easement through the property should be considered as a possible alternative.

If utilization of the existing alignment on private property is considered to be the most cost effective alternative, various methods can be considered for replacement or rehabilitation of the drain. A drainage easement along the alignment would be desirable to allow for future maintenance and replacement. Replacement of the existing drain with a new concrete pipe would be the most desirable option for the long term benefit of the drainage system. If installation of a new drain would be too disruptive or costly, rehabilitation of the existing drain could be considered. For example, if the bottom of larger CMP drains (30-inch and larger) has deteriorated but the remainder of the pipe is structurally sound, lining the bottom of the pipe to extend the life of the existing storm drain can be considered.

In some cases, the existing storm drain may discharge into or receive flow from an open channel area that local residents feel is a significant natural resource. Rerouting flows may disrupt or eliminate these natural areas. In these natural drainage areas where additional capacity should be provided, a possible solution is to allow low flows (for example a 6-inch pipe) to continue through the open channel areas and divert the majority of flows through a rerouted storm drain.

STORM DRAIN MASTER PLAN IMPROVEMENT PROGRAM

The master plan improvement program has been divided into two phases. The first phase, to be implemented during the first five years of the construction program, would include those existing areas with the most serious deficiencies. Other storm drain problems would be corrected over a future time period.

The first phase of the storm drain improvement program includes most drain segments with the higher deficiency points. This phase would include: (1) all drains on private property that have known or potential condition problems (CMP drains); (2) the drains with more serious capacity problems on private property; and (3) the drains with more serious capacity and condition problems on public right of way. The correction of some drainage problems with a lower priority are recommended for cost effectiveness reasons due to their proximity to a higher priority problem. That is, it is more cost effective to include all improvements in the same area in one construction project. Sixty possible projects have been identified which have 12 or more deficiency points. The general location of these proposed projects is shown in Exhibit "E", and are identified by project number. A brief description of some of the major projects proposed for Phase I is included in the Technical Appendix. A summary of all the recommended projects for this first phase and their estimated construction cost is shown in Table 9. As can be seen, the total construction cost of these sixty projects for Phase I is estimated to be $5.8 million.

The first phase construction program does not address all deficiencies in storm drains that have been identified. The drainage problems with lower priorities would be deferred to a later construction program. A few drains with higher priorities have been excluded from the first phase construction program due to special circumstances. For instance, several drain segments near Cypress Avenue have a high priority but improvements would not be effective without correction of downstream capacity problems in the City of Richmond.

Storm drains with identified deficiencies but having a lower priority assessment than those included in the first phase construction program should be reviewed further to determine if there are any special circumstances not considered in our general evaluation which would warrant a higher priority rating. For instance, plans for road reconstruction or drainage improvements required for a specific development may make the correction of some lesser drainage deficiencies more cost effective to perform in conjunction with these other construction projects.

FINANCING MECHANISMS

An essential requirement for implementation of El Cerrito's Storm Drainage Master Plan is a feasible funding program. Once the Master Plan is adopted, positive steps should be taken to assure that adequate monies will be available to construct the required facilities. This report outlines a number of possible sources of funds and financing methods which might be considered to implement the City's storm drainage improvement program. In considering these potential funding mechanisms, it may become evident that no single financing method will be sufficient to provide the funding necessary to implement all of the recommendations contained in the Master Drainage Plan. Accordingly, the City may consider various combinations of financing mechanisms in implementing this plan.

Possible sources of funds discussed in this report include General Funds, Redevelopment Funds, Gas Tax Funds, Development Exactions/Fees, Special Tax, Utility User Tax and City-wide Storm Water Utility Fees. Special Assessment District Financing methods are also presented, consisting of Mello-Roos Community Facilities District, Municipal Improvement Act of 1913, Benefit Assessment Act of 1982, or Landscaping and Lighting Act of 1972. Bond financing mechanisms discussed include the Revenue Bond Acts of 1933, 1941, and 1957, General Obligation Bonds, Limited Obligation Bonds, Certificates of Participation, Lease Revenue Bonds, and Tax Allocation Bonds. Possible Federal and State Assistance programs are also identified, such as the Federal Community Development Block Grant Programs (CDBG), the Federal Economic Development Act (EDA), and Urban Creek Restoration Program.

Given the size of the proposed Phase I drainage improvement program, it appears that El Cerrito will have to finance the construction of these drainage improvements rather than implementing a "pay as you go" program. Table 10 shows what the approximate annual assessment for a typical single family parcel would be if the City finances the entire Phase I program estimated to cost $5.8 million. This annual assessment of $83.67 is based on an estimated 4200 square feet of impervious surface per single family parcel. Actual assessments may differ from this amount depending on method of spreading these drainage improvement costs and refinement of parcel information used to calculate this assessment.

CONCLUSION

The main purpose in preparing this Storm Drain Master Plan for the city of El Cerrito is to address the City's concern for the increasing number of problems caused by deteriorating and inadequate storm drain facilities. These problems have recently emerged in the form of several claims filed against the City for damage due to flooding and saturated soil. This history of law suits has resulted in $307,000 of claim payments over the last ten years.

The City needs to limit their exposure to the potential of future claims by focusing of three objectives: (1) replace deteriorating metal pipes; (2) relocate public drainage facilities from private right-of-way (or easements); and (3) improve under-capacity storm drain lines. These three objectives are the basis for the improvement projects recommended in this study.

The research, inventory, and analysis conducted during development of the storm drain master plan has resulted in up-to-date computerized mapping system of the city's existing storm drain facilities, a general indication of deficient storm drain segments, a recommended construction plan to resolve high priority deficiencies, and cost estimates for future improvements needed to bring the City's storm drain system up to present standards.

There are three types of deficiencies within the existing storm drain system: condition deficiency, hydraulic capacity deficiency, and operation and maintenance deficiency. Based on field survey and pipe material life expectancy, it is generally assumed that metal pipes are in poor to fair condition and concrete pipes are in fair to good condition. The hydraulic capacity deficiencies are based on the standard practice of providing 10-year storm protection with the underground storm drain facilities. In general, it is not cost effective to convey major flood flows through minor underground storm drain pipes. Therefore, storms larger than a 10-year storm are accommodated by a system of overland flow facilities which consist of streets, channels, creeks, and open space. If the major overland system is lacking in a particular area, the City may wish to increase the design criteria for the underground improvements. Operation and maintenance deficiencies can be eliminated with routine maintenance of the storm drain system and a plan for a safe overland release point if a particular facility is not properly operating.

The cost estimate for City-wide storm drain improvements indicates a general magnitude cost of $13.25 million to be used for long-range planning purposes. This study outlines sixty proposed projects called the "Phase I Construction Program. These recommendations are aimed at resolving the high priority drainage problems which represent the most benefit to the community. These projects have an estimated cost of approximately $5.8 million; however, the cost of "no action" may result in damage to private property which could be many times the cost of constructing the improvements. For example, if the $5.8 million is spread to all the parcels in the City, the resulting cost is approximately $640 per parcel which may be less than claims resulting from flood damage. Possible funding mechanisms for the improvements include a Utility User Tax Benefit Assessment District and Storm Drain Utility Fees. The annual assessment, if the City decides to finance the entire $5.8 million storm drain restoration program by assessing all of the parcels within the City corporate limits and selling bonds with the revenue generated by these assessments, is estimated to be about $84 per single family residence.

1. INTRODUCTION

The City of El Cerrito has retained Willdan Associates to prepare a Master Plan for the City's storm drain system. This Storm Drain Master Plan Study consists of three major tasks: (1) research and mapping of the existing storm drain facilities; (2) evaluation of the existing facilities based on capacity, location and condition; and (3) identification of storm drainage improvements and estimation of construction cost to correct major deficiencies. The Master Plan of Drainage is being prepared in order to address the City's concern for the increasing number of problems caused by deteriorating and inadequate storm drain facilities, including liability claims related to the drainage system. Documents produced as a result of this study include: this El Cerrito Storm Drain Master Plan Report, separate Technical Appendices, and a set of Storm Drain Master Plan Facility Maps.

1.1 BACKGROUND

The City of El Cerrito, located in West Contra Costa County as shown on Exhibit A, was incorporated in 1917; however most of the residential area was developed during the late 1940's and 1950's. During that era, it was common practice to drain public streets into the nearest natural drainage way rather than constructing a separate drainage system in the street to convey storm drain to the nearest creek. Accordingly, the City's original storm drainage system was not installed in a systematic manner, and many drains were installed on private property rather than public easements. In some cases, buildings have been constructed over storm drain facilities.

Most of the City's storm drain system is currently 40 to 50 years old and in many locations, the original storm drains are deteriorating. The main concern is that the deterioration may lead to collapsed pipes, eroded soil, or flooding. In addition, there are many areas where the capacity of the existing storm drains is inadequate, causing frequent overflows and flooding problems.

Over the past ten years, from 1982 through 1991, there have been 23 drainage-related claims filed with the City. Settlement payments totaling about $307,000 have been made on 13 of these claims for an average of $23,600 per claim. Five claims are still pending. Since these claim payments are generally for damages caused and do not necessarily correct the drainage problem that caused the damage, the City must still expend additional monies to correct the drainage problem before additional damage occurs.

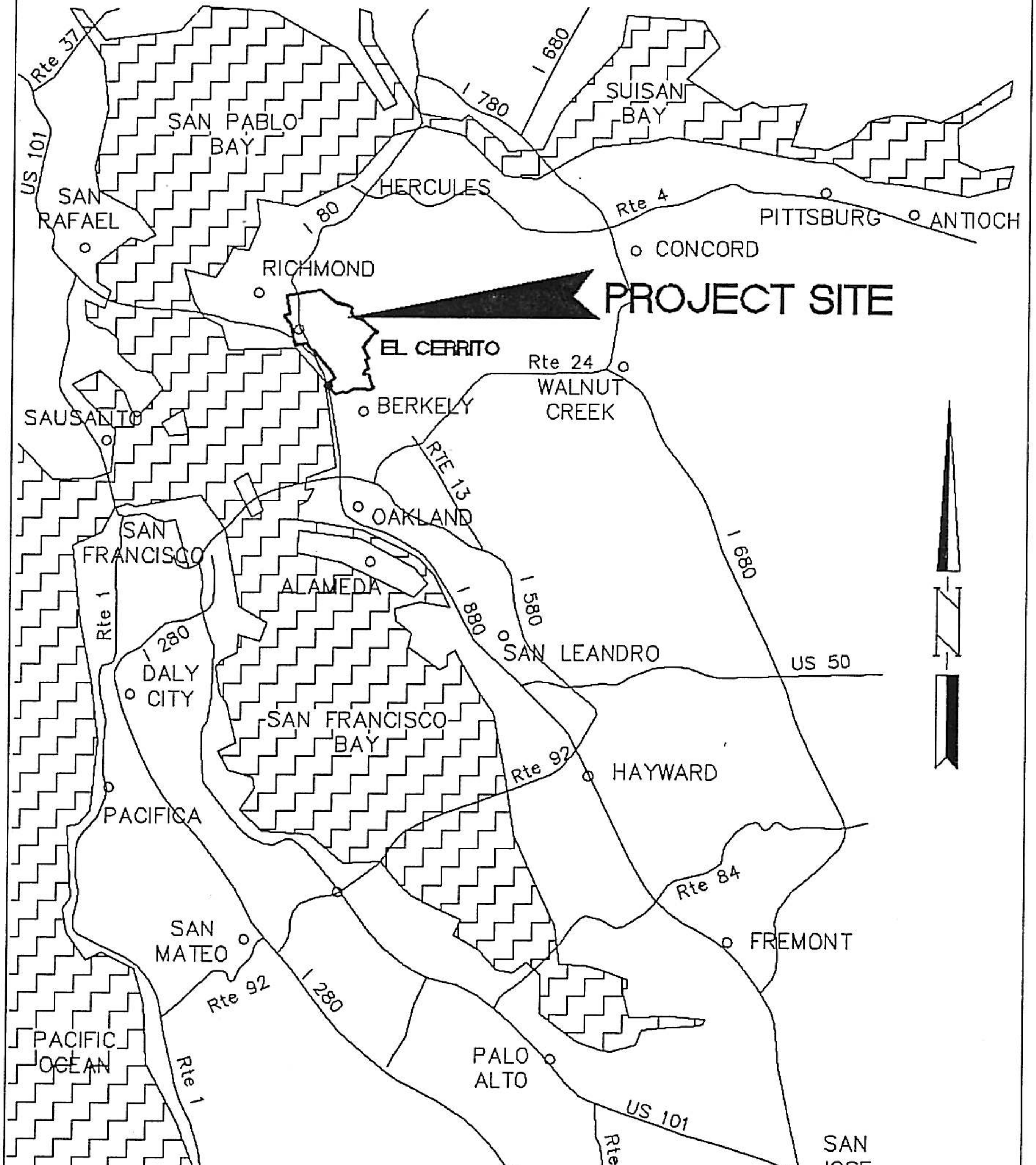

EXHIBIT A
VICINITY MAP
(NOT TO SCALE)

WILLDAN ASSOCIATES
ENGINEERS & PLANNERS
PLEASANTON

1.2 OBJECTIVES

It is the objective of this study to provide the following items:

1. Prepare Storm Drain Utility Maps (1" = 100') in AutoCAD format to show the existing storm drain facilities within the City Limits.

2. Provide a database inventory of the City's storm drain facilities.

3. Estimate the 10-year and 100-year storm flow rates throughout the drainage system.

4. Perform a hydraulic deficiency analysis based on 10-year flow rates to provide a general indication of system deficiencies.

5. Identify construction improvements and associated costs to correct major deficiencies in the storm drain system.

6. Identify potential mechanisms to finance a storm drain improvement program.

7. Describe and document the storm drain evaluation in a Storm Drain Master Plan Report in order to assist the City in planning for the future.

1.3 APPROACH

This Storm Drain Master Plan has been prepared based on readily available existing data sources. The hydrology and hydraulic analysis was performed at a master plan level of accuracy utilizing computer modeling techniques. The following approach was utilized to accomplish the objectives of this study.

1. Obtain and review existing information regarding the City's storm drain system. This includes research of previous studies, construction drawings, and the City's existing storm drain maps and calculations. This information was obtained from the City of El Cerrito, Contra Costa County, and the City of Richmond.

2. Conduct a field investigation to locate and determine the condition of existing storm drain facilities. All accessible components of the system were observed in the field to record or confirm the research information. Field review consisted of investigating the following items: facility size and location, material, manhole location, outlet location, condition of facilities, drainage boundaries, erosion, and sediment deposition.

3. Identify existing drainage problems through interviews with City staff and review of resident questionnaire forms.

4. Prepare storm drain utility maps to reflect the existing storm drain facilities, incorporating the research information obtained during this project. The utility maps show location of storm drains, manholes, catch basins, easements, facility sizes, invert elevations, facility material, and slopes. Mapping was performed using the AutoCADD system. The base maps, showing roads and property lines, were obtained from East Bay Municipal Utility District (EBMUD) and converted from Intergraph format to AutoCADD format.

5. Compile a data base inventory of the information gathered, utilizing the dBase format.

6. Perform the 10- and 100-year hydrology calculations.

7. Perform hydraulic calculations to estimate the capacity for each storm drain segment.

8. Determine system deficiencies based on the calculated 10-year peak flow rates and estimated hydraulic capacities.

9. Develop alternative solutions to correct major deficiencies identified during the deficiency analysis and estimate the construction cost for the alternatives.

10. Evaluate alternative funding mechanisms available to the City for implementing the needed improvements.

11. Develop a storm drain construction program to implement the recommended storm drain improvements based on the desired level of financing.

12. Prepare a report that documents the methods and findings of the Master Plan Study.

1.4 GENERAL DESCRIPTION OF STUDY AREA

El Cerrito is located in West Contra Costa County approximately two thirds of a mile east of the San Francisco Bay. As shown in Exhibit B, the City is bordered by the City of Richmond to the west and east, unincorporated Kensington to the southeast, unincorporated Richmond Heights to the north, and the City of Albany to the south. The City of El Cerrito is a residential community of approximately 23,000 people and covers an area of approximately 3.7 square miles. The City varies in elevation between 3 feet and 1007 feet above sea level.

EXHIBIT B
CITY OF EL CERRITO
SITE MAP

WILLDAN ASSOCIATES
ENGINEERS & PLANNERS
PLEASANTON

NOT TO SCALE
JULY 6, 1992

2. DATA COLLECTION

2.1 AVAILABLE RESOURCES

No previous comprehensive storm drain Master Plan for the entire City was available as a resource for this study. However, basic information on the City's storm drain system was utilized as much as possible. The following data sources were utilized in preparing this Master Plan Storm Drain Study.

1. **Existing Storm Drain Inventory Maps Prepared by the City.**

   The existing storm drain inventory maps at a scale of 1" = 100' generally show the location, pipe size, and pipe material for the storm drain system. The pipe slopes and invert elevations are only provided on these maps for approximately one fifth of the storm drain segments. As a result of field inspection, these inventory maps were found to be good base information, but inlet and pipe locations were not entirely accurate.

2. **Storm Drain Maps from the City of Richmond.**

   The storm drain maps for the City of Richmond were prepared in 1963 with the latest revision in 1976. These maps were obtained in order to investigate the adjoining downstream areas. These 1" = 400' maps show the location, size, and material of storm drains with occasional references to construction plans. Twenty-five foot contour intervals are shown for the El Cerrito area. These maps have been helpful in confirming drainage basin boundaries in the upper areas of El Cerrito. The City of Richmond is in the process of updating their storm drain maps.

3. **Contra Costa County Storm Drain Maps.**

   Storm drain maps from Contra Costa County were obtained for the adjoining area of Richmond Heights. These maps were used to confirm the drainage boundaries in order to determine the discharge flow rate entering from outside the El Cerrito City limits. No drainage maps are available at the County for the Kensington area.

4. **Flood Insurance Rate Maps (FIRM) by FEMA.**

   The flood insurance rate maps (FIRM) published by the Federal Emergency Management Agency (FEMA) indicate the area of the City which is located within the 100-year flood plain.

5. **Flood Insurance Study Prepared by U.S. Soil Conservation Service.**

A flood insurance study was prepared in 1971 by the U.S. Soil Conservation Service to investigate Cerrito Creek. The study consisted of a hydrology analysis and simplified hydraulic analysis for the culvert structures downstream of Adams Street which includes a small segment in the City of El Cerrito and the remainder in Richmond.

6. **Storm water Flow Analysis, Drainage Basins Northwest from Manila Avenue**

Storm water Flow Analysis, Drainage Basins Northwest from Manila Avenue, prepared by Govers Engineers in 1978, was obtained from the City. This report describes an investigation of flooding problems in the northwest portion of the City. This report includes several recommendations to resolve the flooding problems. Some of these recommendations have been implemented by the City.

7. **Hydrology and Hydraulic Calculations Prepared by the City**

The City has a partial evaluation of the hydrology and hydraulics for the existing storm drain system. This information was used as a basis for this Master Plan deficiency evaluation. However, many changes have been made to the drain segments that were analyzed, and the hydrologic subareas used for this Master Plan are more detailed than the previous evaluation.

8. **Resident Questionnaires**

Resident survey forms were circulated by the City to some residents in areas suspected to have drainage problems. These questionnaires were designed to obtain information from residents about specific areas of drainage problems and the historical occurrence of these problems. About 281 questionnaires were mailed to residents and about 89 responses were received. Of these responses, 17 provided information on drainage problems. This information was utilized for the description of historical flooding problems.

2.2 FIELD VERIFICATION

The entire City of El Cerrito was field reviewed to inspect accessible storm drain facilities. In addition, a few key storm drain facilities downstream of El Cerrito were inspected and areas upstream of El Cerrito were inspected to determine the tributary area.

Field verification included inspection of street catch basin inlets, storm drain manholes, junction box locations, and inlet/outlet headwall facilities. At catch basin and headwall locations, the size and material of the drain pipe was confirmed if accessible. Also, the flow direction and pipe connection configuration was noted when visible.

Where the type of facilities could not be readily determined, inlet grates, manhole covers, and junction box lids were lifted in order to more accurately determine the drain dimension, condition, and connection pattern. A number of the larger facilities (30 inch diameter and larger) were entered at access points and inspected in order to confirm the dimensions and condition of the drainage facility.

Drainage facilities located on private property were inspected when visible from the street or if the property owner was available at the time of inspection. Several facilities located on private property were discovered during the field investigation that had not been plotted on the City's existing storm drain inventory maps. During the field investigation, historical drainage information was ascertained through approximately a dozen conversations with residents. These conversations were valuable sources of information in order to indicate areas of past flooding, as well as indicate where flooding has not been observed in the past.

The field inspection resulted in various corrections to the City's existing utility maps which included deleting catch basins which no longer exist, revising pipe configurations between structures, and properly identifying the location of catch basins, manholes, and junction boxes. Several structures such as catch basins, manholes, and junction boxes which were identified in the field but were not shown on the storm drain utility maps were added to the new maps. Also, at several locations, facility material and dimensions were corrected.

A few storm drain improvements that have been constructed since the utility maps were updated were also added to the storm drain maps.

As a result of the field inspection of storm drain facilities, the reinforced concrete pipes (RCP) in El Cerrito can generally be assumed to be in fair to good condition. Except for a slight misalignment of joints which may have occurred during construction, no unusual problems were observed for concrete structures. In contrast, the metal pipes (CMP) examined revealed corrosion and perforation of the bottom portion of many of these pipes. These drain segments appear to still be structurally sound with no distortion or eminent collapse of the upper portion of the pipe. However, these pipes are candidates for rehabilitation or replacement before more deterioration occurs. Based on the limited field inspection and the age of the City's storm drainage system, all existing metal pipes are assumed to be in poor to fair condition. This description of general pipe condition is based on examination of storm drains at access points. Areas that are not accessible may have more serious problems but were not visible during the field examination. Therefore, the general assumption that RCP is in fair to good condition and metal pipes are in poor to fair condition, is based on limited examination, historical maintenance records, and typical life of various pipe materials.

2.3 STORM DRAIN INFORMATION DATA BASE

A storm drain information database for El Cerrito was created in order to provide a systematic list of information about the existing storm drain system. The database also helps provide an efficient procedure for analysis of the system in determining existing deficiencies and provides a standardized procedure for determining the priority of proposed improvement projects.

The computer software utilized for creating, maintaining, and analyzing this database was the dBase IV database management system. A complete description of the El Cerrito storm drain information database system is contained in the Technical Appendix.

The storm drain information database is intended to contain information on all significant portions of the storm drain system. The database file is organized as a series of data records, and each record contains a set of data fields that contain specific information for one storm drain segment. A storm drain segment consists of a length of storm drain facility with the same characteristics, including drain size, material, and slope. Different drain segments were also utilized whenever a significant junction pipe was encountered, where a manhole or junction box was encountered, and at hydrology inflow node points. For the Master Plan, the information database included data on about 950 storm drain segments (including open channel drains).

Almost all storm drains greater than 12 inches are included in the storm drain information database. Many significant storm drains that are 12 inches or smaller are also included in the database. However, records are not usually included for minor connector pipes which lead from catch basin inlets to main storm drains or other short drain segments that do not drain significant drainage areas.

The information database contains a number of data fields that contain the relevant information about the storm drain system. The information that is entered into the database includes the hydrology subarea, storm drain map number, the drain dimensions, material, length, slope, street location, location on private or public right-of-way, and drain invert and ground elevations. Additional information on the storm drains is calculated by computer programs and stored automatically in the database. Details of this process are described in Section 6 of this report.

As additional information about the storm drain system is gathered, the storm drain information database can continue to be updated to reflect this information. In some cases, it may be necessary to subdivide presently defined drain segments into smaller segments, to reflect a change in storm drain characteristics that has been discovered. It is also easy to add new data fields to the database system if it is desired to store additional information about some or all of the storm drain segments.

3. WATERSHED & EXISTING FACILITIES DESCRIPTION

3.1 GENERAL

The City of El Cerrito consists of eight major drainage basins which generally drain from the Berkeley Hills, westerly towards the City of Richmond and eventually to the San Francisco Bay. Most of the El Cerrito watersheds originate within the City limits, except for the area northeast of the City, where a watershed area in Contra Costa County (Richmond Heights) drains into El Cerrito and the area southeast of the City, where watershed areas in Contra Costa County (Kensington), Berkeley, and Albany also drain into El Cerrito. In addition, a drainage channel from the City of Albany flows into Cerrito Creek approximately 500 feet upstream (east) of the westerly City boundary with the City of Richmond. A portion of the City of Richmond also technically drains into the City of El Cerrito, but this water only flows along San Pablo Avenue and then back to the City of Richmond without entering the storm drain system. The easterly drainage boundary (Berkeley Hills ridge line) generally coincides with the City limits. A small acreage within the City of El Cerrito drains from the Berkeley Hills Ridge easterly over natural hillside to Wildcat Canyon Regional Park. Table 1 summarizes the drainage areas within El Cerrito, and Exhibit C maps these eight drainage basins.

Each of the eight major watersheds are almost fully developed with residential areas generally located in the hills and foothills, and commercial and multi-family residential generally located in the westerly portion of the City surrounding San Pablo Avenue. Section 3.2 provides a brief description of the eight major watersheds and the major drainage facilities in each of the eight basins. Street references are provided in the following text only for general basin location. Estimated drainage boundaries for these basins may be located on the storm drain maps. The length to width ratio provided in the basin description indicates whether the basin is long and narrow which corresponds to a long time of concentration, or whether the basin is short and wide which relates to a shorter time of concentration. A longer time of concentration corresponds to a lower rainfall intensity and, therefore, a lower peak flow rate. The average slope is a general indication of the water velocity (i.e., steeper terrain will have a higher velocity and, therefore, a shorter time of concentration with a higher peak flow rate).

TABLE 1 EL CERRITO WATERSHED AREAS				
Basin No.	Location	Drainage Area Inside El Cerrito (acres)	Drainage Area Outside El Cerrito (acres)	Total Drainage Area (acres)
1	El Cerrito	27.0		
	Outflow from El Cerrito to Contra Costa Co. (Richmond Heights)	11.2		
	Inflow from Contra Costa Co. (Richmond Heights) (1)		63.3	
	Inflow from City of Richmond		7.3	108.8
2	El Cerrito	136.2		136.2
3	El Cerrito	106.7		106.7
4	El Cerrito	197.4		197.4
5	El Cerrito	240.9		240.9
6	El Cerrito	311.5		311.5
7	El Cerrito	454.3		454.3
8	El Cerrito	684.4		
	Outflow from El Cerrito to Contra Costa Co. (Kensington)	24.5		
	Inflow from Contra Costa Co. (Kensington) and Berkeley (1)		614.6	1323.5
Miscellan eous	Outflow from El Cerrito west to Richmond	100.5		100.5
Miscellan eous	Outflow from El Cerrito to east	113.1		113.1
Total		2407.7	685.2	3092.9
(1) Exclusive of outflow from El Cerrito that reenters El Cerrito.				

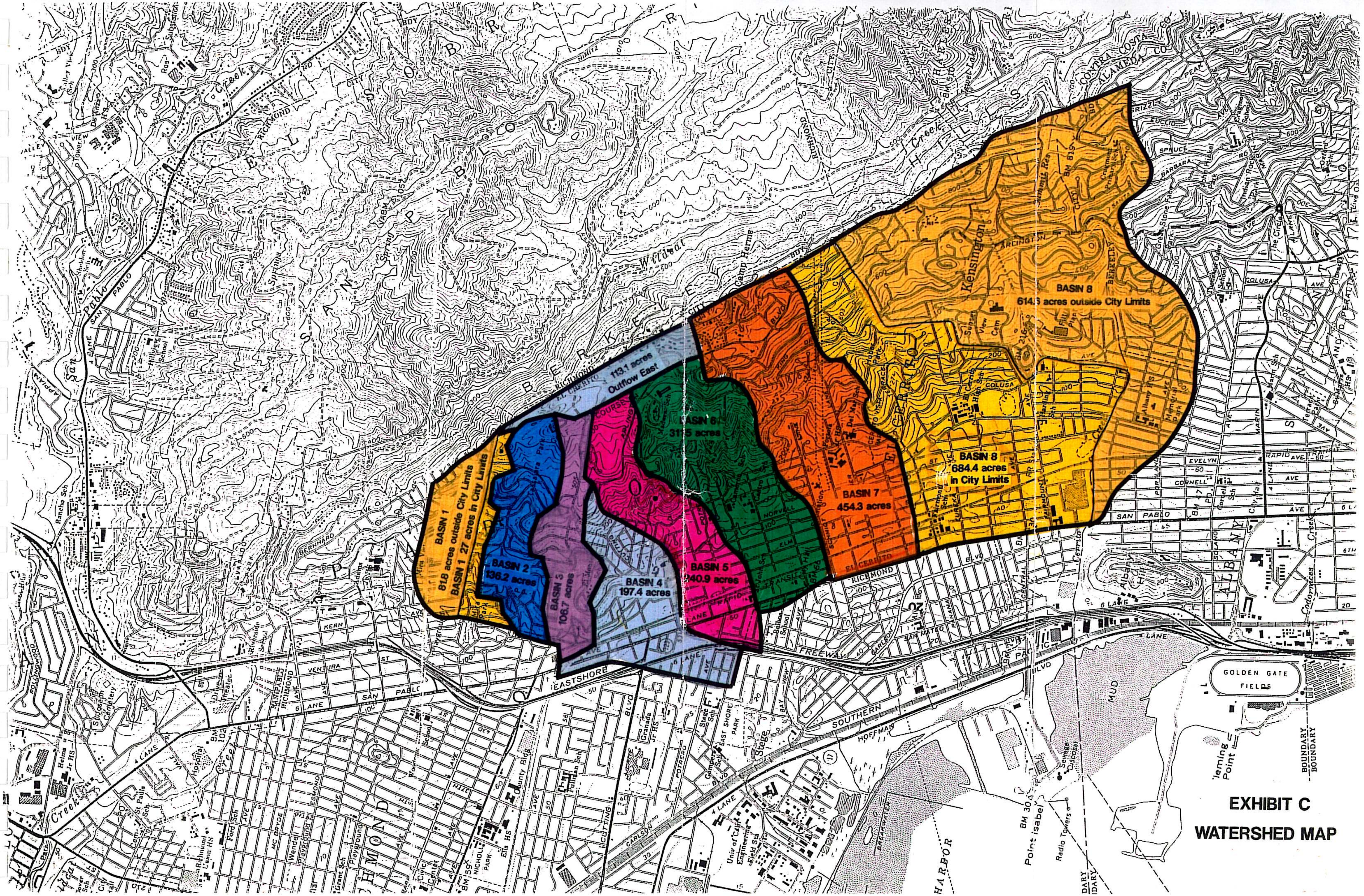

EXHIBIT C

WATERSHED MAP

3.2 BASIN DESCRIPTIONS

Basin 1

Basin 1 is located at the north end of the City. A tributary area of 63.3 acres in unincorporated Contra Costa County enters the City limits through a 42" drain which passes through Richmond for approximately one block before coming into the City of El Cerrito. Basin 1 encompasses approximately 108.8 acres; however, only 27 acres is within El Cerrito City limits, making this the smallest of the eight El Cerrito drainage basins. The City limits is the northerly and westerly border of Basin 1 and is generally bound by Arlington Boulevard and Charles Avenue to the east and south respectively. The length-to-width ratio is approximately 10.0 and the average slope of the basin is 10 percent.

The major facility in this basin is a creek which discharges to the City of Richmond at Mira Vista Park. Most of the existing storm drain facilities are located on private property with drainage crossings at streets on public right-of-way. Invert elevations for most of these drainage facilities are not available from the existing resources.

Basin 2

Basin 2 encompasses approximately 136.2 acres with a length-to-width ratio of 4.2 and an average slope of 11 percent. The basin area is bordered by Charles Avenue to the north and Mira Vista Country Club (east of Arlington Avenue) to the east. Alta Punta and La Gunitas Avenues generally border to the south.

Most of the storm drain facilities are located in the public right-of-way, including Rosalind Avenue, Poinsett Avenue, and Tassajara Park storm drains. However, several drain segments are located on private property. Storm drain invert elevations and slopes are known for only a small portion of the facilities in this basin. Basin 2 drains to the City of Richmond in an open drain which flows to an existing 48" pipe near Carlson Boulevard in Richmond.

Basin 3

Basin 3 encompasses approximately 106.7 acres with a length-to-width ratio of 5.5 and an average slope of 10 percent. The drainage area includes Jordon Avenue and the easterly portion of Cutting Boulevard. Runoff from Basin 3 discharges to Richmond in an open drain near San Pablo Avenue at the BART crossing. Most of the drainage facilities cross private property except at street crossings. A major branch of the drain system is a 30" pipe through Canyon Trail Park which extends toward the Mira Vista Country Club. The only other branch is an 18" drain which extends from Canyon Trail Park about six blocks to Alva

Avenue, generally crossing through private properties. Detailed information on slopes and invert elevations in this basin is very limited.

Basin 4

Runoff from Basins 4, 5, and 6 discharge to Richmond and join a half block downstream of the City limits. Basin 4 encompasses approximately 197.4 acres with a length- to-width ratio of 2.3 and an average slope of 7 percent. The southern border of Basin 4 is between Hill and Blake Streets. The basin extends just east of Arlington Boulevard and includes Cutting Boulevard and the El Cerrito Del Norte BART station.

Basin 4 discharges to a 54" pipe and parallel double 24" drains under Interstate 80, and flows through a 48" drain into Richmond. Most of the facilities in Basin 4 are located in the public right-of-way.

Basin 5

Basin 5 encompasses approximately 240.9 acres with a length-to-width ratio of 4.4 and an average slope of 9 percent. The northern border of Basin 5 is located between Hill and Blake Streets, and the southern border is Gladys Avenue. The basin also extends to Mira Vista Country Club, east of Arlington Boulevard. Potrero Avenue is also a major street within this basin. Basin 5 includes a steep open area near the EBMUD Navellier Reservoir site.

Basin 5 discharges to a 4'x 4' Reinforced Concrete Box (RCB) culvert which enters Richmond on South 56th Street near Carlos Avenue, just east of the Interstate 80 freeway. A 48" RCP is a parallel outlet from the basin which decreases to a 24" pipe before joining with the flow from Basin 4 at Cypress Street. Due to the flow restriction, overflow from this pipe occurs at Cypress Street. A short segment of storm drain pipe extends up Potrero with the main portion of the branching system extending up Blake Street. There is also a drainage facility parallel to Blake Street which consists of a variety of sizes and materials including open channels which traverse through private property except at street crossings.

Basin 6

Basin 6 encompasses approximately 311.5 acres with a length-to-width ratio of 3.0 and an average slope of 10 percent. Gladys Avenue borders Basin 6 to the north and the basin extends southerly to just north of Schmidt Lane. This basin includes the northern part of the Hillside Park area and extends east to Arlington Boulevard.

Basin 6 discharges to a 42" RCP which enters Richmond along Carlos Avenue. One of the branches in the system is a 15" pipe which extends up Manila Avenue. Another branch adjacent and parallel to Gladys Avenue varies from 36" to 48" pipes with some box culvert segments. This facility is located on private property except at street crossings.

Basin 7

Basin 7 encompasses approximately 454.3 acres with a length-to-width ratio of 2.9 and an average slope of 9 percent. The basin area extends from just north of Schmidt Lane southerly to Stockton Avenue. The basin includes the southern portion of Hillside Park and extends to the eastern ridge line.

Basin 7 discharges to a 4'x 8' RCB culvert on Santa Cruz Avenue which extends into Richmond just west of San Pablo Avenue. This facility branches upstream with a 30" drain along Waldo Avenue and a minor drain segment along Moeser Lane. There is also a 36" drain along Schmidt Lane. Basin 7 has a large drainage area consisting of hillside terrain where drainage is mostly provided by open creeks and culverts at street crossings.

Basin 8

Basin 8 is the largest basin area and encompasses about 2.1 square miles. Of this area, approximately 654.4 acres is located within the City limits with the remaining area from Kensington and Berkeley. Basin 8 is bordered by Stockton Avenue to the north, Kensington area of Contra Costa County to the east, Albany City limits to the south, and Richmond City limits to the west.

Cerrito Creek forms the boundary line between the Cities of El Cerrito and Albany. Within the City limits, Cerrito Creek is generally contained by drainage structures and culverts under the El Cerrito Plaza area and San Pablo Avenue. Most of the major drains east of the BART tracks cross private property in the location of former creeks. This includes a 36" to 48" pipe running from north of the BART station towards Eureka and Ashbury Avenues and extends to the eastern ridge line at the end of Moeser Lane. A 36" to 42" drain extends from the BART station to El Cerrito High School and then easterly in smaller pipes to the City limits. Another 36" pipe extends to the EBMUD San Pablo Treatment Plant and drains a large area from Kensington.

A drain carrying runoff from the northern part of the City of Albany enters Cerrito Creek just downstream of Yosemite Avenue, approximately 500 feet upstream of Richmond. Cerrito Creek continues downstream through Richmond and empties into San Francisco Bay after crossing Interstate 80, the Amtrak railroad, and Interstate 580. The drainage crossings downstream of the City limits were examined and compared to the facilities shown in the FEMA Flood Insurance Study. The bridge at I-580 appears to be larger than the facility size indicated in the FEMA study and may have been replaced since the study was prepared.

However, the railroad trestle appears to be smaller than the facility size assumed by FEMA. The I-80 culverts appear to be correctly shown.

4. STORM DRAIN MAPPING

Storm drain utility maps were prepared to reflect the existing storm drain facilities which includes up-dated information, corrections, and clarifications revealed during the research and data collection of this project. The utility maps show location of storm drains, manholes, catch basins, facility sizes, invert elevations, facility material, and slopes.

The City's existing storm drain utility maps were digitized at 1" = 100' using the AutoCAD computer program. The maps were revised as the research and data collection phase of the project developed. The base maps, showing roads and property lines, were obtained from East Bay Municipal Utility District (EBMUD) and converted from Intergraph format to AutoCADD format.

The AutoCADD Storm Drain Utility Maps for El Cerrito consist of 29 sheets which cover the entire area in the City of El Cerrito and seven additional sheets showing the off-site areas of Richmond Heights, Kensington, Berkeley, and Albany. These 36 maps have been plotted on a 11 x 17 page size at a scale of 1" = 250' and are included as a separate volume of this report. An index map is also included to help locate specific facilities and areas.

Information shown on the storm drain maps is intended for determining the general location of storm drain facilities, estimating storm drain deficiencies, and general planning of storm drain improvements. The information provided is primarily based on existing information sources. The original source, elevation datum, and the accuracy of the information shown is generally not known. Field surveys should be performed to verify the location of existing storm drain facilities prior to design or further analysis of proposed storm drain improvements.

5. HISTORIC DRAINAGE PROBLEMS

5.1 City Records, Resident Questionnaire, and SCS Study

There have been a number of large storms in El Cerrito that have caused drainage problems and flooding in the past. Identifying the location and severity of the problem is helpful in developing the storm drain master plan in order to confirm the deficient areas and plan future improvement to help prevent these problems from recurring.

A large storm occurred in the area on December 20 and 21, 1969, with significant flooding in a number of areas in the City. This is the largest recent storm where flooded areas have been well documented. Table 2 shows the flooded areas during this storm as described in the Soil Conservation Service Type 15 Flood Insurance Study, November, 1971, with areas listed generally from north to south, downstream to upstream. The extent of flooding and damage at each site is not known except for specific cases of flooding damage indicated in Table 2, which were compiled from City files. In some cases, the flooding may have been caused by accumulation of debris at inlets or in drains, rather than lack of capacity in the storm drain system.

Additional data sources were utilized to identify historical drainage problems in addition to the problems identified from the 1969 flood. These sources included: (1) the City files which were researched for records of staff reports and citizen complaints on flooding problems; (2) discussions with City staff members regarding known drainage problems; and (3) the drainage questionnaire that was distributed to some residents.

Through interviews with City staff members from the Engineering and Maintenance Divisions, the following areas were identified where recent drainage problems have occurred:

- South 55th Street at Cypress Avenue - overflows from inlet
- Donal Avenue, end of street at 6500 block
- Barrett Avenue and Carquinez Avenue, SW corner
- Glenwood Way and Richmond Street
- Cutting Boulevard and San Pablo Avenue, inlet at NE corner
- Richmond Street and Elm Street between Donal Avenue and Manila Avenue
- Schmidt Lane at Navellier Street
- Hill Street and Lexington Avenue
- Lincoln Avenue at Liberty Street - cross street arch pipe
- Lincoln Avenue at Lexington Street - cross street arch pipe
- Barrett Avenue and Tulare Avenue, NE corner
- Behrens Street near "C" Street

The following areas have experienced previous flooding problems and were identified from the questionnaires returned by residents. A general indication of the time when these problems occurred are also listed below.

- Belmont Avenue near Lassen Avenue (1982 or 1983)
- Lassen Avenue
- Scott Street at Schmidt Lane (February 1992 and other years)
- Donal Avenue, end of street at 6500 block (February 1979, February 1982)
- Liberty Street, 700 block (February 1991, December 1969)
- Arlington Boulevard, south of Barrett Avenue
- Navellier Street and Scott Street (collapsed CMP pipe in 1989 repaired)
- Liberty Street, 1700 block (February 1981)
- Carquinez Avenue at Barrett Avenue
- Everett Street, 1200 and 1300 block north from Schmidt Lane
- Lexington Avenue, 400 block (December 1969)

Further information on drainage problems contained in the questionnaires is contained in the Technical Appendix.

TABLE 2 FLOODED AREAS DURING DECEMBER, 1969, FLOOD	
1	Barrett Avenue south to Rosalind Avenue, from Carquinez Avenue to Edwards Avenue -- House flooded at 6002 Barrett, SE corner at Tulare Street
2	Arlington Boulevard north of Barrett Avenue, to Barrett Avenue and Tamalpais Avenue to Tassajara Avenue, south of Barrett Avenue
3	West of I-80 freeway, west to City line, Ernest Avenue to Cypress Avenue
4	North side of I-80 freeway, Gill Avenue to Hill Street
5	Hill Street and area south of Hill Street, Elm Street to I-80 freeway
6	North of Kenilworth to Glen Mawr Avenue, between Cutting Boulevard and Hudson Street
7	Arlington Boulevard south of Cutting Boulevard and west of Scenic Boulevard below Harvard Street
8	BART west to Kearney and San Pablo Avenue, from Blake Street to Donal Avenue, and Donal Avenue from Liberty Street to BART -- Apartments flooded at 1343 Liberty Street, SW corner at Donal Avenue
9	North of Blake Street from BART east to Wesley Avenue
10	East side of Ganges Avenue below Hillside Park, from Fairview Drive and Glen Mawr Avenue
11	Area near Mound Street
12	Navellier Street to Lawrence Street from Gladys Avenue to Donal Avenue
13	Navellier Street to Scott Street north of Manila Street
14	Glenwood Way, off Richmond Street between Schmidt Lane and Moeser Lane
15	North side of Schmidt Lane between Norvell Street and Everett Street
16	Arlington Boulevard at Brewster Drive, near Arlington Park
17	North side of Waldo Avenue between Lexington Avenue and BART
18	South side of Stockton Avenue between BART and Norvell Street
19	Central Avenue from BART to Lexington Avenue between Central Avenue and Fairmount Avenue, from Liberty Street to San Pablo Avenue, and east of San Pablo Avenue between Fairmount Avenue and Cerrito Creek
20	Susan Avenue from Colusa Avenue to Bonnie Drive
21	Coronado Street at Tahoe Place, near BART
22	San Carlos Avenue to Carmel Avenue, near Colusa Avenue
23	Cerrito Creek to Central Avenue between Belmont Avenue and Yosemite Avenue -- Houses flooded on Belmont Avenue (No. 3218, 3220, 3224, 3226, 3230, and 3235 apartments), and Yosemite (No. 3419, 3471)

Reference: Soil Conservation Service Flood Insurance Study, November, 1971.

5.2 FEMA 100-YEAR FLOOD PLAIN

The only portion of El Cerrito located in a FEMA Flood Insurance Zone is an area called Bayview, located west of San Pablo Avenue and south of Central Avenue. Flooding is generally caused by the relatively low ground elevations in this area, coupled with hydraulic restrictions in the existing downstream channels located in Richmond between El Cerrito and the San Francisco Bay.

Drainage from the Bayview area is provided in two separate channels: Cerrito Creek and a channel in Richmond west of San Diego Street. A small portion of Bayview discharges directly into Cerrito Creek through a pipe with a flapgate. This portion of the area consists of backyards along Belmont Avenue between San Diego Street and Cerrito Creek. The Cerrito Creek Channel flows into Richmond under Pierce Street and the I-80 freeway through box culverts. Then the creek crosses under the Southern Pacific Railroad track trestle, and then through a bridge under the I-580 (Hoffman) freeway to the Bay. Streets and drains in the Bayview area flow away from Cerrito creek towards the north. This water ultimately flows into a channel in Richmond west of San Diego Street, and then through separate box culverts at Pierce Street and the I-80 freeway. Eventually, this channel joins Cerrito Creek upstream of the railroad trestle.

The lowest street elevation in El Cerrito is located on Belmont Avenue near Central Avenue and is estimated to be slightly above 7 feet, which is about 3 feet above the normal annual maximum tide level in the bay and less than one foot above the estimated 100-year tide elevation due to storms or other unusual conditions. Although maximum tide levels occurring at the same time as major storm flows, is infrequent, high tides with the existing flat channel gradients would restrict drainage in this area.

It is not certain what the exact cause of past flooding in this area has been; however, descriptions of previous flooding events indicate that some or perhaps most of the flooding resulted from overflows of the storm drain system in the San Pablo Avenue area which flow down Lassen Avenue. Additional water may have come from overflows of Cerrito Creek. During the 1969 flood, most of the homes in this area that experienced flooding were in the lowest part of Belmont Avenue between Central Avenue and San Diego Street.

The current FEMA Flood Hazard Boundary Map for El Cerrito shows 100-year water surface elevations of 13 to 14 feet in the area west of Carlson Boulevard, as shown in Exhibit D. The flooding represents a water depth of about 6 feet at the lowest point of Belmont Avenue.

The hydraulic analysis of Cerrito Creek performed by the SCS (Soil Conservation Service) for the Flood Insurance Study in 1971 predicted that the 100-year flood would overtop all downstream crossings, including the culverts at I-80, the railroad, and the culvert at I-580. The existing crossing at I-580 appears to be larger than the culvert that was surveyed for the flood insurance study and it may have been improved since the study to pass the 100-year flow.

5.3 DRAINAGE CLAIMS

Over the past ten years, from 1982 through 1991, there have been 23 drainage-related claims filed with the City of El Cerrito. Settlement payments totaling approximately $307,000 have been made on 13 of these claims (for an average of $23,600 per claim), five claims were dropped and five claims are still pending.

As can be seen from Table 3, the number of claims and the amount paid for claims varies considerably from year to year. The average annual payment over the ten-year period has been about $30,700; however, the average over the last three years has jumped to $70,900 per year. If the City's existing storm drainage system is allowed to deteriorate further it is reasonable to anticipate that such claims will continue.

It should also be noted that these claim payments are generally for damages caused, and do not necessarily correct the drainage problem that caused the damage. Accordingly, the City must still expend additional monies to correct these drainage problems before additional damage occurs. In other words, if the City implements a proactive storm drain rehabilitation program to mitigate problems before claims can be made, there should be a reduction in overall cost to the City.

TABLE 3 STORM DRAINAGE CLAIM SUMMARY			
Year	Claims Filed	Claims Paid	Annual Total Paid
1982	0	0	$ 0
1983	0	0	$ 0
1984	0	0	$ 0
1985	5	2	$ 34,321
1986	8	4	$ 59,830
1987	0	0	$ 0
1988	0	0	$ 0
1989	7	4	$ 3,994
1990	2	2	$ 207,330
1991	1	1	$ 1,500
10-Year Total	23	13	$ 306,975
Average Claim			$ 23,613

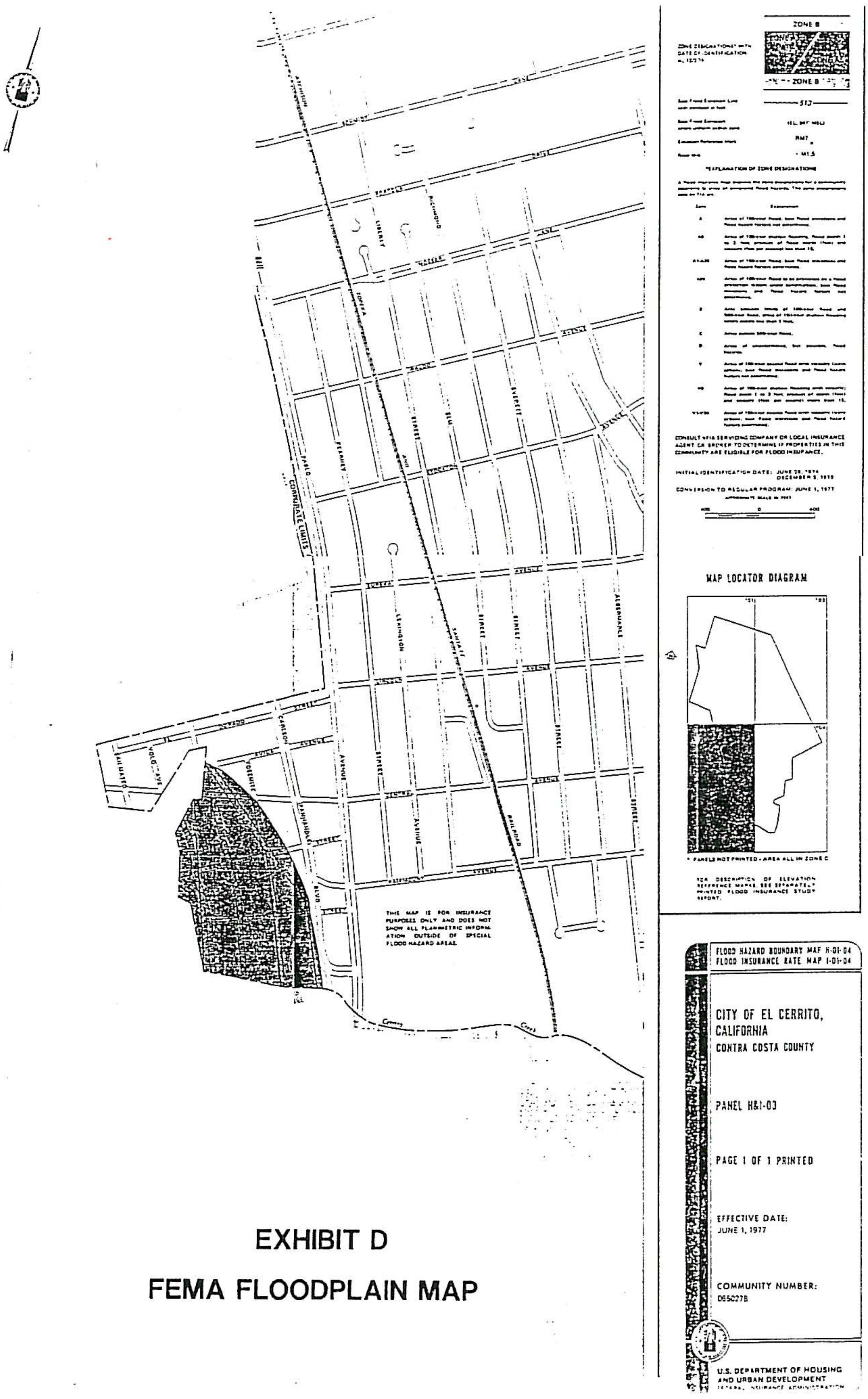

EXHIBIT D

FEMA FLOODPLAIN MAP

6. EXISTING STORM DRAIN DEFICIENCY ANALYSIS

A deficiency analysis was performed for the City's existing storm drain facilities in order to determine the deficient portions of the existing system. This analysis is the basis for the storm drain improvements recommended in Sections 7 and 8 of this Master Plan Report. The items addressed include hydraulic deficiencies, condition deficiencies, and operation and maintenance deficiencies. Any of these deficiencies may result in flow restrictions which may affect the level of flood protection.

6.1 HYDRAULIC CAPACITY DEFICIENCIES

Hydraulic capacity deficiencies of the storm drain system include those drain segments where there is insufficient capacity so that the storm drain system is unable to carry reasonable flows based on a consistent criteria applied to the entire City.

In order to estimate hydraulic deficiencies, hydrology calculations were performed for the tributary watershed areas to determine the peak 10- and 100-year storm runoff. Also, hydraulic calculations were performed to estimate the capacity of the existing storm drain segments. Areas of the system where the estimated 10-year peak storm runoff exceeded the estimated hydraulic capacity are considered to have hydraulic deficiencies.

6.1.1 Hydrology Analysis

The hydrology analysis for the Storm Drain Master Plan consisted of calculating the 10-year and 100-year peak flow values for all significant parts of the storm drain system.

In order to estimate peak flows at selected points in the storm drain system, the watershed area of the drain system was subdivided into a number of subareas. These subareas were defined based on locations where significant inflows to the storm drain system occur. Flow rates for individual catch basins and the flow rates for short connector pipes between catch basins and mainline storm drains were not determined.

The location where runoff from the subarea is considered to enter the storm drain system is called a node point. Each subarea has only one inflow node point where the flow rate is determined. The node points are located at the upstream end of a drain segment as defined in the storm drain information database, and are usually located at a point where significant inflow to the storm drain system occurs such as at a group of catch basin connector pipes, or at a headwall inlet. In cases where subarea runoff actually enters the system through several inlets, the node is located at a point which best represents the actual flow conditions in the system. There are also junction point nodes where two or more mainline branches of the storm drain system meet. A junction point node may or may not coincide with an inflow node.

A total of 335 subareas were defined within the El Cerrito City limits. These subareas range in size from about one half acre to about 35 acres, with the average being approximately two acres. Subareas tend to be larger in the eastern hill area of the City, due to the spacing of inlets and the larger open space area.

Additional hydrology subareas were defined for the tributary watershed areas outside of El Cerrito. These watershed areas were not divided into smaller subareas as provided within the City limits as it is not necessary to determine the flow rates in pipe segments outside of El Cerrito. The subareas were determined in order to estimate the inflow into El Cerrito at the City boundary. The largest subarea defined for areas outside of El Cerrito is about 230 acres, which represents the area of Cerrito Creek basin upstream of El Cerrito.

Drainage area boundaries for each hydrology segment were determined based on available information on the direction of street flow and assumptions about interior flow patterns on private property. Information was obtained from the City storm drainage maps along with available topographical maps from Richmond and the USGS. Drainage boundaries were checked in the field at many locations. The boundaries delineated are appropriate for general planning of the storm drain system; however, the drainage area boundaries should be verified if a detailed study of local areas is performed.

The hydrologic analysis performed utilizes the rational method. The rational method is the most widely used and accepted method for analysis of small urban watersheds. This method is generally accepted as accurate for watersheds up to one square mile in drainage area. The watershed subareas defined for the hydrology analysis of the City are small enough that the rational method of estimating peak storm runoff seems appropriate.

The principle for the rational method is that during uniform rainfall intensity, the maximum discharge at the basin outlet will occur when the entire drainage area above the outlet is contributing runoff. The time when this occurs is commonly known as the time of concentration, and is defined as the time required for runoff to travel from the most distant point in the basin to the node point where the peak flow is estimated. The main assumptions inherent in the rational method are that the rainfall intensity is uniform during the analysis period, and the rainfall intensity is uniform over the basin area. Also, it is assumed that the frequency or return period of the computed peak flow is the same as the design rainfall. Thus, a 10-year rainfall intensity is assumed to provide the basis to estimate the 10-year peak runoff. The rational method requires the estimation of a travel time between the uppermost part of a watershed and the node point at which flows are being estimated. This time can generally be separated into the overland flow travel time (before water reaches a channel), travel time through a channel or street gutter (before water reaches the first drain inlet), and the travel time through the storm drain system.

Overland flow time is dependent on the slope of the land and the surface the water is flowing over. Paved areas permit higher velocities than natural areas where vegetation slows down runoff.

A number of methods are available for estimating the time of concentration for watersheds. Several empirical formulas relating time of concentration to length of basin and the land slope have been developed and are used by a number of agencies. A common method used is the Kirpich equation, developed in 1940 from data gathered by the Soil Conservation Service for seven rural basins in Tennessee. Corrections to the predicted time of concentration are made to utilize shorter times for basins which have concrete or asphalt surfaces. A disadvantage of this approach is that the method was developed for rural watersheds, and may not be accurate for mostly urban watersheds.

Another method commonly used estimates the velocities for each of the several components of the flow path. The advantage of this method is that it can be tailored to specific conditions in individual watersheds. The travel time methodology has been utilized by the Alameda County Flood Control and Water Conservation District for the flood control projects in Western Alameda County and is summarized in a number of charts in their hydrology manual (Alameda County, 1989). These charts are based on published information from other sources.

Since El Cerrito consists of mostly fully developed urban watersheds, the travel time computation method seem to be most appropriate for calculating the time of concentration for the basins.

For urbanized watersheds, a component of the time of concentration is generally added to account for the additional water storage and travel time in roof gutters and across lawns and driveways. For Contra Costa County, a range of times for different land uses are recommended, with the time varying from 3 to 10 minutes. For Alameda County, the roof to gutter times vary from 5 to 10 minutes, with 5 minutes used for secondary drainage facilities (basins less than 50 acres in size), and 10 minutes used for primary facilities if the average ground slope is 7 percent or less, and decreasing to 5 minutes for average ground slopes of 12 percent or more.

A roof-to-gutter time of 5 minutes has been utilized in this study for drainage areas within the City, based on the criteria developed by the Alameda County Flood Control District and the size of the subareas analyzed.

The computation of travel time in the storm drain system was accomplished using the capabilities of the storm drain inventory data base system. During the hydraulic analysis of the storm drain system, the velocity and resulting travel time through the length of the storm drain segment was computed and stored in the data base. These travel times were accessed and summed for the storm drain system upstream of each hydrology inlet point.

The peak flow rate for each hydrology inlet point was determined using the rainfall intensity corresponding to the computed time of concentration.

Rainfall intensity information for the El Cerrito area is relatively limited. There is a daily rainfall station located in the City, with records available from Alameda County. The closest recording rainfall station is located at Richmond City Hall, with additional recording stations located in Berkeley.

The rainfall information utilized for this master plan consisted of the precipitation duration-frequency-depth curves developed by the Contra Costa County Flood Control and Water Conservation District (CCCFCWCD). These curves were developed from rainfall records throughout the County and relate the intensity of rainfall to the mean seasonal precipitation. While the peak rainfall intensity during individual storms does not necessarily vary with the mean seasonal precipitation, this methodology generally appears to be valid for general planning of storm drain facilities in the Bay area. In El Cerrito, the mean seasonal precipitation increases from west to east with the increase in elevations. The total seasonal precipitation compiled by CCCFCWCD varies from about 20 inches in the western areas of the City, to 25 inches in the ridge areas at the easterly side of the City.

Each hydrology subarea was assigned an estimated mean annual precipitation value to account for the variation in rainfall intensity in different locations of the City. The rainfall intensity curves were adjusted for this variation in rainfall.

Another factor used in estimating peak flow rates with the rational method is the runoff coefficient.

For relatively high density residential land use which is common in El Cerrito, Contra Costa County recommends a runoff coefficient of 0.45 to 0.60 (R-10 zoning). Alameda County uses a base coefficient of 0.4 for single family residential areas, but increases the coefficient based on the ground slope and intensity of rainfall. ASCE sources use 0.3 to 0.5 for single family residential areas, and 0.25 to 0.4 for suburban areas (American Society of Civil Engineers, 1970).

For El Cerrito, many of the lots are relatively small, with the 50 by 100 foot lot (0.11 acres) typical in the rectangular street grid area. This corresponds to a relatively high percent of impervious area. Lots in the hill areas tend to be larger, with more