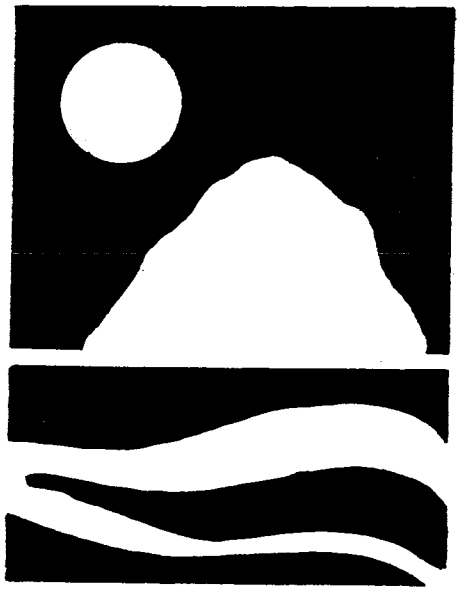
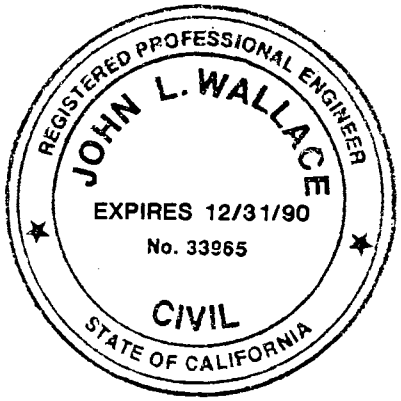
CITY OF MORRO BAY
STORM DRAIN MASTER PLAN
VOLUME I



AUGUST 4, 1987



JOHN L. WALLACE & ASSOCIATES

CONSULTING CIVIL ENGINEERS

1329 CHORRO STREET · SAN LUIS OBISPO, CALIFORNIA 93401 · (805) 544-4011

CITY OF MORRO BAY
DRAINAGE MASTER PLAN

VOLUME I

TABLE OF CONTENTS

I	INTRODUCTION	I-1
	Objectives	I-1
	Acknowledgements	I-2
II	SUMMARY	II-1
	Recommended projects	II-1
	Drainage ordinances	II-1
	Drainage standards	II-2
	Implementation and financing	II-2
III	DRAINAGE HISTORY AND FUTURE CONCERNS	III-1
	Previous studies	III-1
	History of flooding in the area	III-5
	Present drainage programs and policies	III-5
	Present drainage standards	III-5
	Future storm drainage concerns	III-6
IV	ALTERNATIVE STRATEGIES FOR CONTROLLING DRAINAGE	IV-1
	Level of protection provided	IV-1
	Conveyance facilities	IV-4
	Stormwater detention	IV-4
	Floodplain management	IV-4
	Drainage standards and ordinances	IV-4
V	EVALUATION OF DRAINAGE ORDINANCES AND STANDARDS	V-1
	Flood damage prevention ordinance	V-1
	Flood insurance rate map	V-4
	Environmentally sensitive habitat ordinance	V-4
	Siltation and Erosion Control	V-5
	Flood plain development standards	V-5
VI	TECHNICAL METHODOLOGY	VI-1
	Hydrology	VI-1
	Hydraulics	VI-2
VII	MASTER PLAN IMPLEMENTATION AND FINANCING	VII-1
	Adoption of master plan	VII-1
	Financing and budgeting	VII-1
	Ordinance revisions	VII-3
VIII	EVALUATION OF SPECIFIC PROJECTS	VIII-1
	Projects No. 1 through 22	VIII-3

ATLAS MAPS OF THE EXISTING STORM DRAIN SYSTEM ..... VOLUME II

LIST OF FIGURES

III-1	MAJOR WATER COURSES	III-2
III-2	CITY FLOOD INSURANCE RATE MAP (FIRM)	III-3
III-3	COUNTY FLOOD INSURANCE RATE MAP (FIRM)	III-4
IV-1	CURB CAPACITY CHART	IV-3
V-1	REGULATORY FLOOD BOUNDARIES	V-7
V-2	MOBILE HOME STANDARDS	V-8
V-3	SILTATION TRAP	V-9

RECOMMENDED PROJECT AND WATERSHED DISPLAYS FOLLOW INDIVIDUAL PROJECT DISCUSSIONS IN CHAPTER VIII

L I S T O F T A B L E S

II-1	COMPARISON OF FLOW RATES OF MAJOR CREEKS	II-4
VIII-1	SUMMARY OF PROJECT COSTS AND PRIORITY	VIII-3

CHAPTER I
INTRODUCTION

The City of Morro Bay is located on the Central Coast of San Luis Obispo County. Past and anticipated growth over the years has resulted in the need to upgrade portions of the existing storm drain system. The desire to accomplish this upgrading in an orderly and timely fashion has prompted the City to pursue the development of a storm drain master plan.

As a result, the City retained John L. Wallace and Associates, (in conjunction with James M. Stubchaer, Consulting Engineer, and Lawrance, Fisk and McFarland, Civil Engineers) to conduct a comprehensive study of the City's storm drain system and to develop this master plan document. The purpose of the master plan has been to incorporate current land use information and future development policies consistent with the City's General Plan Housing Element, and Local Coastal Program into a plan to meet the City's storm drainage needs.

OBJECTIVES

1. The preparation of an atlas of maps cataloging existing and proposed storm drain facilities.

2. Documentation of a series of construction projects necessary to properly convey storm runoff. Information provided includes schematic layouts, cost estimates, and a priority ranking.

3. Recommend measures to implement the master plan, including budgeting and financing alternatives and drainage ordinances.

ACKNOWLEDGEMENTS

CITY COUNCIL OF MORRO BAY:

MAYOR:	Dale Reddell
COUNCIL MEMBERS:	John Lemons Jim Miller Jeff Odell Rose Marie Sheetz

John L. Wallace and Associates is grateful to the following City personnel for their assistance and review during the preparation of this report:

DIRECTOR OF PUBLIC WORKS:	G. H. Nichols
ASSOCIATE CIVIL ENGINEER:	Bill Boucher

The staff assembled for this project included several key personnel from John L. Wallace and Associates, with additional technical support from James M. Stubchaer, Consulting Engineer, and Lawrance, Fisk and McFarland. The project team which produced this report consists of the following personnel:

PROJECT DIRECTOR:	John L. Wallace
PROJECT ENGINEERS:	Craig Campbell Dennis R. Krouse Gary R. Sims
TECHNICAL REVIEW:	James M. Stubchaer Charles Lawrance

CHAPTER II
SUMMARY

In anticipation of making logical decisions on storm drainage system improvements, the City Council in 1986, authorized that a master plan of storm drainage be prepared. As described in the City's Request for Proposals it was to consist of two major parts, an atlas of existing facilities and a master plan of facilities to meet existing and future needs. This Storm Drain Master Plan for the City of Morro Bay also incorporated a study of the City's drainage ordinances and standards. As a result of this study, changes to the ordinances and standards have been suggested, and a list of 22 possible projects are recommended.

The Atlas of Existing Storm Drains was completed in 1986 and previously submitted to the City to assist staff in operations and maintenance activities pending completion of the overall study.

RECOMMENDED PROJECTS:

A list of 22 construction projects are recommended to improve existing storm runoff problems. Unless mitigated, future development will intensify some of these drainage problems, but in general the nature and location of impacted areas are expected to remain the same. The projects are scattered throughout the City and range in cost from $35,000 to $691,000. (June 1987 costs)

These projects were given a priority ranking according to criteria which was considered in decreasing order of significance: the potential for property damage, traffic problems, the area use intensity and extended periods of ponding.

Chapter VII presents these projects, and a location map and summary table of costs and priority are provided in Figure VII-1 and Table VII-1 respectively.

DRAINAGE ORDINANCES

The City has two primary ordinances which specifically relate to storm drainage, Chapter 14.72, Flood Damage Prevention, and Chapter 17.42, Environmentally Sensitive Habitat (ESH) District. Also, both the Subdivision Map Act and the Uniform Building Code are applied by the City in order to establish requirements for drainage facilities.

These ordinances and their implementation were reviewed for conformance with the Federal Emergency Management Agency (FEMA) requirements as well as accepted engineering practices. This review resulted in the following recommendations:

1. Investigate an ordinance provision requiring setback distances from the major creeks to be based on an engineering analysis of flood elevations. This setback requirement would be intended to protect developed areas against flooding, and would overlap setbacks called for by the Local Coastal Plan which requires development to setback from riparian habitat.

2. Establish a regular program of requiring elevation certificates for development within flood hazard zones. This is a FEMA requirement and is intended to ensure that development within flood hazard areas properly addresses the potential hazard.

3. Implement new ordinances regarding the location of mobile homes within flood hazard areas consistent with pending FEMA regulations. These regulations are expected to have more strict limitations on the anchoring of mobile homes and mobile home pad elevations.

4. Evaluate the benefit of engineering studies to pursue a request with FEMA to review and possibly amend the Flood Insurance Rate Map (FIRM) in the Morro Creek area. Flood flows shown on the current FIRM appear excessively large. The consideration of a lesser flow rate would lessen the extent of flood insurance areas. Flow rate differences are shown in Table II-1.

DRAINAGE STANDARDS

The City has utilized adequate standards during recent times to evaluate drainage impacts. However with pending ordinance revisions, the standards should be reviewed as ordinance amendments are made to retain consistency.

IMPLEMENTATION AND FINANCING

Implementation of this Master Plan has already begun by the City's use of Volume II of the Atlas of Existing Storm Drains to aid its operations and maintenance of existing facilities. Adoption of this Volume I will provide input for future budgeting of drainage improvements and also enable the City to use additional ordinance requirements to fund off-site improvements through the Subdivision Map Act. Various other financing methods are discussed in Chapter VII.

FLOWRATES

Previously established flowrates and new calculations for the City's major watercourses are summarized below. The most significant deviation from previously established flows are evident for Morro Creek. The City's FIRM presently shows a 100 year flow of a 14,900 cfs. This study shows a substantial reduction to a 100 year flow of 8200 cfs. However, a lesser frequency flow (10 year flow), was greater than the FIRM's value.

TABLE II-1
COMPARISON OF FLOWRATES OF THE MAJOR CREEKS

WATERCOURSE	DRAINAGE AREA	PEAK FLOW RATE AT OUTLET (cfs) CALCULATED	CITY FIRM	COUNTY FIRM
CHORRO CREEK[1]	43.9			
10 Year		-----	2,700	-----
25 Year		-----	-----	-----
50 Year		-----	11,900	-----
100 Year		-----	18,900	-----
MORRO CREEK	24.0			
10 Year		3,200	2,200	2,400
25 Year		-----	-----	-----
50 Year		-----	9,200	7,800
100 Year		8,200	14,900	11,200
ALVA PAUL CREEK	1.8			
10 Year		280	450[2]	-----
25 Year		-----	-----	-----
50 Year		410	450[2]	-----
100 Year		650	450[2]	-----
NONAME CREEK	0.5			
10 Year		92	100[2]	-----
25 Year		130	-----	-----
50 Year		-----	100[2]	-----
100 Year		200	100[2]	-----
TORO CREEK[1]	15.1			
10 Year		-----	1,700	-----
25 Year		-----	-----	-----
50 Year		-----	7,200	-----
100 Year		-----	11,900	-----

(1) Flows not calculated because urban areas are not affected.

(2) Does not include assumed overflow diverted outside watercourse.

CHAPTER III
DRAINAGE HISTORY AND FUTURE CONCERNS

The City of Morro Bay is a coastal town with generally hilly terrain. Several major watercourses passing through the City carry storm runoff from large areas outside of the City. With the exception of those watercourses, the storm drainage patterns of the City are of an urban nature, i.e. smaller localized watersheds concentrating and conveying runoff from urban type development on the local street system and storm drainage facilities. As the town has grown, a system of drainage improvements has been constructed. These improvements vary widely in their usefulness and quality. Figure III-1 shows the boundaries of the City, along with the major watercourses. Existing drainage facilities are shown in Volume II of this master plan, an Atlas of Existing Storm Drains.

PREVIOUS STUDIES

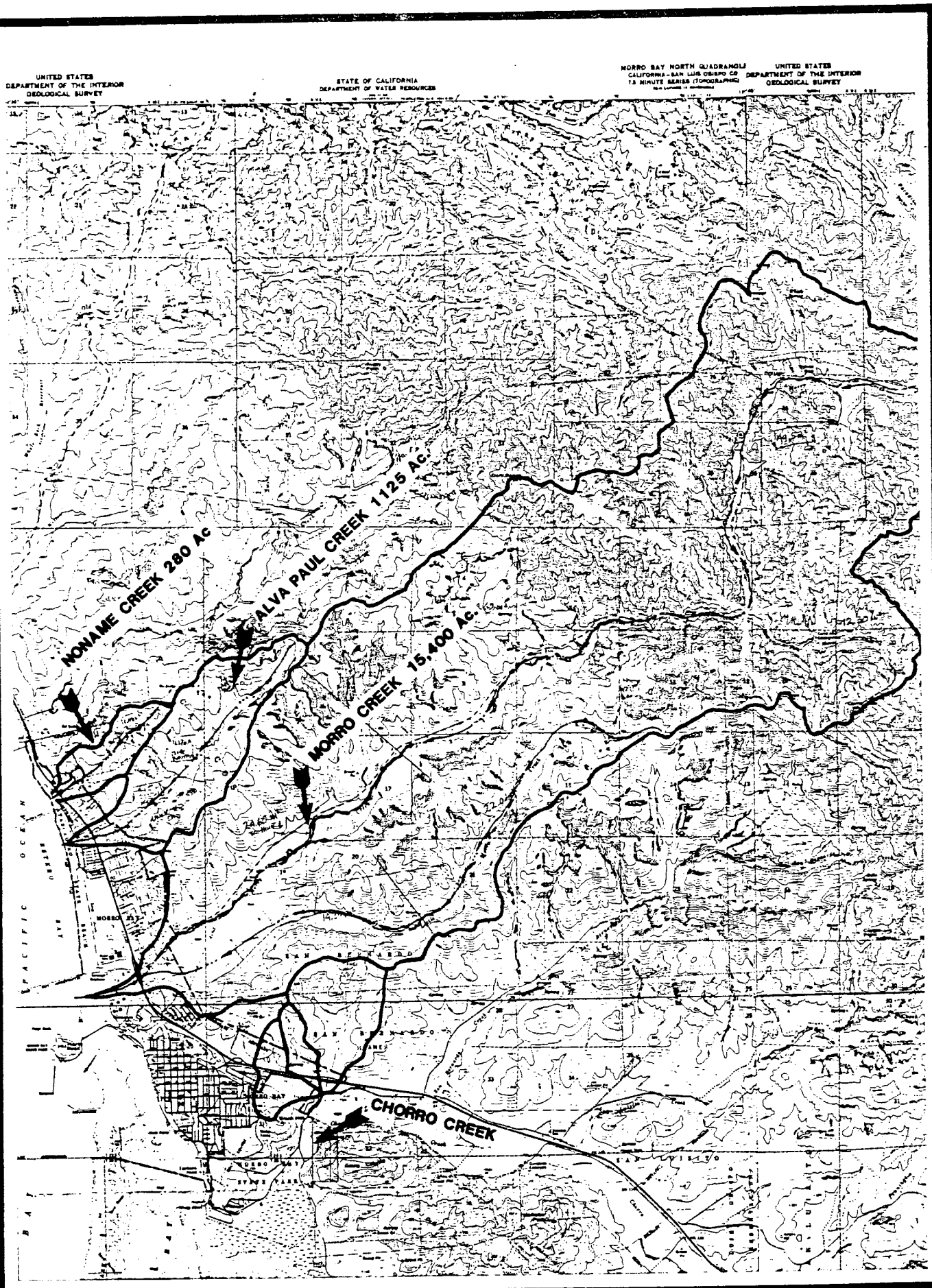
A review of previous investigations relating to storm drainage affecting the City of Morro Bay revealed that most of the work had to do with the flow of the major creeks. Studies by the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers have been prepared for flood insurance mapping. Also, CALTRANS and private developers have analyzed individual facilities on a case by case basis. Prior to this study, no previous work has been done which considered the City drainage facilities from a master plan perspective.

CITY FLOOD INSURANCE STUDY

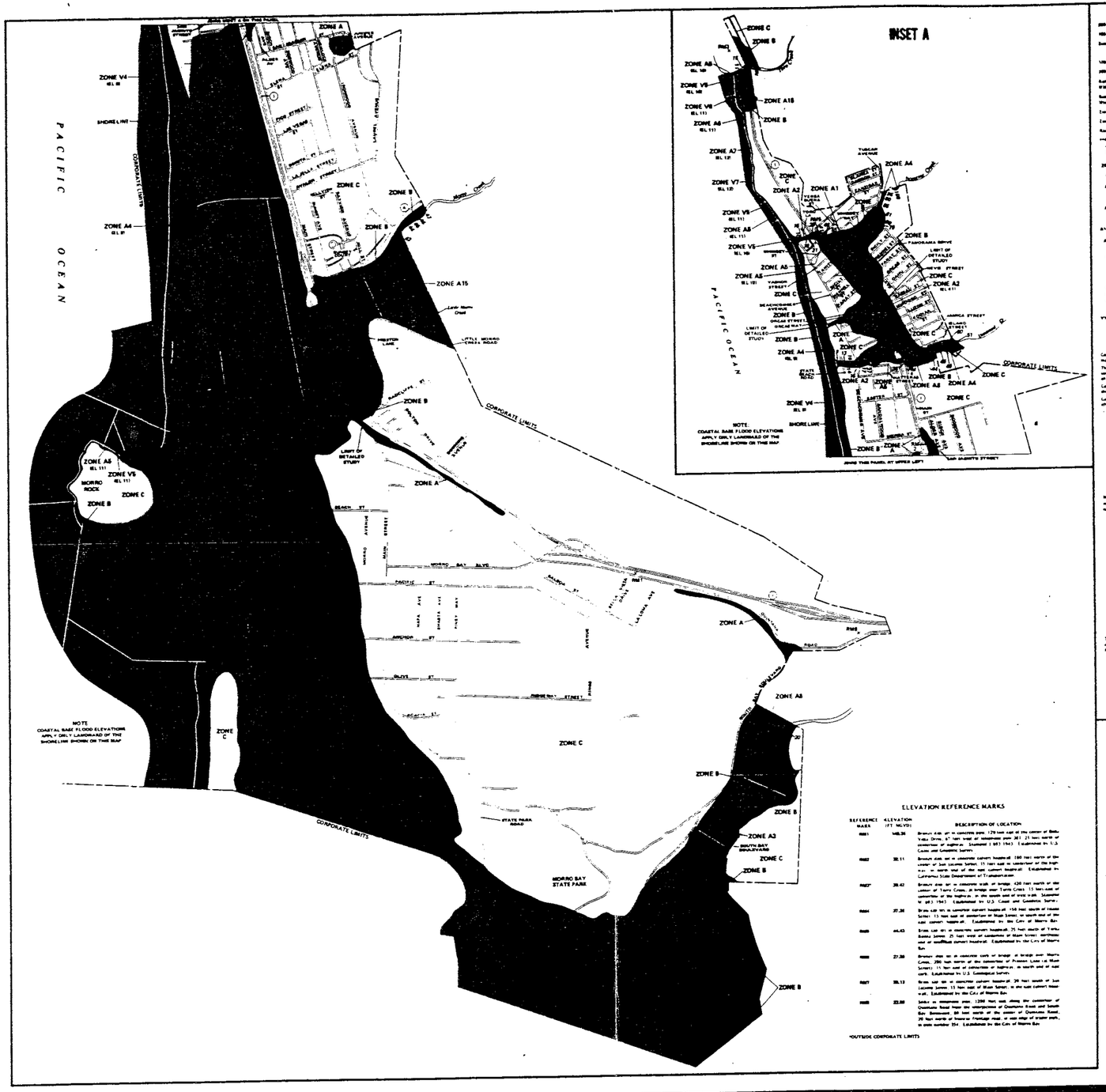
The USGS prepared this study in 1979. It resulted in the publishing of a Flood Insurance Rate Map (FIRM) for the City to show areas within the City boundaries which are subject to flooding from a 100 year storm. This map was updated in 1985 to show areas flooded by storm waves, and it is shown in Figure III-2. The major areas where flooding is indicated are along Morro Creek, Alva Paul Creek, Noname Creek, Toro Creek, and the sand dunes area west of Highway 1 (VRM property). The map also indicates flooding along Chorro Creek, including the overtopping of the Twin Bridges at South Bay Boulevard.

COUNTY FLOOD INSURANCE STUDY

The U.S. Army Corps of Engineers prepared this study in 1984. It resulted in the publishing of the current San Luis Obispo County FIRM. The County FIRM, shown in Figure III-3, shows flooding outside the City boundaries along Toro, Alva Paul, Morro, and Chorro Creeks to an extent similar to that of the 1985 City FIRM.



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN MAJOR WATERCOURSES	FIGURE III-1



KEY TO MAP

30th-Year Flood Boundary
100-Year Flood Boundary
Zone Boundary
100-Year Flood Boundary
200-Year Flood Boundary
Base Flood Elevation Line; ***12***
or Elevation in Feet***
Base Flood Elevation in Feet (EL 987)
Where Uniform Within Zone***
Elevation Reference Mark RM7×
Line of Section
River Mile •M1.5
*Referenced to the National Geodetic Vertical Datum of 1929

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
AR	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or areas the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined but possible flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show areas of other concern, or flooding in the community as a result of local drainage. Numerous factors affecting flood hazard areas.

Contact local flood control agency with questions of the expected effects on the map.

Contact FEMA for flood elevations shown on this map include the effects of wave action.

INITIAL IDENTIFICATION
MAY 31, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS
DECEMBER 5, 1975

FLOOD INSURANCE RATE MAP EFFECTIVE
DECEMBER 16, 1979

FLOOD INSURANCE RATE MAP REVISIONS

For information of flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE IN FEET

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM1	148.36	Bronze disk set in concrete post, 129 feet east of the center of Bella Vista Drive, 67 feet west of telephone pole 361, 21 feet north of centerline of highway. Established 1951-1943. Established by U.S. Coast and Geodetic Survey.
RM2	32.11	Bronze disk set in concrete current hydrant 180 feet north of the center of San Luisito Street, 11 feet east in centerline of the highway, in south end of the east current hydrant. Established by California State Department of Transportation.
RM3*	39.42	Bronze disk set in concrete wall, at bridge, 120 feet north of the center of Turri Creek, at bridge over Turri Creek, 13 feet east of centerline of the highway, in the south end of bridge wall. Established 1951-1943. Established by U.S. Coast and Geodetic Survey.
RM4	37.38	Brass cap set in concrete current hydrant 150 feet north of Indian Street, 13 feet east of centerline of Main Street, in south end of the east current hydrant. Established by the City of Morro Bay.
RM5	46.43	Brass cap set in concrete current hydrant, 25 feet north of Yerba Buena Street, 25 feet west of centerline of Main Street, northeast end of southbound current hydrant. Established by the City of Morro Bay.
RM6	27.38	Bronze disk set in concrete curb at bridge at bridge over Morro Creek, 280 feet north of the centerline of Pacific Street at Main Street, 11 feet east of centerline of highway, in south end of east curb. Established by U.S. Geological Survey.
RM7	38.13	Brass cap set in concrete current hydrant 26 feet south of San Luisito Street, 11 feet east of Main Street, in the east current hydrant. Established by the City of Morro Bay.
RM8	23.88	Spike in telephone pole, 1290 feet east along the centerline of Quintana Road from the intersection of Quintana Road and Beach Bay Boulevard, 84 feet north of the center of Quintana Road, 25 feet north of Beach of Frontage road, at east edge of power pole, in pole number 354. Established by the City of Morro Bay.

*OUTSIDE CORPORATE LIMITS

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
MORRO BAY,
CALIFORNIA
SAN LUIS OBISPO COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
060387 0005 C

MAP REVISED:
NOVEMBER 1, 1985

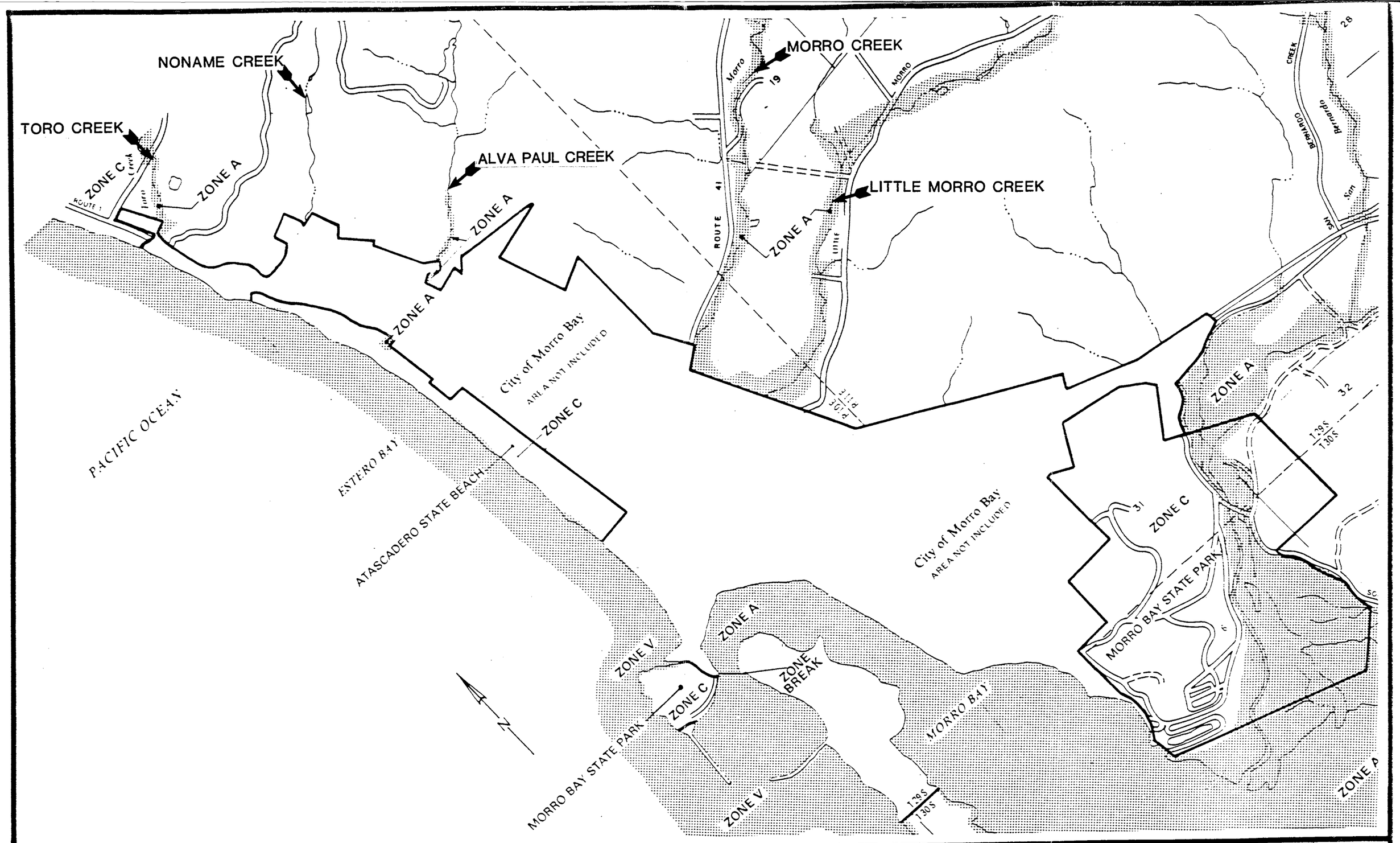
Federal Emergency Management Agency

JOHN L. WALLACE
& ASSOCIATES

MORRO BAY STORM DRAIN MASTER PLAN

FLOOD INSURANCE RATE MAP – CITY

FIGURE
III-2



JOHN L. WALLACE & ASSOCIATES	FLOOD INSURANCE RATE MAP – COUNTY	FIGURE III-3

HISTORY OF FLOODING IN THE AREA

Morro Bay has experienced relatively few major flooding events. However property owners within the flood zones indicated on the FIRM have and do experience flooding in larger storms (particularly along Morro Creek). These problems are mainly confined to properties alongside the Creek, and major city-wide flooding is not likely to occur.

However, small localized flooding problems do occur within the City. These are generally caused by a lack of adequate facilities to control the runoff. While the flows may be small in terms of flood plain area, they can still have substantial damage and nuisance potential due to their uncontrolled nature.

PRESENT DRAINAGE PROGRAMS AND POLICIES

The City of Morro Bay has for some years maintained a program of limited capital improvements and maintenance of storm drain facilities within the City. Due to budget limitations, it has been necessary to restrict the program to secondary types of storm drain construction projects and relevant street improvements. The revenues to support this limited program are derived from Gas Tax and General Fund income. There have been no assessment districts for this work to date.

PRESENT DRAINAGE STANDARDS

The City already has certain standard drawings for street construction pertaining to cross slopes and gutter slopes for drainage. These are intended to provide channel capacity in the streets to accommodate storm runoff from properties fronting on the streets. The City also has existing standards for curbs and gutters, for cross gutters, and for various types of drainage inlets and manholes.

On a provisional basis, the City has been employing the following standards:

> Curbs and gutters are required for new commercial and large or multi-family residential developments. Storm drains are required for local portions of new streets being developed pursuant to these new developments. The exact details are arranged to fit the local circumstances for each case.
>
> Curbs and gutters are not required for infill development of existing residential neighborhoods.
>
> Where street improvements are being developed, including those for handling storm drainage, it has been a provisional

standard to require that the improved streets do not overflow onto sidewalks or walkways during a 25-year storm.

Review of the current City standards indicates that for the most part they are sufficient. However in the past these standards did not exist, and as a result some of the existing drainage facilities are not adequately sized or constructed to serve the area drainage. For example, certain streets become flooded during heavy rainstorms because the inlets are undersized. In a few instances, culverts have been undersized or improperly maintained. These examples generally reflect construction that occurred many years ago, including freeway construction, at which time the City standards were either not fully developed (prior to incorporation in 1964) or were inconsistently applied.

FUTURE STORM DRAINAGE CONCERNS

The future concerns with storm drainage in Morro Bay are generally the same as present concerns. Much of Morro Bay is already developed, and there appears to be relatively little prospect of annexations. Rather, future growth of the City, projected to occur at moderate rates, is anticipated to result from infill of existing vacant lands. Most of these vacant lands front existing improved streets. While infill-type development will marginally increase stormwater runoff, it is not likely to be the sole source of major new drainage problems. However, developer-installed facilities can be instrumental in resolving existing drainage problems worsened by the effects of development.

While the infill-type of City growth expected will increase the severity of existing drainage problems, it is not as likely to create major new problems. The concern with storm drainage in Morro Bay can be separated in two categories:

1. How and when to implement a program of correcting existing drainage deficiencies.

2. How to insure that future development does not create any deficiencies.

One of the primary purposes of this master plan is to prepare and prioritize a list of projects meant to correct existing and anticipated drainage problems. Later sections will present these projects and discuss how the City might implement them. An analysis of drainage standards and ordinances is intended to set the stage for ordinance amendments that can hopefully insure that future drainage is adequate.

CHAPTER IV
ALTERNATIVE STRATEGIES FOR CONTROLLING DRAINAGE

A variety of strategies are available to reduce or mitigate storm drainage problems. These strategies were all investigated and selected from to be applied to the assorted drainage problems in Morro Bay. Some potential strategies and their potential applications are listed below.

LEVEL OF PROTECTION PROVIDED

This strategy is in the form of a policy regarding drainage facility design. Normally, drainage facilities are designed to convey the storm runoff (provide protection) from a specified level of storm. Storms are commonly specified as having a 10, 25, 50, or 100 year reoccurrence interval. The City currently uses criteria from the San Luis Obispo County Engineering Department regarding level of protection. The County policies are graduated according to the significance (size) of the facility as shown below.

Two revisions to the County criteria are recommended for application to the City of Morro Bay. One is the allowable flow on street surfaces. In a City with steep streets such as Morro Bay, a six inch flow reaching the top of a curb is excessive, even for a ten year storm because of the momentum of the fast moving water. A more realistic standard is one which varies the allowable depth of flow with the street slope. An example of such a standard is shown in Figure IV-1, which is a curb capacity nomograph used by the City of San Luis Obispo. This varies the allowable flow depth from 6" for a street at 0.3% slope, to 3" for a street at a 15% slope. It should also be pointed out that this standard can only be applied to areas of the City which have curb and gutters. The streets of Morro Bay without curbs and gutters vary greatly in their flow capacity and must be considered on a case by case basis.

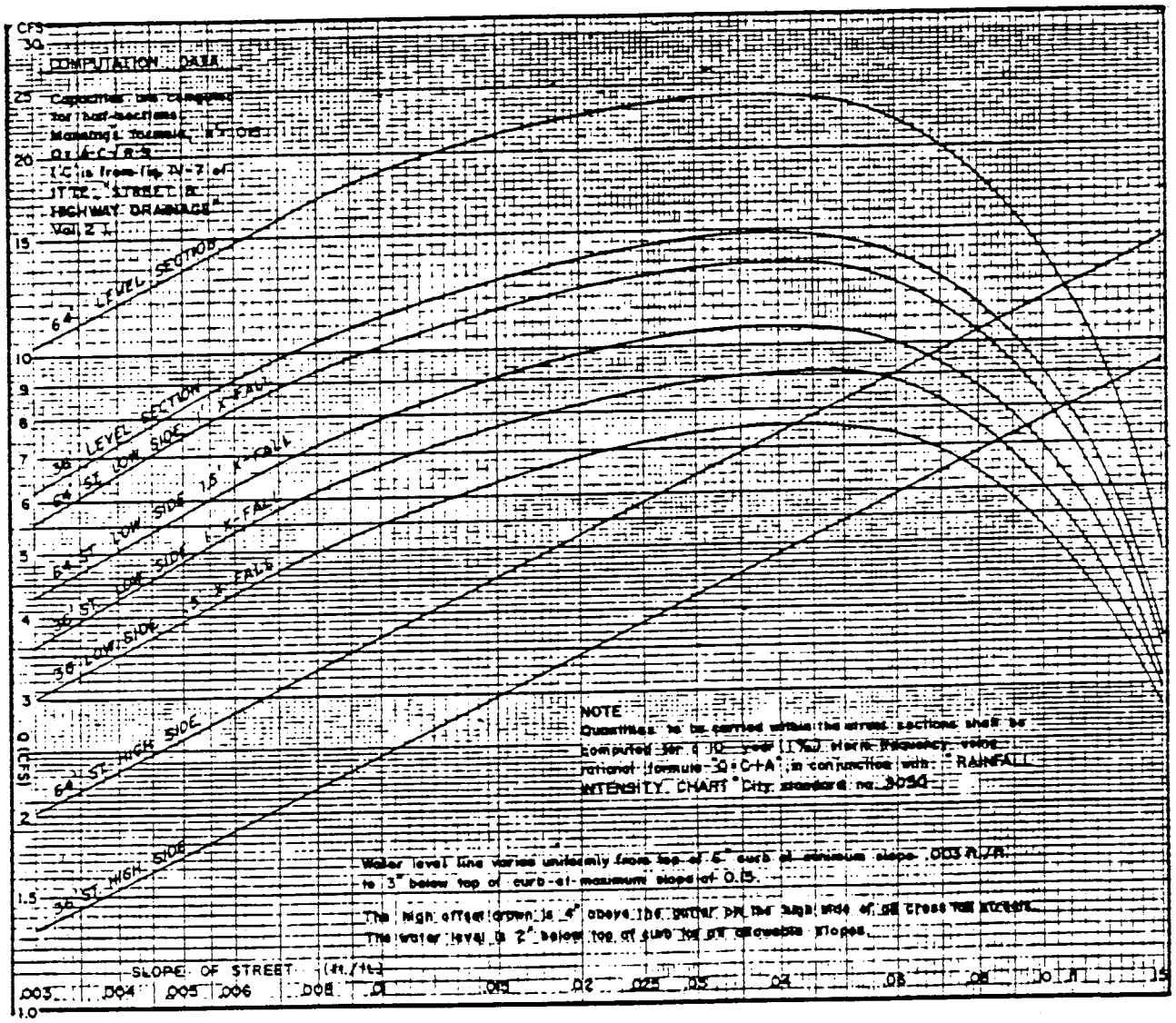
The second revision to the County criteria is the addition of a requirement that the flow from a 100 year storm be contained in the right of way. This requirement insures that while large storms may exceed the storm drain system capacity, they will not cause excessive damage or hazards to private properties.

Otherwise, these standards relating to levels of protection have been found to provide a good balance between the need to construct adequate facilities and the need to conserve expenditures. Recommendations in this report are generally based on providing the levels of protection shown.

The level of protection criteria recommended for the City of Morro Bay is as follows:

RECOMMENDED LEVEL OF PROTECTION

ITEM	FACILITY SIZED FOR RECURRENCE INTERVAL:
Major waterways (drainage area exceeding 4 sq. mi.)	100 Yr with freeboard
Secondary waterways (drainage area of 1 - 4 sq. mi.)	50 Yr w/o freeboard or 25 Yr w/ freeboard
Minor waterways (drainage area of less than 1 sq. mi.)	25 Yr w/o freeboard or 10 Yr w/ freeboard
Residential finished floor elev to be one ft above	100 Yr flood level
Commercial finished floor elev to be one ft above or floodproofing required	100 Yr flood level
Street Gutter flow levels	Per Figure IV-1
Drainage inlets spacing (along streets) so that flow does not exceed 6-in. at face of curb for	10 Yr storm
No flow escapes right of way during	100 Yr storm



(SLO CITY DRAWING NO.3210)

JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE IV-1
	CURB CAPACITY CHART	

CONVEYANCE FACILITIES

Conveyance facilities include ditches, culverts, gutters, etc. Nearly all of Morro Bay's existing drainage improvements consist of conveyance facilities (as opposed to detention facilities). As a drainage strategy, new facilities would be designed, or existing facilities upgraded, to convey the flows associated with the level of protection recommended above.

STORMWATER DETENTION

Stormwater detention is another common strategy for controlling stormwater runoff. Through detention the highest flows from a storm are stored in basins for later release when the storm's peak flowrates have passed. This practice results in less impact downstream. Stormwater detention is most efficient when applied to the upper portions of a watershed. Because Morro Bay does not have significant land available within the City to detain runoff from the smaller watersheds and the flows in major creeks are all too large to effectively detain peak flows, stormwater detention has only limited applicability within the City.

FLOODPLAIN MANAGEMENT

With the strategy of floodplain management, rather than attempting to eliminate a floodplain, steps are taken to allow development to safely occur within a portion of the floodplain limits. Floodplain management is implemented in the form of City policies and standards and usually incorporates some of the following provisions:

Elevating structures above the floodplain.

Restricting the types of construction allowed in floodplains.

The purchasing of flood insurance for improvements within floodprone areas.

The establishment of floodway setback areas to provide for the right of way for future drainage projects.

The existing City Flood Damage Prevention Ordinance (MBMC Sec. 14.72) contains these as well as other flood plain management policies.

DRAINAGE STANDARDS AND ORDINANCES

Drainage standards and ordinances provide for consistent sizing of developer-installed drainage facilities and enforcement of building codes to achieve a uniform level of protection. Through

adoption and enforcement of consistent drainage standards, developers can be required to install facilities which compliment the area-wide facilities to a pre-planned level of protection. Current ordinances and anticipated revisions are discussed next in Chapter V.

CHAPTER V
EVALUATION OF DRAINAGE ORDINANCES AND STANDARDS

The City's drainage related ordinances depend upon four primary documents. The Flood Damage Prevention Ordinance, Chapter 14.72 of the Municipal Code, the Environmentally Sensitive Habitat District Ordinance, Chapter 17.42 of the Municipal Code, the Uniform Building Code which is incorporated by reference as part of the City's Building Code, and the Subdivision Map Act which provides for a basis for drainage improvement requirements for new subdivisions.

In reviewing past examples, successful drainage and flood plain management ordinances generally have the following characteristics:

1. Reference to and dependance on a comprehensive drainage master plan, at least for the most severely impacted areas in the community.

2. Comprehensive flood zoning that regulates the extent of encroachments into the flood plain and takes into account the increase in flooding levels due to future development.

3. Provisions for identifying and publicizing the location and extent of flood hazard areas.

4. Modifications to the local building code to incorporate sound flood proofing techniques.

The City's ordinances currently meet most of these criteria. However, they could be made even more effective by clearly translating the regulatory nature of the ordinances into more easily administered drainage standards and permit/plan check procedures.

FLOOD DAMAGE PREVENTION ORDINANCE

The National Flood Insurance Program (NFIP) requires as a condition of participation that communities such as the City of Morro Bay adopt local flood plain management regulations after receiving flood level data and flood insurance rate maps (FIRM's). These local ordinances must be structured to not only be acceptable to the community but must also meet the basic requirements of the federal program. These basic requirements include elevating new construction above flood levels, flood proofing certain types of structures, and reserving a portion of the flood hazard areas as unbuildable.

Each community may adopt the model ordinance suggested by the Federal Emergency Management Agency (FEMA) or may develop their

own ordinance consistent with their particular needs. The City of Morro Bay Municipal Code Chapter 14.72, "Flood Damage Prevention", closely follows the model ordinance suggested by FEMA.

The flood plain regulation aspects of the National Flood Insurance Program are a requirement of continued community membership in the program. It is important to note that the flood insurance program and its attendant ordinances are mandatory in order to receive federal funding for projects in a community. In addition, loans through federally insured lending institutions to property owners who develop in flood prone areas are not available unless the City participates in the program. Since 1974 new property owners with mortgages obtained from federally insured lending institutions have been required to purchase flood insurance if their homes or businesses are located within identified flood hazard areas. Since 1975 communities can receive no federal financial assistance, including disaster relief, unless they participate in the NFIP.

In 1985, the City of Morro Bay received an update of the previous 1979 Flood Insurance Rate Map from which flood insurance area and rates are established. In North Morro Bay these maps show substantial flooding along Morro Creek and to a lesser extent along Noname and Alva Paul Creeks as well as an area along North Main Street from Oahu Street to Kodiak Street. In Southern Morro Bay, there are areas along Willow Camp Creek and Quintana Road which the map identifies as subject to flood hazard and also a substantial portion of the town near the Embarcadero is shown as areas of shallow flooding. The 1985 map update also incorporated areas subject to high velocity waters from storm waves. Likewise areas along Atascadero Road near the Wastewater Treatment Plant and North to San Jacinto Street through the "VRM" property are covered by flood hazard. All of these areas need attention when dealing with grading or building permits. The 1985 Flood Insurance Rate Map is previously shown as Figure III-2.

The Flood Damage Prevention Ordinance is the major tool by which the City applies flood plain management. To be successful, a flood plain management program must rely primarily on the establishment of sound flood plain management regulations and procedures which would include the following:

PERMIT REVIEW

The City Staff responsible for development permits would review permits to determine compliance with applicable flood plain management ordinances and obtain information from the best available sources for reviewing permits with respect to flood depths. The permit review process would also include record keeping for the proper elevation for buildings in accordance with established flood levels.

RECORD KEEPING

Communities participating in the NFIP are responsible for keeping records pertaining to permits issued in flood plains. The following records must be retained and be available for public inspection.

1. A copy of the Flood Plain Ordinance.

2. Flood Maps and Flood Insurance Study.

3. Elevation of the lowest floor of all new and substantially improved structures in special flood hazard areas.

4. Elevation to which structures have been floodproofed and a file for each development permit that would contain pertinent correspondence and documentation regarding flood proofing and construction to and above pertinent flood levels.

MAP BOUNDARIES & WATER COURSE MODIFICATIONS

Interpretation of map boundaries and modification of water courses would also be kept on file in order to determine subsequent changes for flood boundaries and flood hazard areas.

OTHER INFORMATION

Other information and technical data that will serve for future analyses of the extent of the flood plains should be retained.

Recently FEMA published new standards applying to mobile home parks. These standards require the elevating of new mobile homes placed in flood hazard areas, even in existing parks, and will also require elevating and anchoring of existing mobile homes in the event of "substantial improvement". Substantial improvement has been defined to mean improvements that are greater than 50% of the market value of the unit at the time that the improvements are made. These standards were to be incorporated in local flood plain management regulations by April 1, 1987. However, current legislation in congress is being proposed that may delay the implementation until 1988. A new model ordinance is being sent to the City for adoption by September 1, 1987 in order to remain within the program. This ordinance has a number of minor changes in addition to the mobile home provisions and if not adopted (or similar changes made to the City's existing ordinance), the City will be suspended from the NFIP.

FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map (FIRM) is the basic map of flood prone areas within the City and is used as part of the ordinances as well as to rate properties for flood insurance premiums. There is a discrepancy between flood flows derived by the original flood insurance contractor and the City's consultant on this study. The most significant deviation is in Morro Creek in a 100 year storm. Previous flows were estimated by FEMA to be 14,900 cfs. Current estimates based on a detailed study of the upper watershed and its hydrologic characteristics reveals that the flood flows may be in the neighborhood of 8,200 cfs. This means that the flood boundaries as shown on the City's approved flood insurance rate maps are possibly larger than necessary and therefore structures that are currently regulated by the flood hazard prevention ordinance would be outside of this area if they are redrawn. Because no major topographic data was developed as part of this study, these flood boundaries can not be replotted at this time. . However, the City may wish to pursue a map amendment with these results which will possibly result in a lessening of the flood hazard boundaries along Morro Creek. The concept of Regulatory Flood Boundaries and FEMA suggested mobile home standards are shown in Figures V-1 and V-2.

ENVIRONMENTALLY SENSITIVE HABITAT DISTRICT ORDINANCE

The Environmentally Sensitive Habitat District chapter of the City's code designates as stream corridors many of the same areas the FIRM designates as flood hazard areas. The ordinance allows only conditionally permitted facilities such as public trails, foot paths and bridges in a stream corridor. Buffers are also required and extend 100 feet in non urban areas and 50 feet in urban areas. There are also provisions for reducing these buffers after consultation with Fish and Game. Decreased buffers for existing structures and uses are also recognized.

A combination setback for flood and environmental purposes in riparian corridors could be coordinated to serve both purposes. This might be done by reserving the area of worst flood hazard along the creeks so that a portion of the flood plain that is equivalent to the NFIP floodway or equivalent to a 100 year Q flowing at 10 feet per second (the limit for containment within earthen and levees and pipe and wire revetment) which ever is greater. The Flood Damage Prevention Ordinance would need to be modified to include this concept and offers of dedication for future drainage ways could be obtained as development took place in these areas. In all likelihood, however, because of the density of existing development along the creeks it would be a lengthy process before sufficient right of way would be available to allow wider low cost flood protection structures.

SILTATION AND EROSION CONTROL

Another environmental concern relating to drainage ordinances has to do with siltation and erosion control. In 1979 the Regional Water Quality Control Board adopted new regulations pertaining to non point sources of pollution including siltation caused by erosion. In the ensuing years they have insisted that local agencies adopt sufficient ordinances that will as a minimum prevent siltation from construction projects from reaching water courses. The City has in fact experienced maintenance problems with siltation occurring at several of the 27 Bay and Ocean storm drain system outlets. It appears that the majority of this siltation comes from construction projects but is also produced by typical urban area erosion. The City has relied upon Chapter 70 of the Uniform Building Code (UBC) having to do with grading and erosion control which includes a requirement to maintain slopes to control against erosion.

The current concern with the harbor is with siltation and grease control at different points along the bay front. Special areas of interest near the Morro Bay Fuel Dock and Bayshore Villas have led the City to consider the use of silt and grease traps in the storm drains. One such design being considered is shown in Figure V-3 and would contain approximately 3 cubic yards of silt when properly functioning. A slight modification is shown which will allow a silt trap to also function as a grease trap. Several silt traps already installed as part of the Bayshore Villa's project are somewhat similar in design but it is not conclusive as to whether they are effective in trapping the silt and preventing it from entering the harbor during peak storm events. In any event the City should continue its program of evaluating the erosion control ordinances as well as evaluating different structures that could be placed within storm drains to reduce silt and grease loading to the ocean outlets.

FLOOD PLAIN DEVELOPMENT STANDARDS

The following recommended general standards would apply to any new or substantially improved construction or new development in flood hazard areas.

ELEVATING AND FLOODPROOFING

In areas shown as flood hazard, all new residential structures must be elevated above the base flood elevation (100 year flood) or storm wave heights. All new commercial structures must either be elevated above the base flood elevation or floodproofed to that level.

ANCHORING

All new construction and substantial improvements must be properly anchored to prevent flotation collapse or lateral movement of the structure. All mobile homes must meet the anchoring requirements and are subject to specific tie-down regulations and performance standards. The anchoring systems that are typically used are shown in Figure V-2.

CONSTRUCTION MATERIALS AND METHODS

New buildings in flood hazard areas must be constructed with materials and by methods to resist or minimize flood damage. The most common method is elevating buildings above the base flood elevation (100 year flood). Another method of protection that is used most commonly for commercial buildings is to flood proof the building including structural walls that have been reinforced to withstand the lateral forces of flood flows. Utilities must also be above flood levels or be floodproofed and secured to prevent displacement due to water pressure. Heating, air condition and ventilation equipment is also required to be above flood levels. In addition, floor drains and other plumbing below the base flood elevation should be fitted with valves to prevent backflow of water that would damage the interior of the building. Utilities, including sanitary sewer systems must be designed to minimize infiltration of flood waters and sewage systems must be designed to avoid causing contamination during flooding.

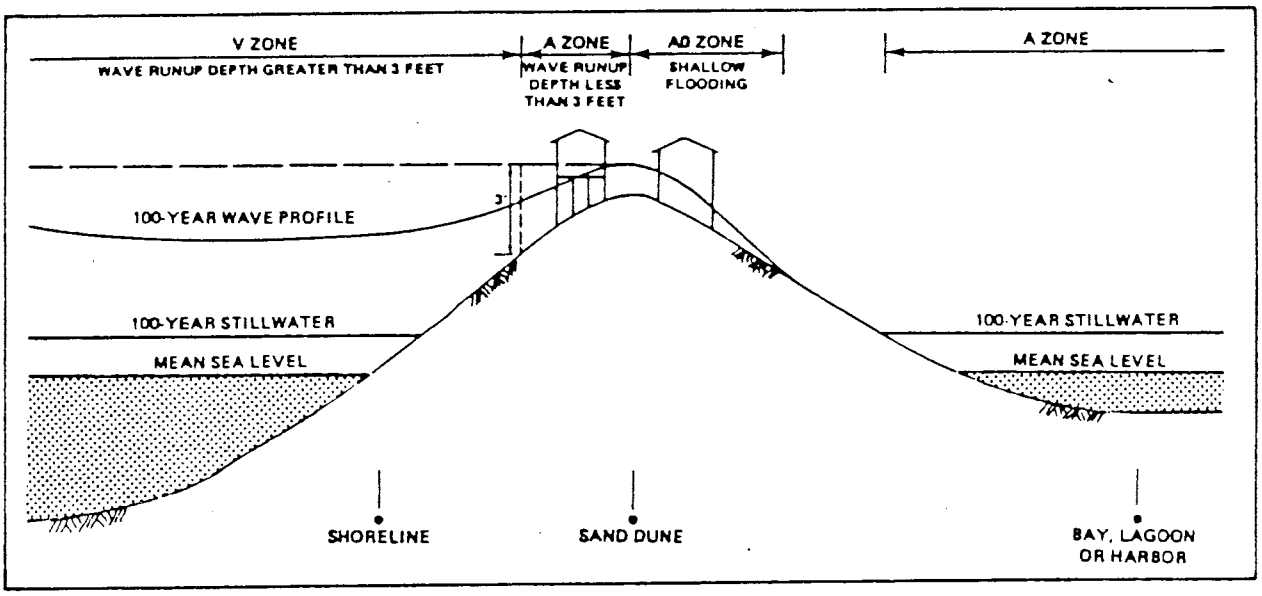
SUBDIVISION PROPOSALS AND DEVELOPMENTS

New subdivisions must protect utilities and ensure adequate drainage such that public utilities and facilities including electrical, gas, water and sewer systems are located and constructed to minimize damage from flood. Lots must also be configured so that flood free building sites can be provided. Building permits must be reviewed for proper drainage before being issued.

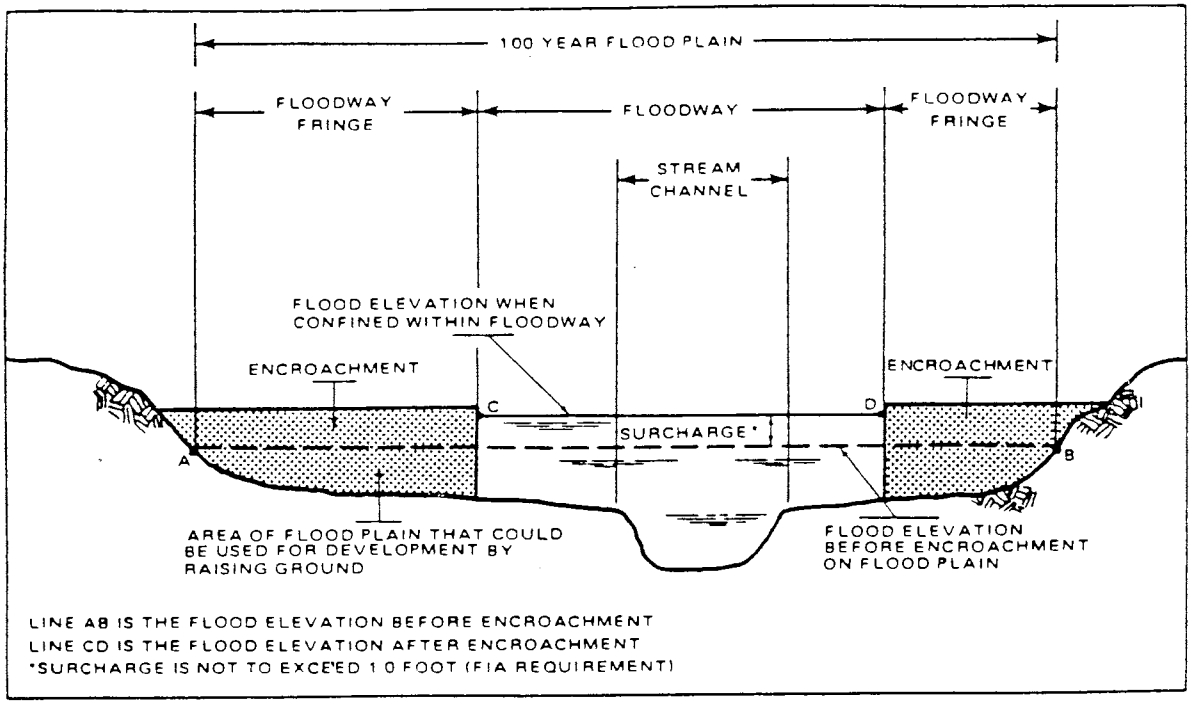
OTHER DRAINAGE STANDARDS

The City currently uses a set of standard drawings for public improvements in addition to recognized standards from the County and other sources. Several modifications have been suggested as part of this report and others will be required in the future as ordinance revisions are made.

TYPICAL TRANSECT SCHEMATIC

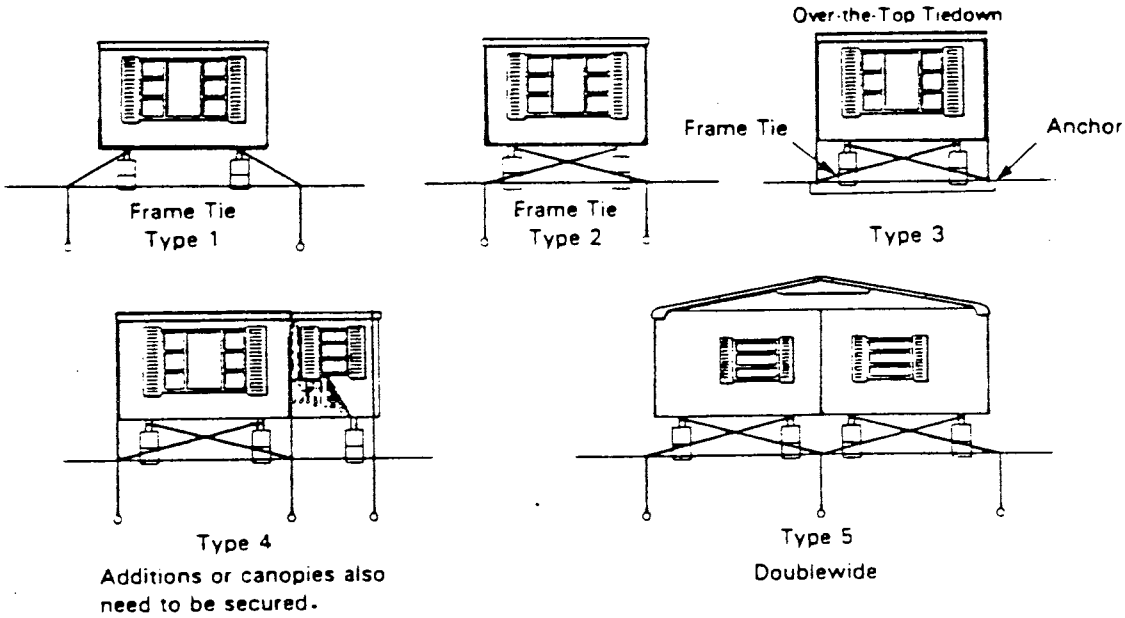


FLOODWAY SCHEMATIC



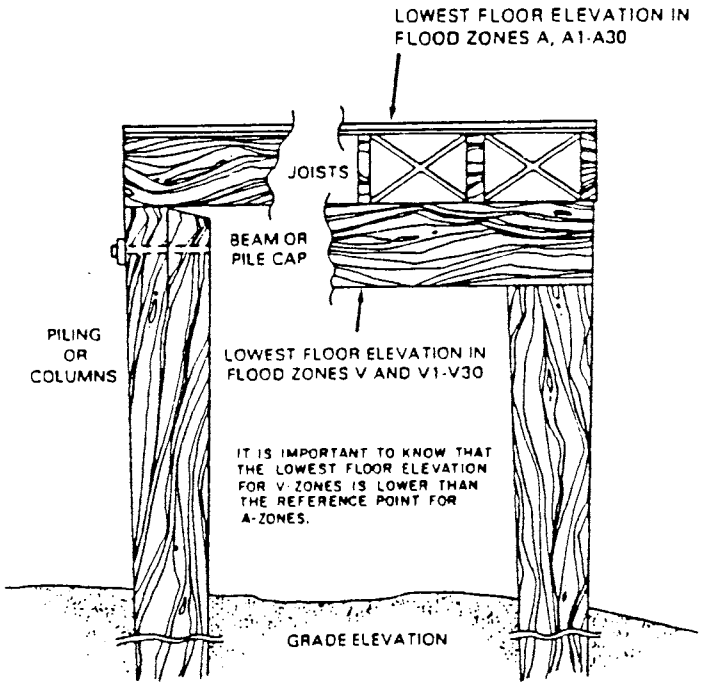
JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE
	REGULATORY FLOOD BOUNDARIES	V-1

MOBILE HOME ANCHORING SYSTEMS

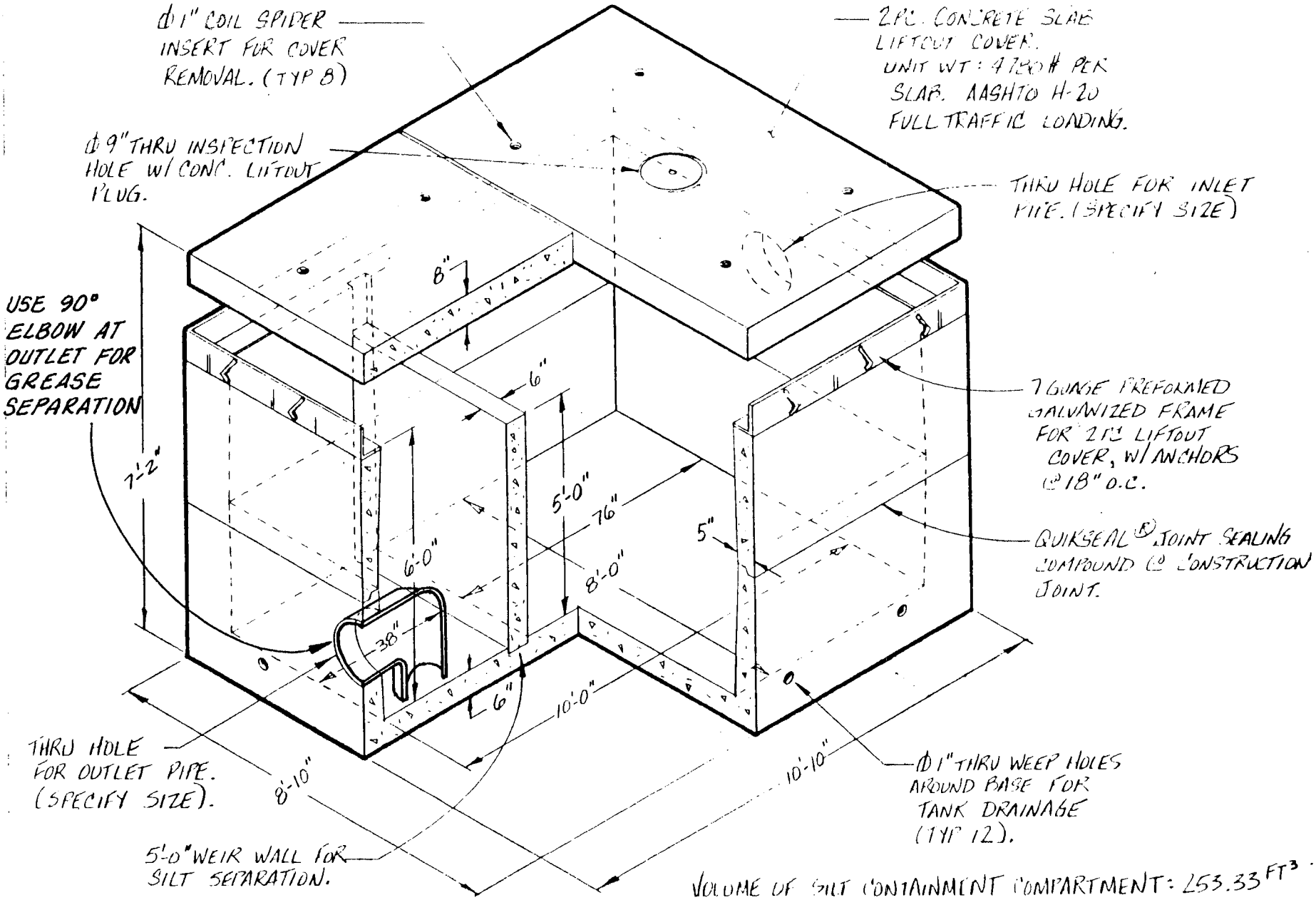


These sketches illustrate various methods for connecting frame ties to the mobile home frame. Type 2 system can resist greater horizontal forces than Type 1. Type 3 system involves placement of mobile home on concrete slab. Anchors embedded in concrete slab are connected to ties.

LOWEST FLOOR ELEVATION, A and V ZONES



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE
	MOBILE HOME STANDARDS	V-2



VOLUME OF SILT CONTAINMENT COMPARTMENT: 253.33 FT^3.

JOHN L. WALLACE & ASSOCIATES

MORRO BAY STORM DRAIN MASTER PLAN

SILTATION TRAP

FIGURE V-3

CHAPTER VI
TECHNICAL METHODOLOGY

In order to prepare this Master Plan, an evaluation of the City's existing (and proposed) storm drain system was performed. This evaluation involved computer analysis, consideration of the input of local residents regarding drainage deficiencies, and also direct observation of runoff patterns during the heavier rainfalls of 1985-86. With these techniques, a list of existing and anticipated drainage deficiencies were identified. Next, a set of potential projects to correct those deficiencies were derived, and prioritized according to cost and benefit. The technical methodology used to analyze the City storm drainage is described below.

In general, the methods used have been selected as being the most applicable from well established drainage engineering procedures, with local data used for the actual analysis and calculations. The methods used can be separated into two broad categories, hydrologic and hydraulic. The study of the area's hydrology provides the amount of stormwater runoff at various points of concentration within the tributary watersheds, while the study of the system hydraulics determines the type, size and shape of the drainage facilities necessary to carry the runoff. The following sections discuss in detail the hydrologic and hydraulic analysis methods used in the project study.

HYDROLOGY

The hydrologic portion of the study uses two separate methods to generate stormwater runoff amounts. For the downtown areas, with small watersheds, the Rational method of calculating runoff is used. This method is desireable because it is a well established method which is easy to apply, and is the method most commonly used by the local engineering community. The Rational method as used locally is applicable only to watersheds smaller than 200 acres. The mostly undeveloped watersheds upstream of the City are considerably larger than this and require a more rigorous analysis. The Santa Barbara Urban Hydrograph (SBUH) method is a hydrograph procedure allowing detailed descriptions of the watersheds applicable to these areas and is used for this study. The two methods, and their relative merits are summarized below:

RATIONAL METHOD - USED WITHIN THE CITY

1. Established method - familiar to local engineers.
2. Easy to apply, can be used by other engineers for projects within the City.
3. Can use criteria developed locally for rainfall, runoff factors, etc.
4. Applicable only to areas less than 200 acres.

5. Adopted by the City as a part of their Engineering Standards.

SBUH METHOD - USED OUTSIDE THE CITY

1. Applicable to the larger watersheds outside of the City.
2. Allows detailed description and modeling of watershed Characteristics.
3. Uses a hydrograph method which can be used for detention basin design.
4. Easily applied computer program which can be used by local engineers and City staff.

HYDRAULICS

After the flow amounts were determined through the hydrology portion of the study, specific problem areas were identified by a review of the flow quantities and locations, as well as direct observation and local experience. These specific problem areas were studied in terms of the hydraulic adequacy of existing or proposed facilities on a case by case basis. The proposed facilities were recommended to provide the level of protection according to the standards described earlier. Some areas of analysis and the associated methods are listed below:

DROP INLETS:

There are many kinds of drop inlets installed in the City's storm drain system, featuring different grate sizes, grate types and bar spacing. The major limitation to analysis of the existing drop inlet capacities is the variation of the type of inlets and their elevation relative to flow in the adjacent streets. This required that the inlets be analyzed on a case by case basis, and often the problem inlets were identified first by direct observation during storms.

The City now has two standard designs for drop inlets, what it calls "Type I" and the higher capacity "Type II". The proposed projects make use of these inlets and locate them according to their interception capacity. In some cases the adequacy of existing drop inlet capacity was determined from local experience, particularly in the commercial areas. Where a shortage of capacity has been experienced the problem area is discussed in the report.

STREET FLOW:

For areas with curb and gutters, the street capacity was based upon the curb capacities shown in Figure IV-1. In much of the City, however, the inconsistency of street crowning, curbs, gutters and roadside ditches makes it

impractical to assume a consistent allowable street flow for the existing streets. For this report the flow capacity of these streets is considered adequate unless that flow is related to a specific drainage facility being studied, a proposed drainage system extension, or a known problem area.

CULVERT AND STORM DRAIN ANALYSIS:

Culverts were analyzed according to standard BUREAU OF PUBLIC ROADS culvert capacity nomographs. Storm drain piping was analyzed according to open channel flow calculations based on Manning's equation. The recommended projects are based on Reinforced Concrete Pipe (RCP) culverts. Other pipe materials may eventually be chosen by the City to be used in a project and may result in different pipe sizes.

CHAPTER VII
MASTER PLAN IMPLEMENTATION AND FINANCING

As noted previously, the City's annual budget for storm drainage is relatively modest in comparison with the potential need for capital improvements. The fiscal year 1986-87 budget is $112,500 for street and storm drain improvements. The street overlay program alone requires about $100,000 per year, so only about $12,500 remained for maintenance and actual drainage improvements such as the projects recommended in this report.

In order to implement the projects recommended, the existing budget level for drainage improvements will need to be increased. There are several vehicles for additional financing that can be considered by the City, including the establishment of new development fees for drainage. This Storm Drain Master Plan and supporting financing programs can be implemented by the adoption of new ordinances and the development of new revenue sources as discussed below.

ADOPTION OF MASTER PLAN

This Master Plan includes a number of projects which have been evaluated and prioritized according to need, and will be subsequently considered according to cost. The adoption of a master plan is an integral part of the City's Public Works planning effort, and will provide the City with a tool for a systematic and purposeful approach to stormwater management.

It is anticipated that public hearings will be held to discuss this plan. This will provide for public input regarding the recommended drainage projects, ordinance revisions and financing methods that might be employed.

FINANCING AND BUDGETING

There are several revenue vehicles that the City could use to finance the improvements called for in this master plan. Drainage improvements within the City have traditionally been funded through the Public Works portion of the General Fund. Facilities have also been installed as required by subdivision and development conditions of approval. Often these subdivision improvements are sized to take drainage entering the site from upstream and in some cases developments have been required to take drainage a considerable distance downstream. However, the General Fund continues to be the primary source of monies for the drainage improvements for the City. Additional funding will be required to finance the recommended projects. Other than an increase in the General Fund allocation for drainage projects, the following are financing methods available to generate the necessary funding:

DEVELOPMENT TAX

The City can implement a development tax on new construction to finance all categories of public improvements within the City including drainage improvements. A tax of this sort has been taken to being a general tax and not a special tax and therefore outside of the limit of Proposition 13 and not subject to voter approval. The City of Atascadero has recently adopted such a tax for financing numerous improvements within the City. However, a basic criterium is that these monies can not be earmarked for any special use and must flow to the General Fund.

DRAINAGE IMPACT FEE

The City can also adopt a drainage impact fee on new construction whereby new construction would pay a fee based on some relationship to its impact on the local drainage system. Some communities have adopted this fee with some credit given if a portion of the on-site drainage improvements built as part of the development also accommodate regional drainage. This type of a fee is not subject to Proposition 13 and has been adopted by a number of California communities including the City of San Diego. Such a fee can be based on the amount of runoff created from different types of development with a different amount of fee expected from detached single family dwellings versus other more intensive developments such as motels or hotels. As an example, the Los Angeles County Flood Control District has computed runoff factors and based assessments on runoff factors for different kinds of properties throughout the District.

ASSESSMENTS

Benefit assessments can be made similar to special assessment district proceedings. However, bond financing in the case of benefit assessments is usually not used. Rather funds are collected over an area that will benefit from a future improvement and the improvement is then constructed. This has the advantage of having the funds available to do the work rather than waiting for the funds to be collected over a long period of time with the uncertainty of inflation eroding the value of earlier funds collected.

Special assessment district financing can be used to place assessments on all property within a drainage area for a specific project. Typically, the 1913 and 1915 acts are used to accomplish these projects. The process is well known to the City which has used it in the past for other Public Works types of projects.

SUBDIVISION FEES

The Subdivision Map Act provides (in section 66483) that local ordinances may be adopted to impose fees on new subdivisions for storm drainage and sanitary sewer off-site facilities. These fees can be collected in an area that has been designated and adopted as part of a drainage plan that includes an estimate of the total cost of constructing the facilities. This Master Plan has been designed to accommodate such an ordinance. The fees collected can be deposited in a "drainage facilities fund" and can only be expended for the construction of the designated facilities or to reimburse the General Fund for funds advanced for these projects. Such an ordinance must also provide that the fee imposed does not exceed the pro-rata share of the total cost as if the cost had been apportioned uniformly on a per acre basis within the area.

ORDINANCE REVISIONS

Several ordinance revisions are suggested in this Master Plan, some of which are optional and others which are required by the National Flood Insurance Program (NFIP). The City must revise its ordinance to be compatible with the national regulations by September 1987. The main thrust of these revisions have to do with the regulation of mobile homes within flood plains and require the elevating of existing mobile homes when replaced and the anchoring of existing units.

Other code revisions required to be in conformance with the NFIP are contained in the FEMA regulations published in the Federal Register in August of 1986. It is recommended that the City review FEMA's model ordinance and decide on the exact changes needed. This will sustain the City's participation in the National Flood Insurance Program and insure that its residents can buy flood insurance. Without participation in the NFIP, mortgages cannot be obtained from federally insured lending institutions for property within flood prone areas.

In addition to the required ordinance amendments "flood protection setback areas" can be established which can provide for relatively low cost flood control improvements over a period of years and also be consistent with the City's Environmentally Sensitive Habitat Districts. The procedures for establishing such setback areas are based on engineering calculations which reserve the area of worst flood hazard to be maintained as a floodway free of encroachments.

FLOODPLAIN MAPPING

An integral part of regulating flood-hazard areas is the calculation and mapping of those areas. Because this study has found that the some of the flows previously used by FEMA to produce flood insurance maps appear excessive, a recalculation of flood-prone areas should be performed so that new flood boundaries could be mapped. These calculations could only be done with accurate topographic mapping along the major water courses and were beyond the intent of this report. In order for the revised mapping to be accepted by the NFIP, it must be processed as a Flood Insurance Map amendment by FEMA.

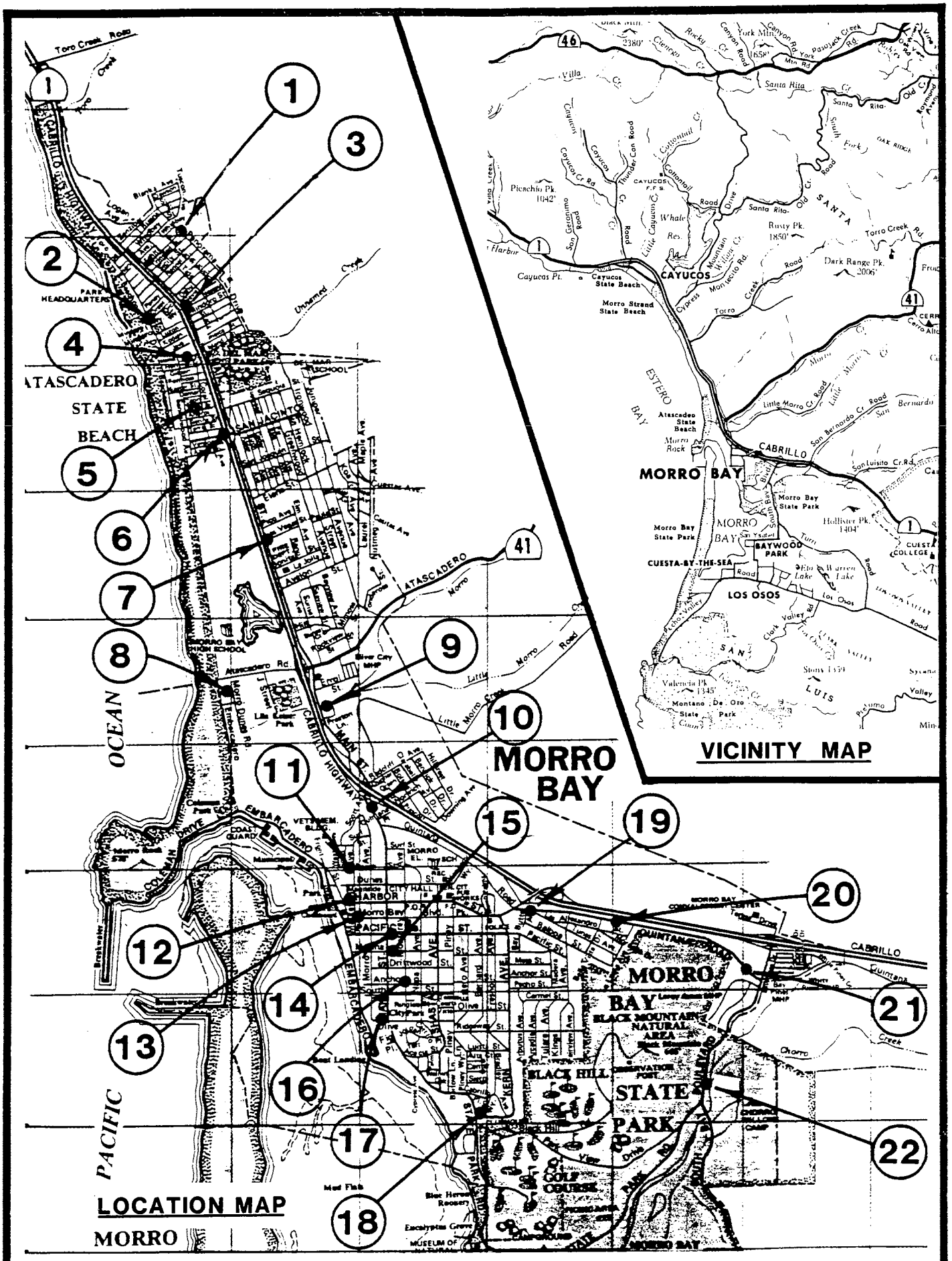
PERIODIC REVIEW AND UPDATING

A drainage master plan should be revised as policies and physical features change within the City. A periodic review of this report should be made in order to determine the revisions needed. Because the formal adoption of a drainage master plan is a requirement if the City wishes to utilize the provisions of the Subdivision Map Act dealing with drainage fees, it is anticipated that updates would be evaluated yearly.

CHAPTER VIII
EVALUATION OF SPECIFIC PROJECTS

This chapter presents discussion and recommendations for 22 drainage problem areas within the City of Morro Bay. The drainage problems were identified through a combination of watershed and hydraulic analyses, discussions with City staff, and the experience of the local residents and business people. Along with each project recommendation is a cost estimate and a priority ranking.

The priority rankings were based upon a weighting of four categories. A drainage problem with the potential to cause property damage was given four points, potential traffic problems were assigned two points, a drainage problem in an area of high intensity use was also assigned two points, and a problem which lingered on in the form of ponding or extended flows was given one point. None of the problems were considered life or health threatening, and therefore this was not considered in the ranking. A problem was considered to be a high priority if it earned four or more points, less then four and two or more points is a medium priority, and less than two points is a low priority project.



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN PROJECT MAPS	FIGURE VIII-1

TABLE VIII-1
SUMMARY OF PROJECT COSTS AND PRIORITY

No.	PROJECT NAME	COST	POTENTIAL PROPERTY DAMAGE	POTENTIAL TRAFFIC HAZARD	LINGERING PONDING OR FLOW	HIGH USE AREA	PRIORITY
1	NONAME CREEK	$192,395	Y	Y	–	–	6
2	BEACHCOMBER DRIVE AT ORCAS STREET	$49,259	Y	–	–	–	4
3	NASSAU STREET AT MAIN STREET	$97,702	Y	Y	–	–	6
4	ALVA PAUL CREEK	$118,273	Y	–	–	–	4
5	BALI STREET – SANDLEWOOD TO HIGHWAY ONE	$70,271	Y	–	–	–	4
6	SAN JACINTO STREET AT MAIN STREET	$78,202	–	Y	–	–	2
7	MAIN STREET – PICO TO LAS VEGAS STREET	$45,753	–	–	–	–	0
8	WASTEWATER TREATMENT PLANT	$252,460	–	Y	–	–	2
9	MORRO CREEK AT MAIN STREET	$186,739	Y	Y	–	Y	6
10	WILLOW CAMP CREEK	$93,231	–	–	–	–	0
11	BEACH STREET – EMBARCADERO TO MORRO AVENUE	$261,519	–	Y	Y	Y	5
12	HARBOR STREET AT EMBARCADERO DRIVE	$239,651	Y	Y	–	Y	7
13	MORRO BAY BOULEVARD – MARKET TO MAIN STREET	$108,676	Y	Y	–	Y	7
14	PACIFIC STREET – MAIN TO NAPA AVENUE	$105,420	–	–	–	–	0
15	MARINA STREET – MAIN TO SHASTA AVENUE	$140,903	–	–	–	–	0
16	ANCHOR STREET – EMBARCADERO TO ARBUTUS AVENUE	$759,924	Y	Y	Y	–	8
17	OLIVE STREET – MORRO TO MAIN STREET	$61,783	–	Y	–	–	2
18	KERN AVENUE AT MAIN STREET	$37,849	–	Y	–	–	2
19	LAS TUNAS AVENUE – BUTTE TO KINGS AVENUE	$209,901	–	Y	Y	Y	5
20	QUINTANA ROAD – BELLA VISTA TO LA LOMA AVENUE	$100,745	–	Y	–	–	2
21	QUINTANA ROAD – WEST OF SOUTH BAY BOULEVARD	$34,789	–	Y	–	–	2
22	TWIN BRIDGES AT SOUTH BAY BOULEVARD	———	Y	Y	–	Y	7
	TOTAL:	$3,245,451					

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

NOTES

THE PROJECTS ARE ASSIGNED PRIORITY POINTS AS FOLLOWS:
4 POINTS IF THE PROJECTS RELIEVE A DRAINAGE PROBLEM WITH THE POTENTIAL FOR PROPERTY DAMAGE.
2 POINTS IF THE PROJECTS RELIEVE A DRAINAGE PROBLEM WITH THE POTENTIAL FOR TRAFFIC HAZARDS.
2 POINTS IF THE PROJECTS RELIEVE A DRAINAGE PROBLEM WITH THE POTENTIAL FOR LINGERING PONDING OR FLOW.
1 POINT IF THE PROJECT RELIEVES A DRAINAGE PROBLEM IN A HIGH USE AREA.

A PROJECT WITH A HIGHER POINT TOTAL IS A HIGHER PRIORITY PROJECT.

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER: 1

NONAME CREEK

Noname Creek is located at the northern edge of the City of Morro Bay's residential area. Most of its 279 acre watershed is steep hillside grasslands with a small amount of residential area east of Highway One at the lower end of the watershed. The facilities of this watershed should be designed to carry a 10 year flow with freeboard, and a 25 year storm without freeboard.

The Creek enters a 36" diameter culvert through a flat concrete headwall located at the Navy Fuel Storage Facility. The ground surface is approximately 5.5 feet above the culvert invert. The culvert conveys the flow to the west beneath Panorama Drive and beneath a condominium development adjacent to Panorama Drive. The Creek emerges in a poorly maintained channel west of the condominiums and flows to Tide Avenue where it enters a 48" diameter CMP culvert. The ground surface is approximately 6.6 feet above the culvert invert. The water emerges from the 48" culvert west of Tide Avenue between Whidbey Street and Vashon Street. It then flows through a wide unimproved drainage channel to Main Street where the water enters a 54" diameter RCP CALTRANS culvert through concrete wing walls and drains to the west beneath Highway 1 and discharges to the beach. Main Street is approximately 13.7' above the invert of the 54" diameter culvert. The streets in the vicinity of Noname Creek do not have curbs.

There is a Standard Oil containment basin, consisting of two ponds, near the top of the Noname Creek watershed. This basin has a large diameter overflow pipe as well as a valved drain beneath the dam. If drained prior to a storm, the ponds serve as detention basins, retarding peak flows in the Creek. Standard Oil does operate the basins to be normally empty as to be full would defeat the ability to store and contain oil. As a result, the ponds play an important role in preventing lowering peak stormwater runoff amounts. However, the outlet to the basin is a valved outlet, dependent upon the awareness of an operator to insure that the basin is properly drained. For this reason the beneficial effect of the oil containment basins cannot be always counted upon.

DRAINAGE PROBLEM:

Without considering the role of the oil containment basins as detention basins, the existing 36" culvert beginning in the Navy fuel storage facility yard appears to be too small to accommodate even a 10 year event. Water will surcharge at the inlet and flow across an open field towards Panorama Drive and then to Tahiti

Street. There is the potential for some property damage to the condominiums located at the corner of Tahiti Street and Panorama Drive and possibly to houses along Tahiti Street. Almost all of the excess flow will be deflected by the condominiums toward Tahiti Street.

The channel located between Panorama Drive and Tide Avenue is relatively unimproved and is clogged with foliage. The 48" diameter CMP culvert at Tide Avenue immediately downstream from the unimproved channel is adequate for a 10 year storm but not for a 25 year storm. Overflow from this culvert will have a definite impact on residences immediately west of Tide Avenue and along Vashon Street, the overflow channel.

However, it is not clear exactly how much of the flow from a 25 year event would reach the 48" diameter culvert, since some of the excess flow would continue down Tahiti Street toward Main Street. The unimproved channel located west of Tide Avenue is adequate in size because the adjacent houses are constructed well above and horizontally distant from the channel. However, the channel makes a sharp turn at Main Street, greatly reducing its capacity at that point. The hydraulic characteristics of the channel could be significantly improved with some grading and foliage control. The CALTRANS 54" culvert is adequately sized for a 100 year storm event although water will be significantly higher than the culvert entrance. There should be no property damage adjacent to this culvert as long as the culvert remains clear of debris. A grading and maintenance program is needed for this channel, particularly since houses are located along each side of the channel and will be directly effected by channel surcharging.

The Flood Insurance Rate Map (FIRM) delineates the boundaries of a 100 year flood event passing through the residential area along Noname Creek. The conclusions of the Flood Insurance Study are essentially the same as in this report although the flow may not actually overflow Highway One, as indicated by the FIRM. If there is debris clogging the CALTRANS 54" culvert then the runoff could backup and flow across Highway One. Otherwise the existing culvert is probably sufficiently large. Also, the FIRM shows the excess flood water spreading out along Panorama Street, flowing around the condominiums, and then reentering the Creek. It is more probable that the excess flows will be deflected by the condominiums down Tahiti Street.

Local experience has shown that there has been little of the flooding predicted by traditional methods. This lack of flooding may be attributed to the oil containment ponds serving as detention basins. Runoff analysis of the potential flows originating above and below the basins supports the theory that the ponds are significantly moderating the peak flows. Because of this important relationship, Standard Oil should be encouraged

to maintain the water levels in the ponds as low as possible, to provide the maximum amount of detention volume available, consistent with the requirements of oil containment. If the ponds are inadvertently allowed to remain full during a peak flood event so that no detention occurs, the downstream channel will experience significantly higher peak flows.

According to the City Staff, there is a drainage easement under the condominiums next to Tahiti Street but not elsewhere between Tahiti Street and Highway One. The lack of a drainage easement makes flood control action difficult. Responsibility for the maintenance and improvement of flood routes is not clearly defined relative to existing improvements that may be damaged by flood water. Future improvements and drainage responsibility may be controlled and clearly defined through the permit process. For existing drainage routes without easements, where the City meets with opposition from property owners when attempting to implement drainage improvements and maintenance activities, the City should attempt to clearly document the limits of the City's liability and to inform the property owners of their own liability.

POTENTIAL SOLUTIONS:

1. Complete a study delineating the role of the oil containment ponds as detention basins, comparing the relative costs of maximizing the potential of the basins and installing a new storm drain in Tahiti Street to the existing channel west of Tide Avenue.

2. Examine the existing ponds' ability to withstand a major flood event and determine the danger to property and public safety if the ponds are found to be inadequate.

3. Encourage the installation of automatically operating drain inlets that will optimize the detention capacity of the oil containment ponds.

4. Complete a study examining the feasibility of installing a relief storm drain for the existing 36" storm drain.

5. Clean and grade the existing drainage channel between the condominiums and Tide Avenue to maximize the flow capacity of the available area. Building improvements that could contribute to debris within the channels should be removed.

6. Increase the frequency of clearing the drainage channels between Panorama Avenue and Main Street of debris that clogs culverts and restrain flows during a flood. The channels should be observed to determine a cleaning interval that will maintain the channels in a clear state.

7. If other improvements are not considered, provide an interception storm drain in Tahiti Street to direct flood waters flowing down Tahiti Street back to the drainage channel. These improvements will minimize damage caused by overflowing flood waters that are deflected by the Panorama Drive condominiums down Tahiti Street.

8. Clearly define the responsibility for maintaining and improving drainage routes. Document the responsibilities and inform all of the parties involved.

HYDROLOGY:

Noname Creek at Highway 1, without the detention effect of the oil containment ponds

Q10 = 101 cfs
Q25 = 136 cfs
Q100 = 191 cfs

Noname Creek at 36" CMP culvert, Tahiti Street, without the detention effect of the oil containment ponds.

Q10 = 84 cfs
Q25 = 113 cfs
Q100 = 158 cfs

Noname Creek at oil containment ponds.

Q10 = 43 cfs Q25 = 57 cfs Q100 = 79 cfs

Noname Creek between oil containment ponds and 36" CMP culvert, assuming no flow from the ponds.

Q10 = 54 cfs Q25 = 71 cfs Q100 = 97 cfs

Flood Insurance Study flows at Panorama Drive, not including overflows.

Q10 = 105 cfs Q50 = 615 cfs Q100 = 1010 cfs

Flood Insurance Study flows at Tide Avenue, not including overflows.

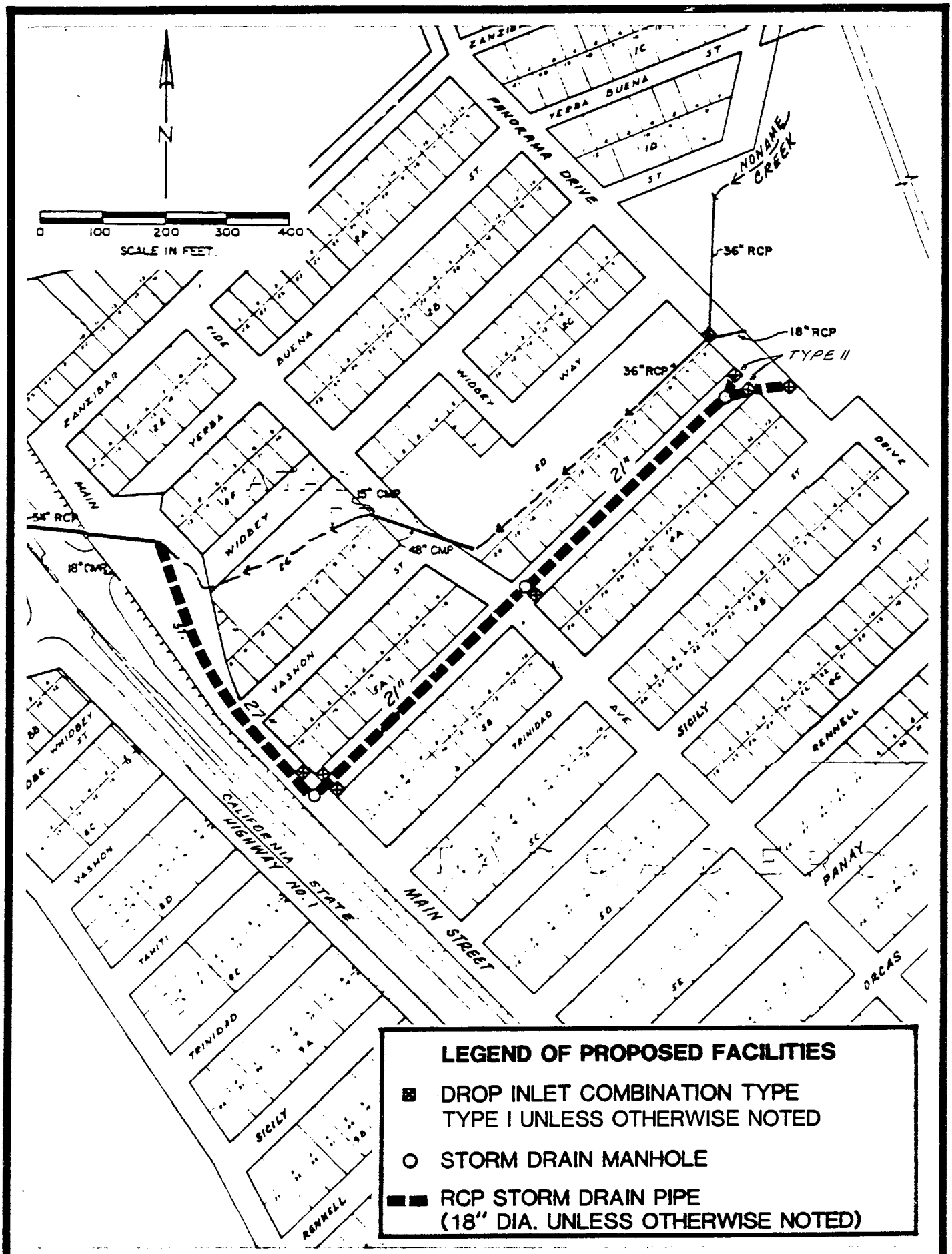
Q10 = 100 cfs Q50 = 240 cfs Q100 = 340 cfs

Flood Insurance Study flows at Whidbey Way (extended).

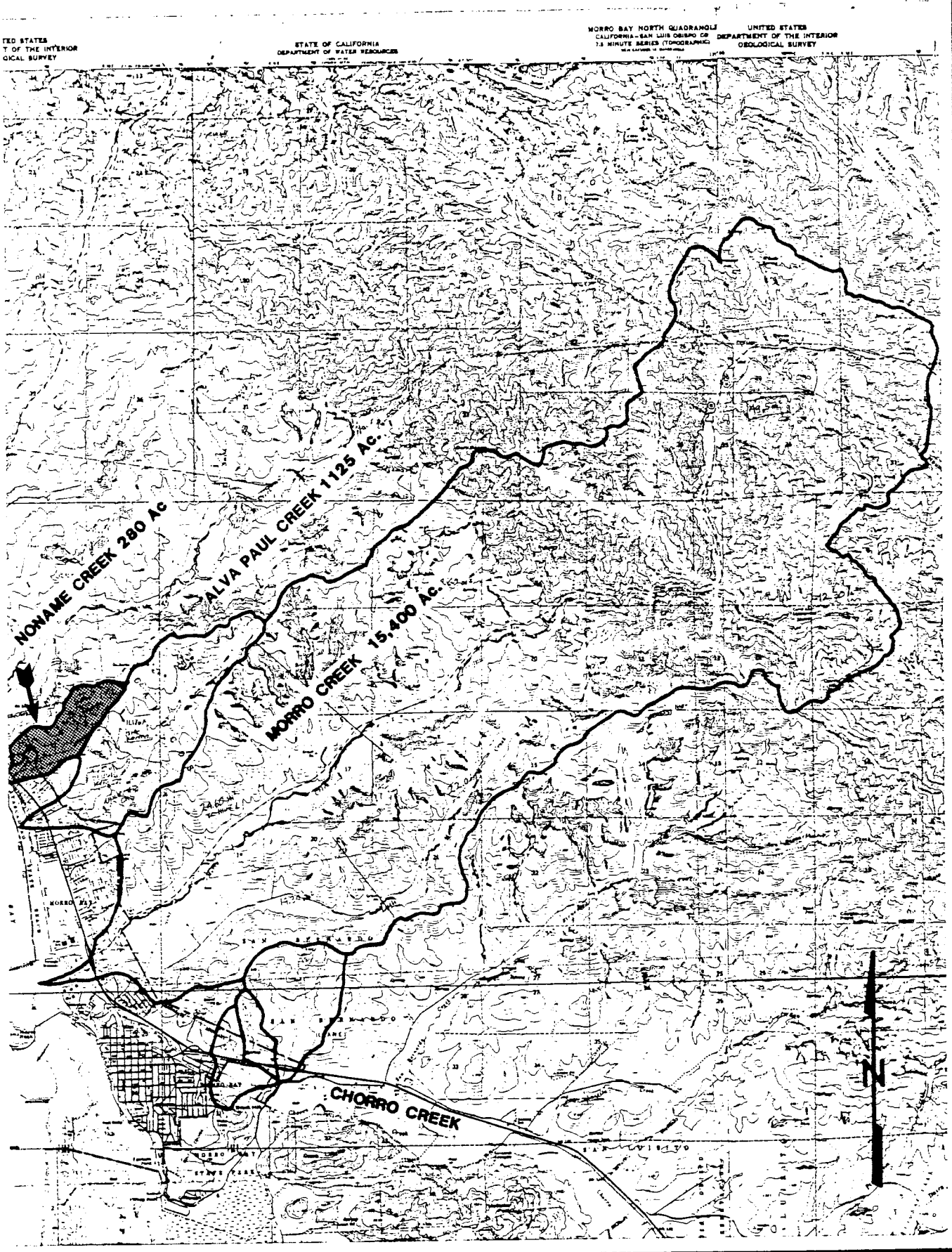
Q10 = 180 cfs Q50 = 700 cfs Q100 = 1100 cfs

Flood Insurance Study flows at Yerba Buena Street, not including overflows.

Q10 = 100 cfs Q50 = 170 cfs Q100 = 210 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-2
	NONAME CREEK	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-3
	NONAME CREEK	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 1
NONAME CREEK
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	360	Lin. Ft.	$60.00	$21,600.00
2	21" RCP STORM DRAIN PIPE	915	Lin. Ft.	$64.00	$58,560.00
3	27" RCP STORM DRAIN PIPE	485	Lin. Ft.	$73.00	$35,405.00
4	CATCH BASINS - TYPE I	5	Each	$1,700.00	$8,500.00
5	CATCH BASINS - TYPE II	2	Each	$2,100.00	$4,200.00
6	REMODEL EXISTING CATCH BASIN	1	Each	$2,500.00	$2,500.00
7	STORM DRAIN MANHOLE	3	Each	$2,500.00	$7,500.00
8					
9					
10					
CONSTRUCTION SUBTOTAL					$138,265.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$13,826.50
SUBTOTAL					$152,091.50
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$22,813.73
PROJECT SUBTOTAL					$174,905.23
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$17,490.52
TOTAL PROJECT COST					$192,395.75

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER: 2

BEACHCOMBER DRIVE AT ORCAS STREET

This area is the downstream path for Nassau Street watershed. After flowing beneath Highway 1, the water travels through an unimproved channel to Mindoro Way adjacent Beachcomber Drive, and then spills out onto the pavement and flows toward a culvert under the Atascadero Beach State Park. The watershed includes residential and steep hillside grassland areas and Highway 1. Existing peak flows are reduced by the undersized inlet capacity at Highway 1 (see project number 2). The facilities of this watershed should be designed to carry a 10 year flow with freeboard, and a 25 year storm without freeboard.

DRAINAGE PROBLEM:

The unimproved channel is subject to erosion and should be examined after large flows to check for damage. The outlet at Mindoro Way is uncontrolled and unnecessary erosion is occurring at that point. There will be erosion damage to the banks below Beachcomber Drive, particularly opposite the outlet of the unimproved channel. During a peak flow event pedestrian activity in that area will be hazardous.

According to the City Staff there is no drainage easement between Highway 1 and Mindoro Way. The responsibility for maintaining the existing drainage path or installing improvements if the upstream CALTRANS culvert size is increased (see project number 3) is not clear.

POTENTIAL SOLUTIONS:

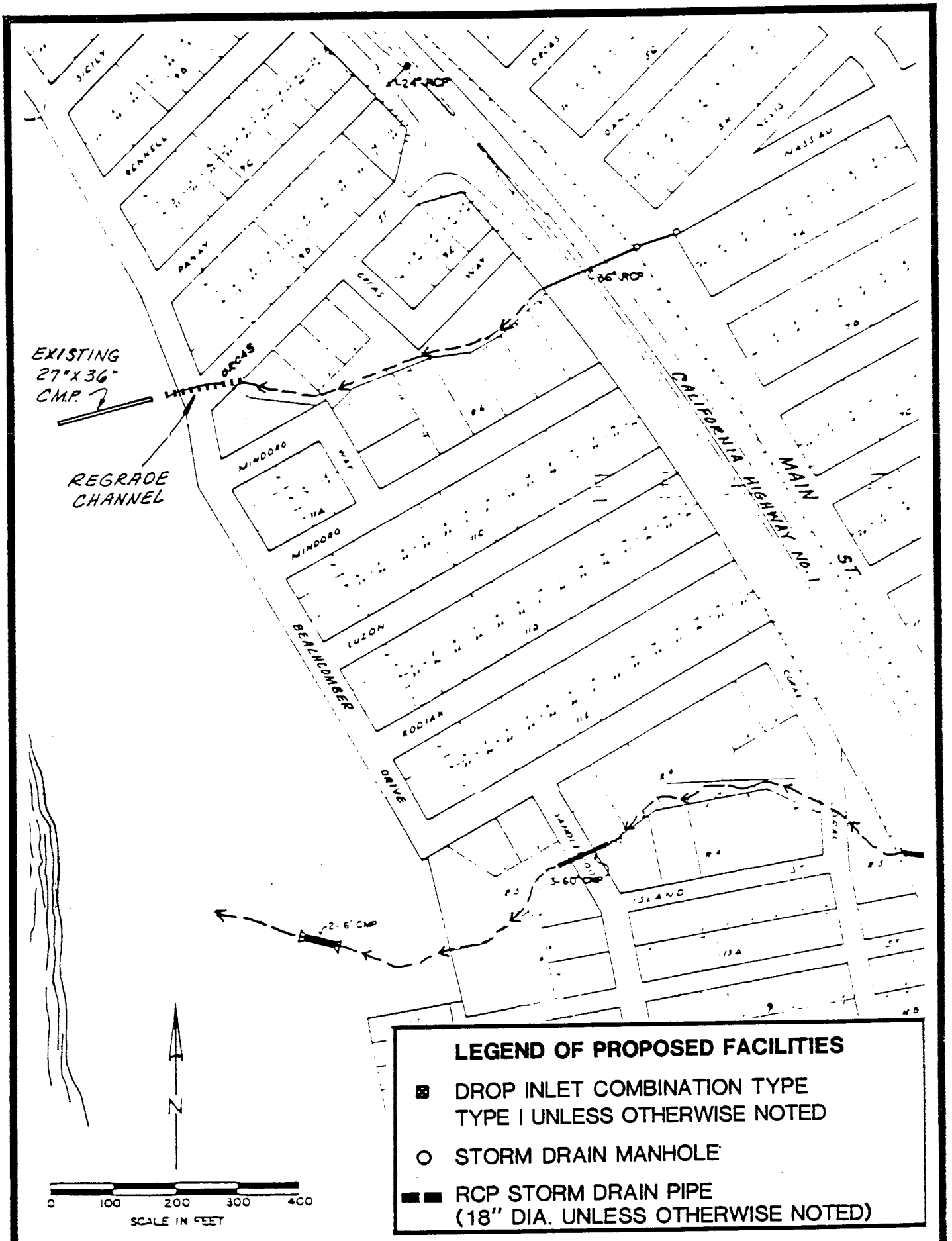
1. Install a confined drainage path from the unimproved channel outlet to the State Park culvert. This channel could be made to appear as a natural waterway with rock and foliage lined banks and a bridge for pedestrian traffic.

2. Clearly define the responsibility for the maintenance of the drainage route and for completing improvements. Document the limits of the City's responsibility and inform the property owners involved.

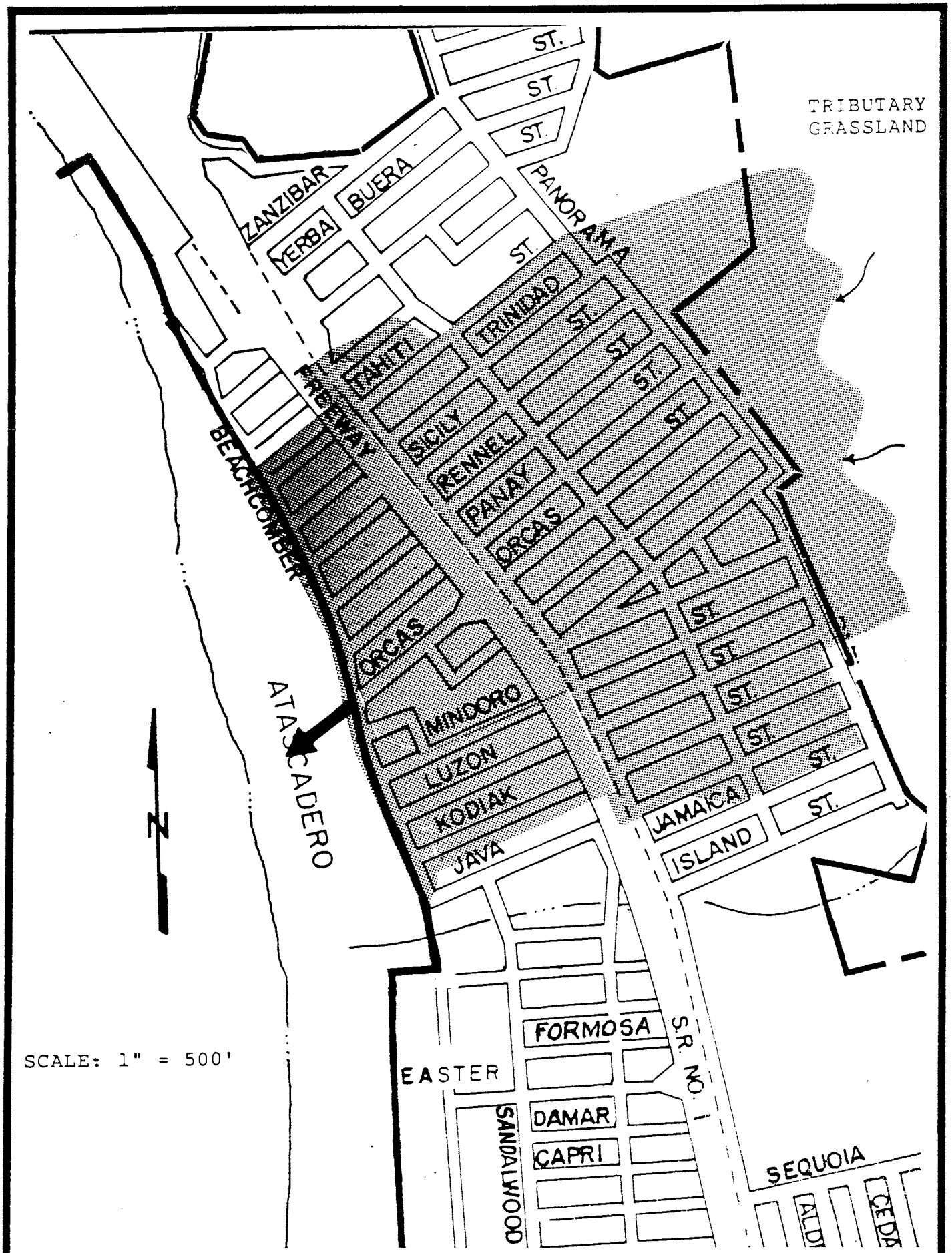
HYDROLOGY:

Peak flows assuming 70 cfs from the 36" RCP Highway 1 culvert.

Q10 = 95 cfs Q25 = 97 cfs Q100 = 107 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN BEACHCOMBER DRIVE AND ORCAS STREET	FIGURE VIII-4



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN BEACHCOMBER DRIVE AND ORCAS STREET	FIGURE VIII-5

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 2
BEACHCOMBER DRIVE OVERPASS AT ORCAS STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	42" RCP STORM DRAIN PIPE	200	Lin. Ft.	$112.00	$22,400.00
2	CATCH BASIN CULVERT HEADWALL	1	Each	$4,000.00	$4,000.00
3	MISCELLANEOUS CONNECTIONS, GRADING AND STREET REPAIRS	1		$9,000.00	$9,000.00
4					
5					
6					
7					
8					
9					
10					
CONSTRUCTION SUBTOTAL					$35,400.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$3,540.00
SUBTOTAL					$38,940.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$5,841.00
PROJECT SUBTOTAL					$44,781.00
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$4,478.10
TOTAL PROJECT COST					$49,259.10

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER: 3

NASSAU STREET AT MAIN STREET

At the intersection of Nassau Street and Main Street there is a 5'x3' grate inlet with a curb inlet at the southeast corner of the intersection and a 4'x8" curb inlet at the west side of the intersection. The inlets lead to a 36" RCP CALTRANS culvert that drains to the west beneath Highway One. The top of the grate is 6' above the culvert invert, and Highway One is approximately 5' above the top of the inlet grate. The watershed includes residential and steep hillside grassland areas and Highway One. The lower blocks of Nevis Street and Nassau Street have curbs and gutters.

DRAINAGE PROBLEM:

The CALTRANS culvert is undersized for the magnitude of flows that will occur, even for a 10 year event. Also, the inlet capacity is clearly too small to utilize the existing culvert capacity. With the inlets and culvert operating in the most efficient manner, the street will be filled 1 to 3 feet deep during a 10 and 100 year storm events. If the water could fill the intersection to the Highway One road surface or so that water flows out to the north, Main Street will be flooded to Panay Street to the North, approximately one block east to Tide Avenue, and to Java Street to the south. Whether or not it would reach this depth would depend on the hydraulic characteristics of the inlets. According to the Flood Insurance Study, the 100 year event will flood north almost to Orcas Street, east almost to Tide Avenue, and south to Kodiak Street.

POTENTIAL SOLUTIONS:

1. Install a larger culvert or a parallel culvert beneath Highway 1.

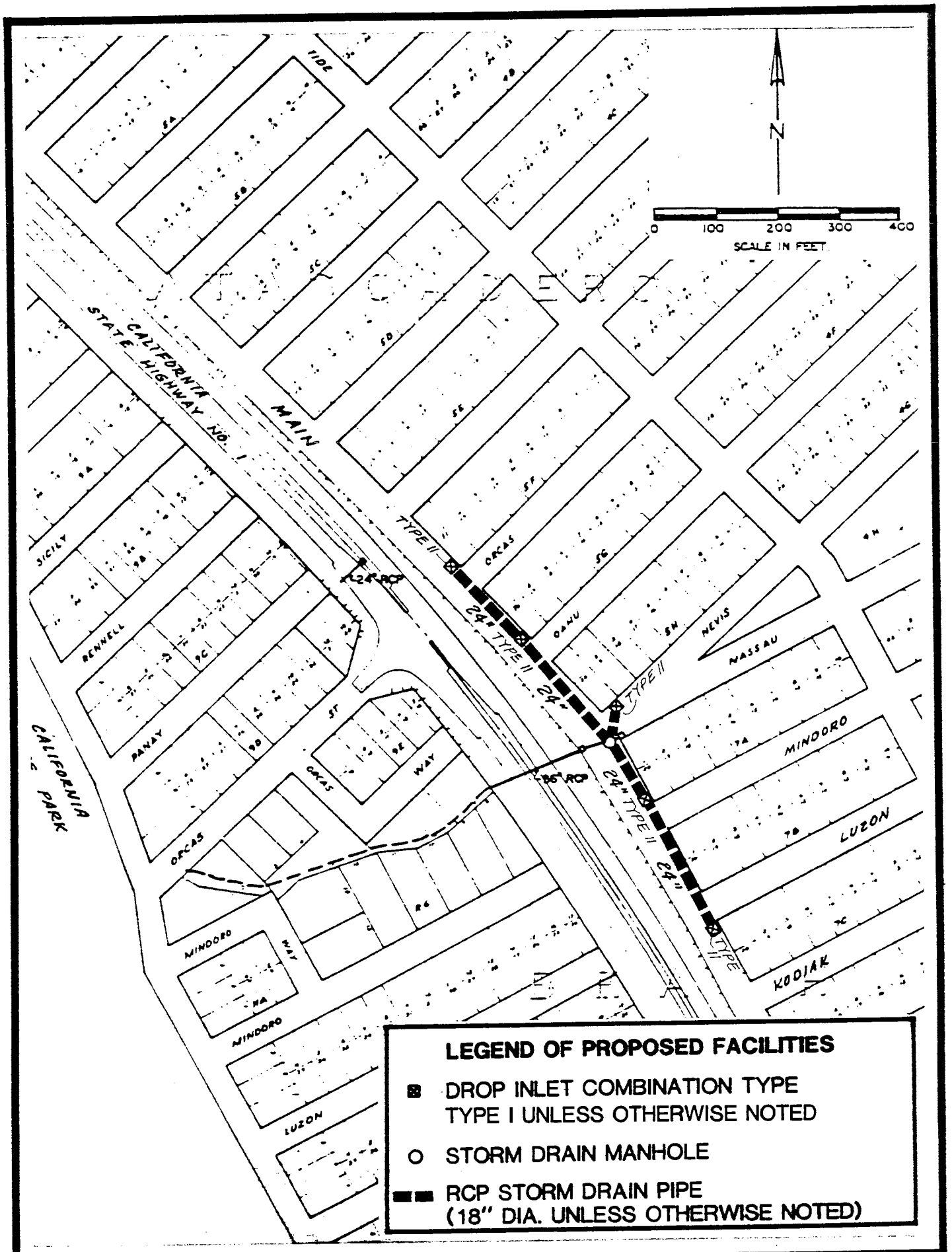
2. Provide sufficient inlet capacity to completely utilize the culvert capacity.

3. Extend a storm drain system up the adjacent streets to intercept the street flow.

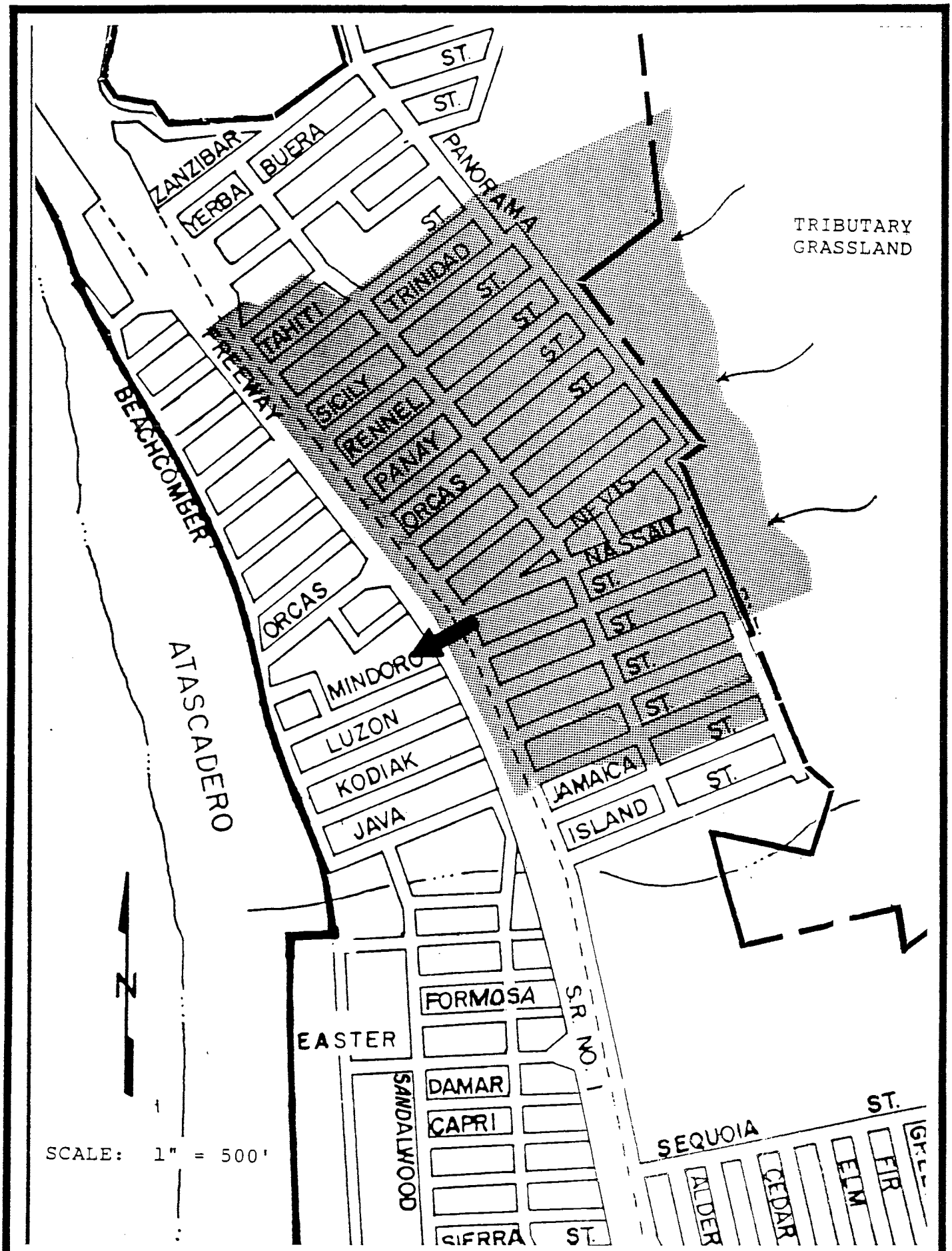
A combination of solutions 2 and 3 were selected as the most cost effective manner of improving this drainage problem.

HYDROLOGY:

Q10 = 74 cfs Q25 = 84 cfs Q100 = 108 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN NASSAU STREET AT MAIN STREET INTERSECTION	FIGURE VIII-6



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-7
	NASSAU STREET AT MAIN STREET INTERSECTION	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 3
NASSAU STREET AT MAIN STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	55	Lin. Ft.	$60.00	$3,300.00
2	24" RCP STORM DRAIN PIPE	740	Lin. Ft.	$68.00	$50,320.00
3	CATCH BASINS - TYPE II	5	Each	$2,100.00	$10,500.00
4	STORM DRAIN MANHOLE	1	Each	$2,500.00	$2,500.00
5					
6					
7					
8					
9					
10					
CONSTRUCTION SUBTOTAL					$66,620.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$6,662.00
SUBTOTAL					$73,282.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$10,992.30
PROJECT SUBTOTAL					$84,274.30
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$8,427.43
TOTAL PROJECT COST					$92,701.73

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER: 4

ALVA PAUL CREEK

Alva Paul Creek drains an 1100 acre watershed consisting mostly of steep hillside grasslands, a small amount of residential area and Highway One. The Creek emerges from the hills at Del Mar Park and flows parallel to and North of Island Street. The Creek passes beneath Main Street and Highway One through two 5'x 5' concrete box culverts. Main Street is 7.2' above the culvert inverts and Highway One is approximately 14' above the culvert inverts. The facilities of this watershed should be designed to carry a 25 year flow with freeboard, and a 50 year storm without freeboard.

The water emerges from the concrete box culverts west of Highway One into an unimproved channel that flows between houses located along both sides of the channel. At Beachcomber Street the water passes through three 5' diameter culverts to the beach. The two lower culverts have 5'x 5' concrete box culverts in the mid section of the culverts. There are two 72" culverts buried in the sand at the beach beneath a dirt access road leading to the Atascadero Beach State Park.

Similar to Noname Creek, there is a Standard Oil containment pond located less than half way up the watershed from the residential area. The pond serves as a containment basin in case of a major oil spill and has a concrete overflow channel as well as a 5' diameter CMP overflow pipe. The pond also has a valved drain pipe beneath the dam that is used to release water, maintaining the water level in the pond well below the spillway. If operated properly, the dam can serve to retard peak flows in the Creek. If the dam is full, it will not assist in limiting peak flows. Standard Oil regularly lowers the water level behind the dam because spillway flow defeats the purpose of the oil containment dam and using the 5' diameter overflow pipe contributes to erosion at the base of the dam.

DRAINAGE PROBLEM:

The existing 5'x 5' concrete box culverts are inadequate to accommodate the flows without flooding Main Street and possibly Highway One. This area is shown as a 100 year flood plain in the FIRM.

There have been extensive design activities by Garing, Taylor & Associates, including a channelization design of the Creek east of Highway One and the design of inlet and outlet improvements for the existing CALTRANS culverts. These improvements were not

constructed because the property owners along the Creek would not approve the formation of drainage easements or the installation of the improvements.

There has been controversy in the past surrounding efforts to install stream bank protection west of Highway One and the implementation of improvements to the drainage channel on both sides of Highway One. The second residence west of Highway One and south of the unimproved drainage channel has experienced severe erosion and flooding. The first residence west of Highway One and north of the unimproved drainage channel is experiencing erosion problems. Property lines on both sides of Highway One extend to the center of the Creek, making action by the City difficult. The legal responsibility for controlling the flood water and making drainage system improvements is unclear because the drainage channel is located on private property and a drainage easement does not exist. East of Highway One there are improvements constructed in the stream bed that can increase future flood damage by providing debris that will clog the downstream channel by inhibiting flow. The drainage channels are designated as a Sensitive Habitat Area, which will limit the degree of modifications which can be made to the creek

POTENTIAL SOLUTIONS:

1. Require that each stream improvement plan submittal address the impacts along the complete length of the section of stream involved rather than merely approach the problems as site specific to the applicant.

2. An alternative would be to develop a comprehensive plan for providing long term improvements for each discrete section of the stream, working closely with the streamside property owners to clearly establish the limits of potential damage and acceptable solutions.

3. If property owners refuse to remove improvements from the streambed that will inhibit flow or increase debris potential, or refuse to consent to necessary improvements, the City should document the limits to the City's liability for future flood damage and to make the property owners aware of their own liability.

4. Complete a study to determine if the Standard Oil containment pond can be utilized to serve as an automatically operating detention basin while still serving as an oil containment basin. This existing facility may be the reason that flooding does not occur more regularly along the Creek. Complete improvements to the pond to optimize its usefulness as a detention basin.

5. Establish a program of streambed maintenance to maintain the stream clear of obstructions and debris that could contribute to clogging.

Solution 3 is presented as the proposed solution for this drainage problem. However, the conceptual improvements suggested could be constructed either as an entire project, with City involvement, or piecemeal by the property owners.

HYDROLOGY:

Flows at Main Street, without consideration of the detention effects of the Standard Oil containment pond.

Q10 = 312 cfs Q25 = 429 cfs Q100 = 624 cfs

Flows above the oil containment pond.

Q10 = 235 cfs Q25 = 319 cfs Q100 = 453 cfs

Flows below the oil containment pond to Main Street, assuming 100% interception of the flows above the oil containment pond.

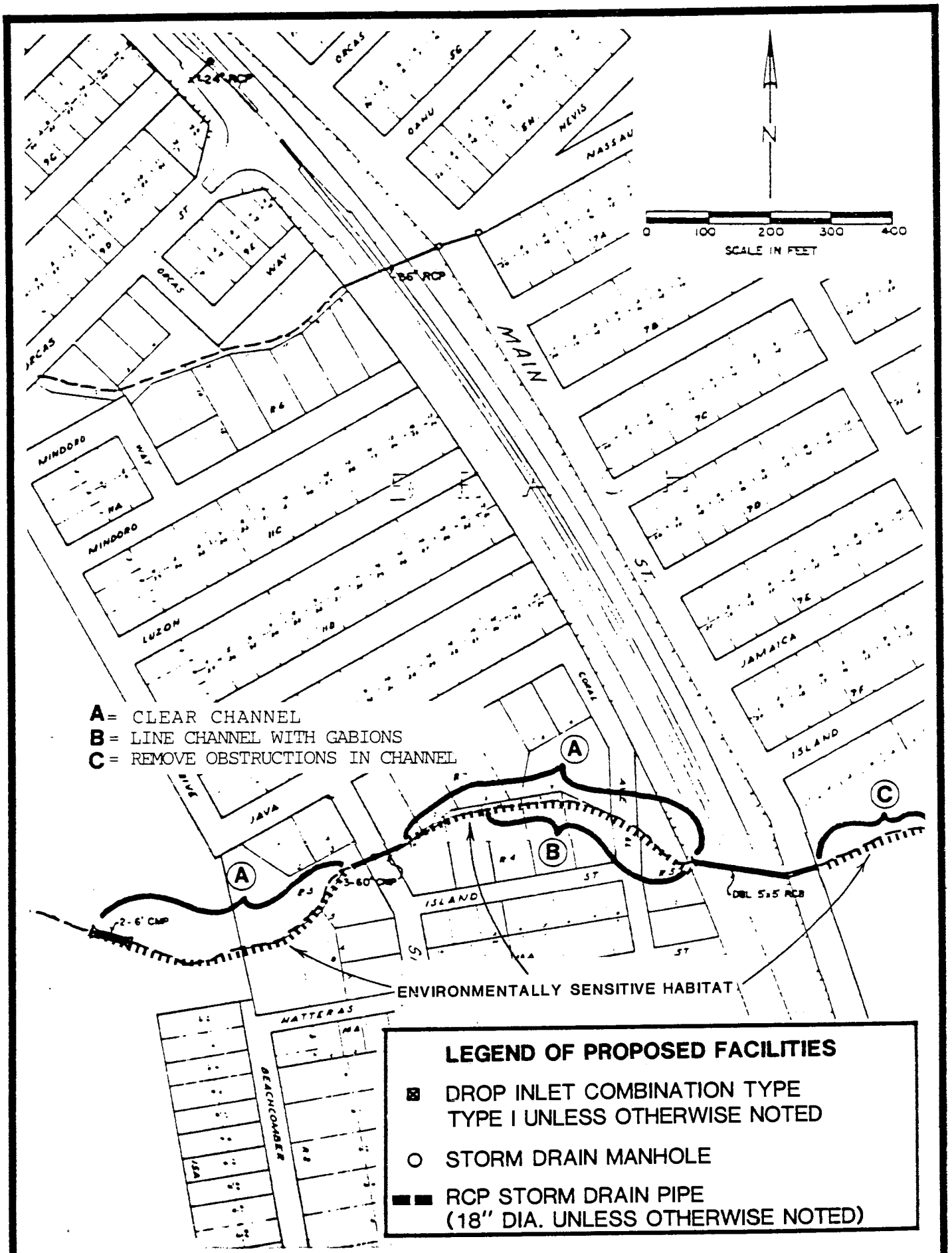
Q10 = 158 cfs Q25 = 212 cfs Q100 = 297 cfs

Flood Insurance Study flows at Main Street, not including overflow from the channel.

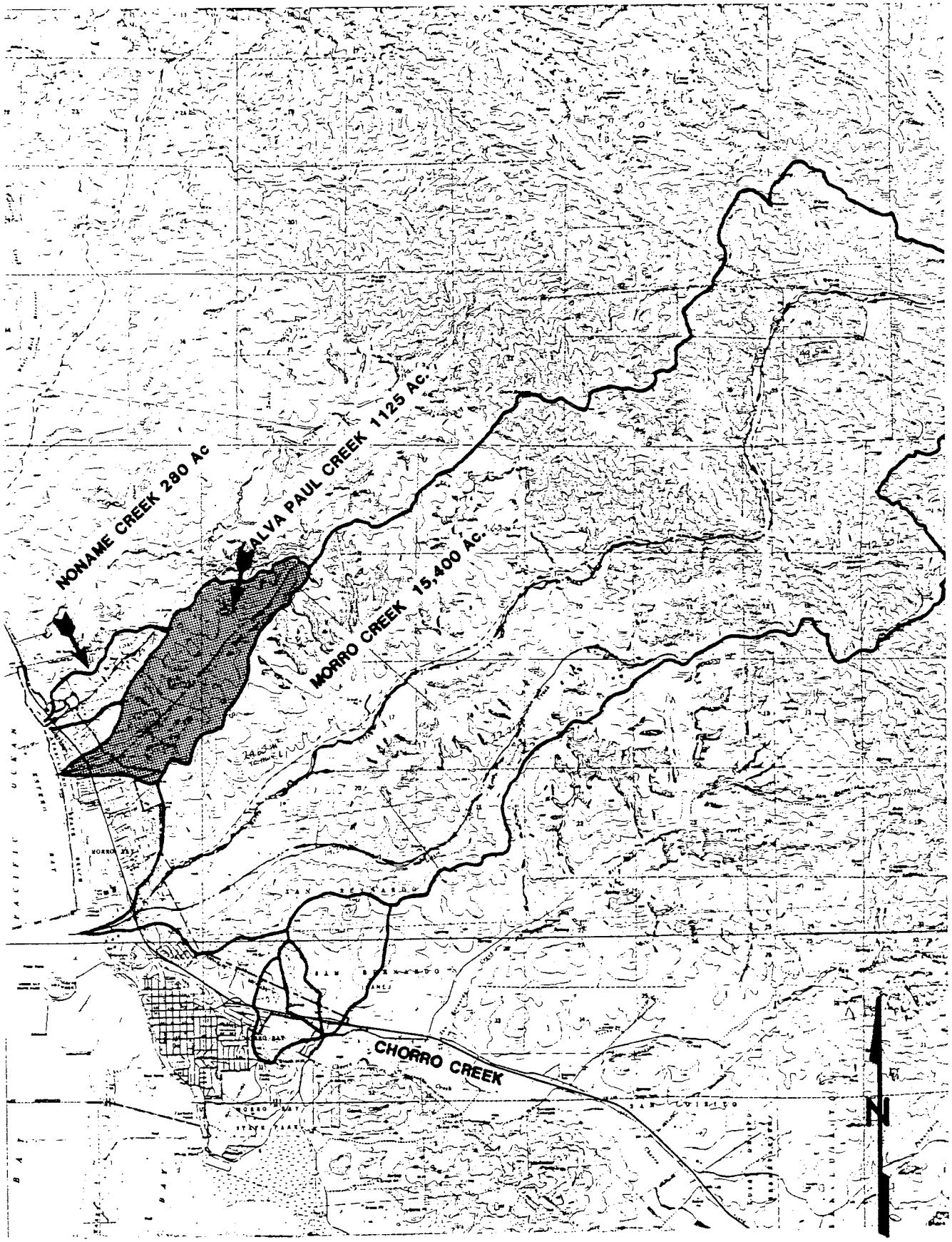
Q10 = 450 cfs Q50 = 1350 cfs Q100 = 2200 cfs

Flood Insurance Study flows at Tide Avenue (extended), not including overflow from the channel.

Q10 = 450 cfs Q25 = 1800 cfs Q100 = 2900 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN ALVA PAUL CREEK	FIGURE VIII-8



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-9
	ALVA PAUL CREEK	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 4
ALVA PAUL CREEK
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	CLEAR AND STRAIGHTEN CHANNEL WEST OF SANDLEWOOD			$4,000.00	$4,000.00
2	CLEAR CHANNEL - HIGHWAY TO SANDLEWOOD			$6,000.00	$6,000.00
3	STRAIGHTEN AND GRADE CHANNEL - HWY. TO 300' WEST OF HWY			$12,000.00	$12,000.00
4	INSTALL GABIONS OR RIP-RAP SAME AREA AS ABOVE			$59,000.00	$59,000.00
5	REMOVE OBSTRUCTIONS IN CHANNEL - MAIN TO DEL MAR PARK			$4,000.00	$4,000.00
6					
7					
8					
9					
10					
CONSTRUCTION SUBTOTAL					$85,000.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$8,500.00
SUBTOTAL					$93,500.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$14,025.00
PROJECT SUBTOTAL					$107,525.00
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$10,752.50
TOTAL PROJECT COST					$118,277.50

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 5

BALI ST. - SANDLEWOOD TO HIGHWAY ONE

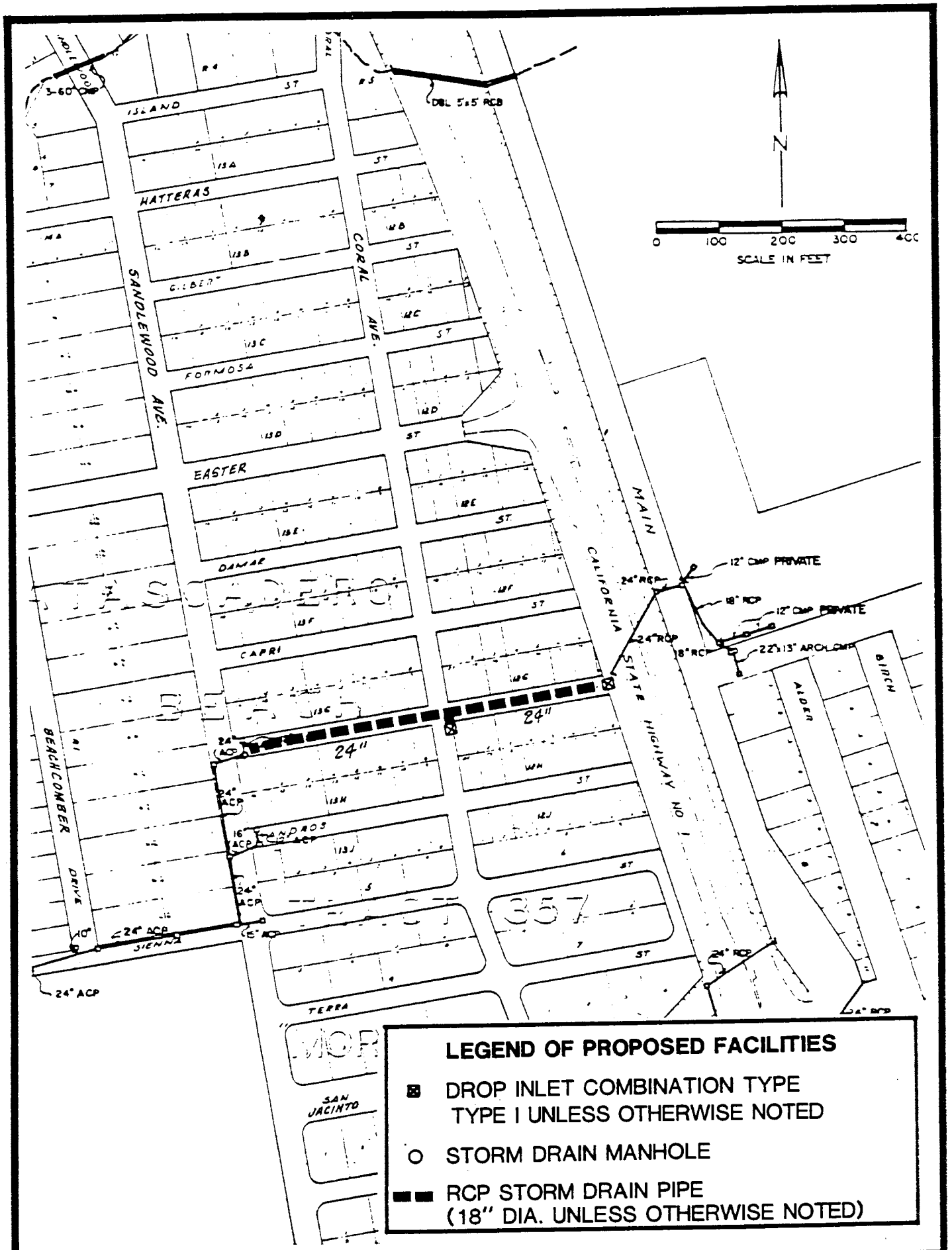
This watershed contains residential areas east of the Highway One and some drainage from the highway itself. There are existing storm drain systems east and west of this location. This area is essentially the gap between the two systems. On the east, water is picked up in basins in Main and Sequoia Streets and from adjacent private property. This drainage is conveyed via a 24" RCP drain under the highway to Bali St. where a freeway overside drain discharges. Two blocks to the west at Sandlewood and Bali is the upper end of a storm drain that conveys water to the ocean via a beach outlet.

DRAINAGE PROBLEM:

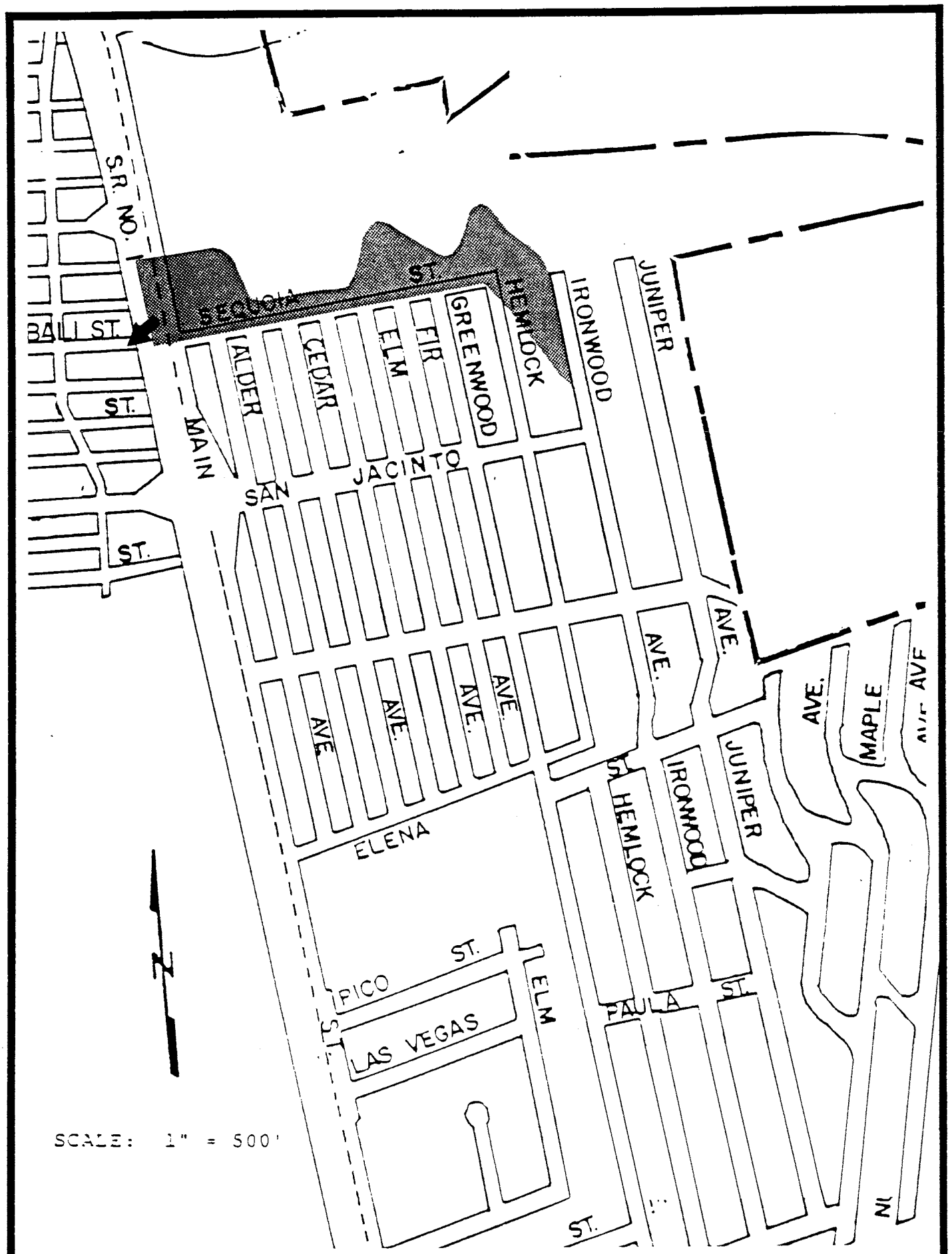
The existing storm drain system has a gap in it between Highway One ant Sandlewood Avenue. To prevent an excessive amount of overland flow in this area, a culvert system should be installed connecting the existing systems. The best solution for the problem is to construct a storm drain to pick up the subject flow and complete the overall drainage system for this area.

HYDROLOGY/HYDRAULICS:

Q10 = 7 cfs Q25 = 8 cfs Q100 = 11cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-10
	BALI STREET - SANDLEWOOD TO HIGHWAY ONE	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN BALI STREET – SANDLEWOOD TO HIGHWAY ONE	FIGURE VIII-11

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 5
BALI - SANDLEWOOD TO HIGHWAY NO.1
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	20	Lin. Ft.	$60.00	$1,200.00
2	24" RCP STORM DRAIN PIPE	600	Lin. Ft.	$68.00	$40,800.00
3	INLET STRUCTURE	1	Each	$2,100.00	$2,100.00
4	CATCH BASINS - TYPE I	1	Each	$1,700.00	$1,700.00
5	REMODEL EXISTING CATCH BASIN OR REMOVE AND REPLACE	1	Each	$1,900.00	$1,900.00
6	STORM DRAIN MANHOLE	1	Each	$2,500.00	$2,500.00
7	REMOVE DEFLECTING CURB, ETC.	1	Each	$300.00	$300.00
8					
9					
10					
	CONSTRUCTION SUBTOTAL				$50,500.00
	DESIGN @ 10% OF CONSTRUCTION SUBTOTAL				$5,050.00
	SUBTOTAL				$55,550.00
	CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL				$8,332.50
	PROJECT SUBTOTAL				$63,882.50
	PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL				$6,388.25
	TOTAL PROJECT COST				$70,270.75

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 6

SAN JACINTO STREET AT MAIN STREET

The intersection of Main Street, San Jacinto Street, Alder Street and Highway One has a number of existing drainage improvements. At the north end of the intersection there is a CALTRANS 24" diameter RCP culvert with an inlet between Main Street and Highway One, within the Highway One right of way. This culvert drains to the west under Highway One and has a flat concrete headwall. On the south side of the intersection there are two 36" diameter RCP CALTRANS culverts with inlets located between Main Street and Highway One. These two culverts drain to the west under Highway One and have a flat concrete headwall. A 24" diameter RCP culvert drains the area between Alder Street, San Jacinto Street and Main Street, at the north side of the intersection, beneath San Jacinto Street, to the two 36" diameter culverts. A 36" diameter RCP culvert drains the area between Main Street, San Jacinto Street and Alder Street, at the south side of the intersection, beneath Main Street, to the two 36" diameter culverts. The watershed includes predominately residential areas with some steep hillside grassland and Highway One.

DRAINAGE PROBLEM:

The street flow in the intersection is poorly directed toward the existing drainage facilities. Water flowing from the north along Alder Street flows across San Jacinto to the 36" culvert rather than to the 24" culvert located at the north side of the intersection. Water flowing from the north toward the CALTRANS culvert must sheet flow across a wide sandy area before reaching the entrance, resulting in excessive sand deposits in the CALTRANS 24" diameter culvert. The narrow strip of land between Alder Street, Main Street and San Jacinto Street, at the north side of the intersection, is without curbs and gutters, allowing uncontrolled sheet flow between the streets rather than effectively utilizing the existing 24" culvert.

The culverts themselves have the capacity to carry 25 year storm flows. The inlets, however are undersized and poorly placed resulting in a lack of utilization of the culvert capacity. A 100 year event could also be drained, assuming that the deposited sand in the Caltrans culvert is removed through scouring, although there would be local intersection flooding.

POTENTIAL SOLUTIONS:

1. Provide a comprehensive intersection improvement plan.

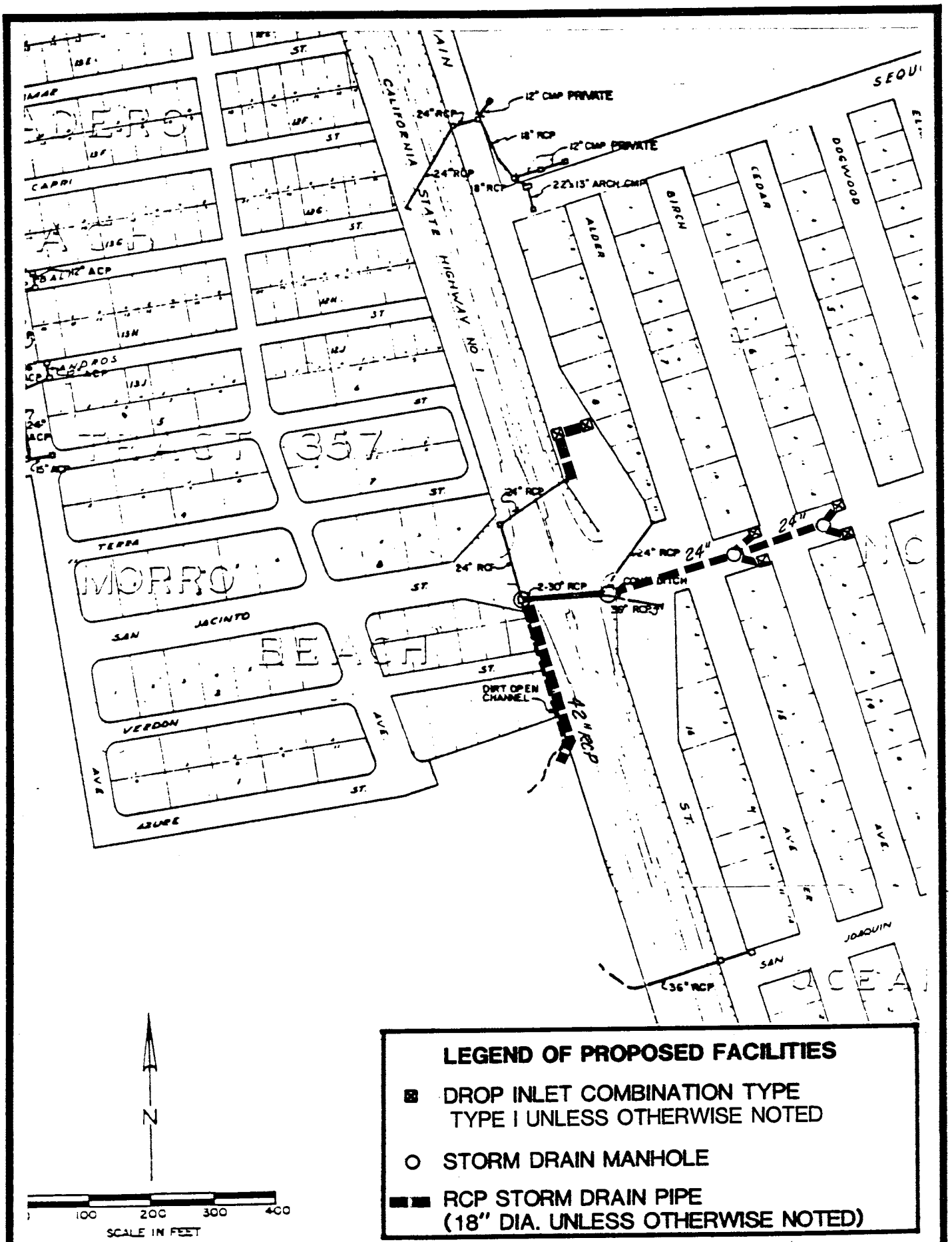
2. Install curbs, gutters, cross gutters, drop inlets and intersection storm drains to direct the flows toward the existing culverts.

3. The flow paths should be lined and delineated to avoid excessive siltation and unnecessary sheet flows. If the property on the north side of the intersection between Main Street and Alder Street is developed, careful consideration should be given to the impacts of drainage and the potential for flood damage to the development.

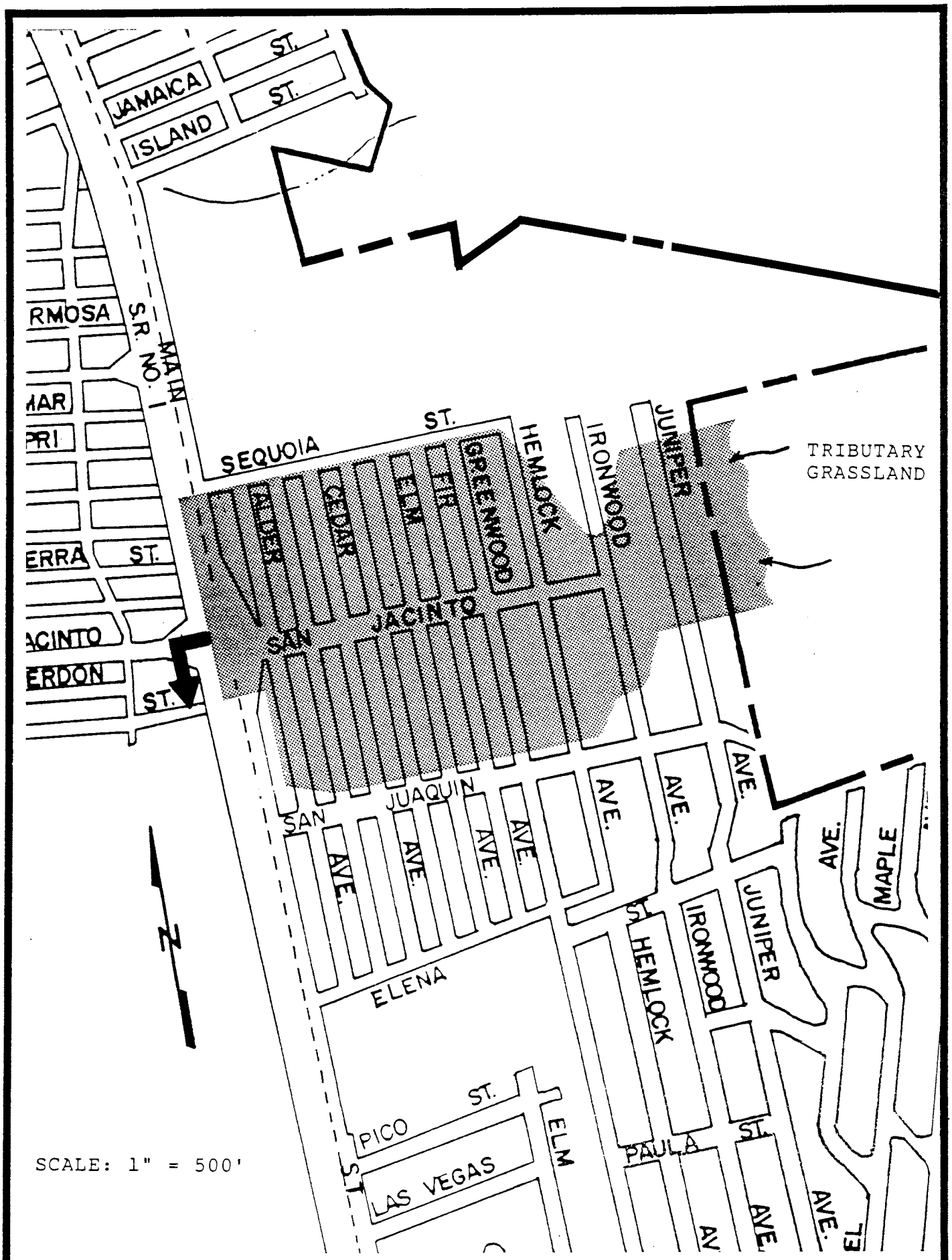
HYDROLOGY:

Flows that can be expected in the intersection include the following.

Q10 = 46 cfs Q25 = 52 cfs Q100 = 67 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-12
	SAN JACINTO STREET AT MAIN STREET	



SCALE: 1" = 500'

JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN SAN JACINTO STREET AT MAIN STREET	FIGURE VIII-13

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 6
SAN JACINTO STREET AT MAIN STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	24" RCP STORM DRAIN PIPE	370	Lin. Ft.	$60.00	$22,200.00
2	42" RCP STORM DRAIN PIPE	275	Lin. Ft.	$68.00	$18,700.00
3	CATCH BASINS - TYPE I	4	Each	$1,700.00	$6,800.00
4	STORM DRAIN MANHOLE	3	Each	$2,500.00	$7,500.00
5	REMODEL EXISTING STORM DRAIN MANHOLE	1	Each	$1,000.00	$1,000.00
6					
7					
8					
9					
10					
CONSTRUCTION SUBTOTAL					$56,200.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$5,620.00
SUBTOTAL					$61,820.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$9,273.00
PROJECT SUBTOTAL					$71,093.00
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$7,109.30
TOTAL PROJECT COST					$78,202.30

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 7

MAIN STREET - PICO TO LAS VEGAS STREET

At Las Vegas Street and Main Street there is a 64" x 24" grate drop inlet with a 6" high curb opening and a 3' x 4" curb inlet leading to two 24" RCP culverts that drain under Highway One to the west. The top of grate elevation is 2'-6" above the flow line of the culvert. The watershed includes predominately residential area and some steep hillside grassland and Highway One. There are curbs and gutters in this area.

DRAINAGE PROBLEM:

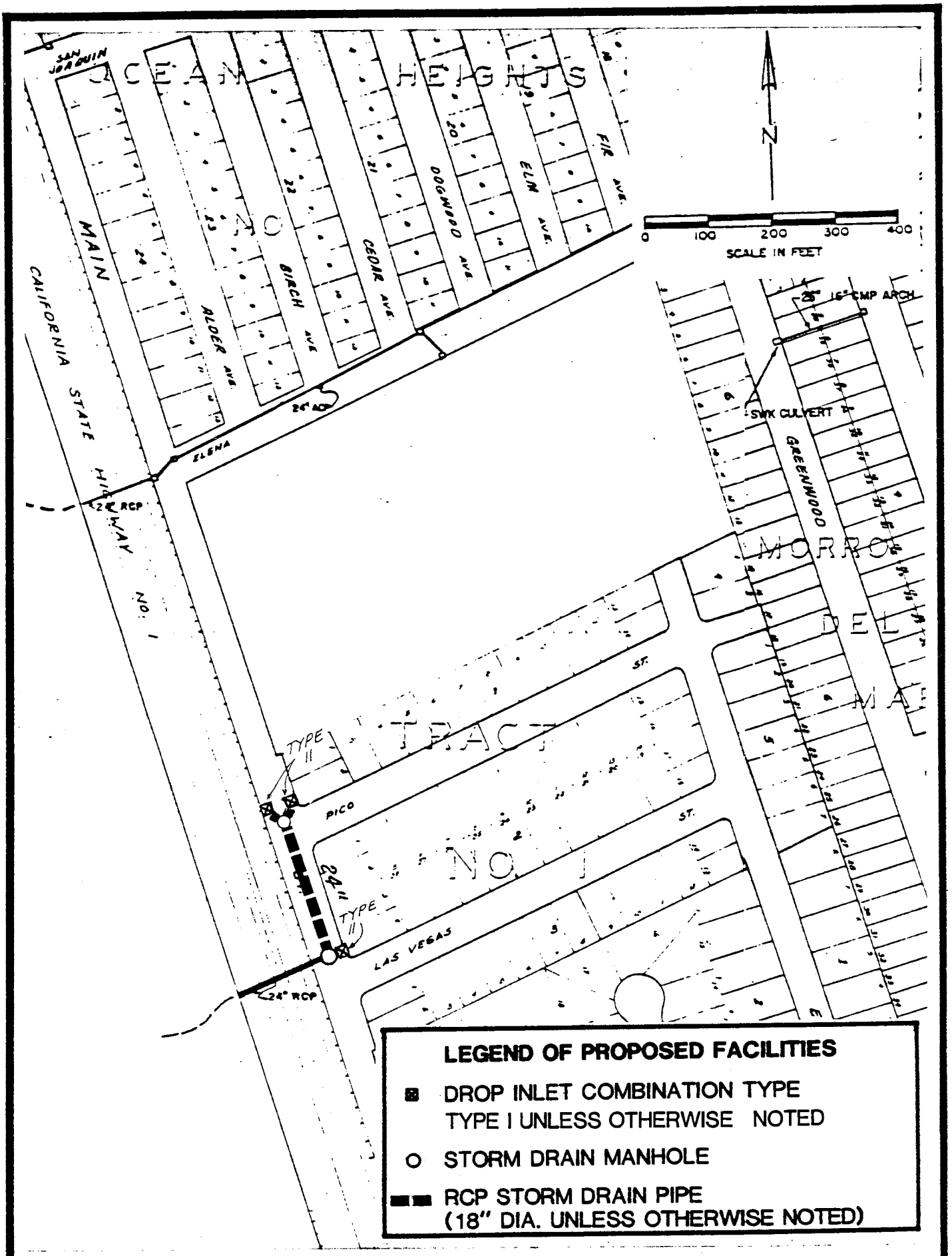
The two inlets are inadequate to fully utilize the capacity of the two 24" RCP CALTRANS culverts. The culverts are adequate to accommodate a 100 year rainfall event. At a depth of approximately two feet above the inlet grate, the runoff water will drain to the south along Main Street towards Bonita Street. There will be no significant property damage resulting from street flooding.

POTENTIAL SOLUTIONS:

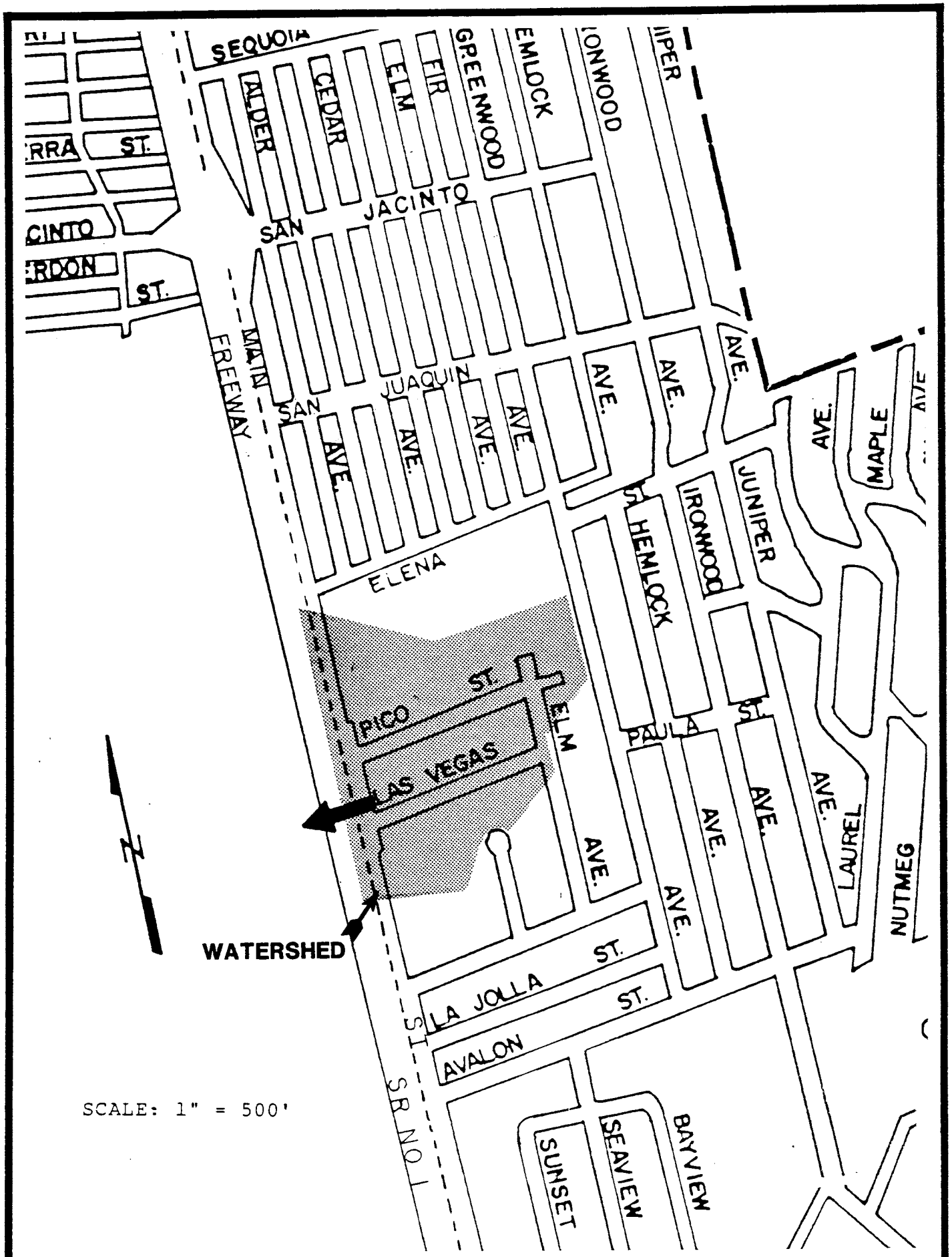
1. Provide adequate drop inlet capacity to fully utilize the existing culvert capacity.

HYDROLOGY:

Q10 = 19 cfs Q25 = 22 cfs Q100 = 28 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-14
	MAIN STREET - PICO TO LAS VEGAS STREET	



SCALE: 1" = 500'

JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN MAIN STREET - PICO TO LAS VEGAS STREET	FIGURE VIII-15

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 7
MAIN STREET - PICO TO LAS VEGAS STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	40	Lin. Ft.	$60.00	$2,400.00
2	24" RCP STORM DRAIN PIPE	260	Lin. Ft.	$68.00	$17,680.00
3	CATCH BASINS - TYPE II	3	Each	$2,100.00	$6,300.00
4	REMOVE EXISTING CATCH BASIN AND 24" CONNECTING PIPE	1	Each	$1,000.00	$1,000.00
5	STORM DRAIN MANHOLE	2	Each	$2,750.00	$5,500.00
6					
7					
8					
9					
CONSTRUCTION SUBTOTAL					$32,880.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$3,288.00
SUBTOTAL					$36,168.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$5,425.20
PROJECT SUBTOTAL					$41,593.20
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$4,159.32
TOTAL PROJECT COST					$45,752.52

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 8

WASTEWATER TREATMENT PLANT

The Morro Bay wastewater treatment plant is located on Embarcadero Drive near Morro Creek.

DRAINAGE PROBLEM:

The elevation of the treatment plant site provides minimal ability to drain towards either Morro Creek or the Ocean. Stormwater ponds within the plant site, and also along adjacent Embarcadero Drive. An attempt was made to use an ocean outfall line abandoned for treatment plant use as a storm drain outlet, but it is clogged and cleaning is prohibitively expensive. Draining these areas to the creek is hampered by the low elevation of the site. A storm drain system can be installed which drains the site to Morro Creek in low storms, but at larger (10 year) storms, the water level in the creek will be too high to allow gravity drainage.

POTENTIAL SOLUTIONS:

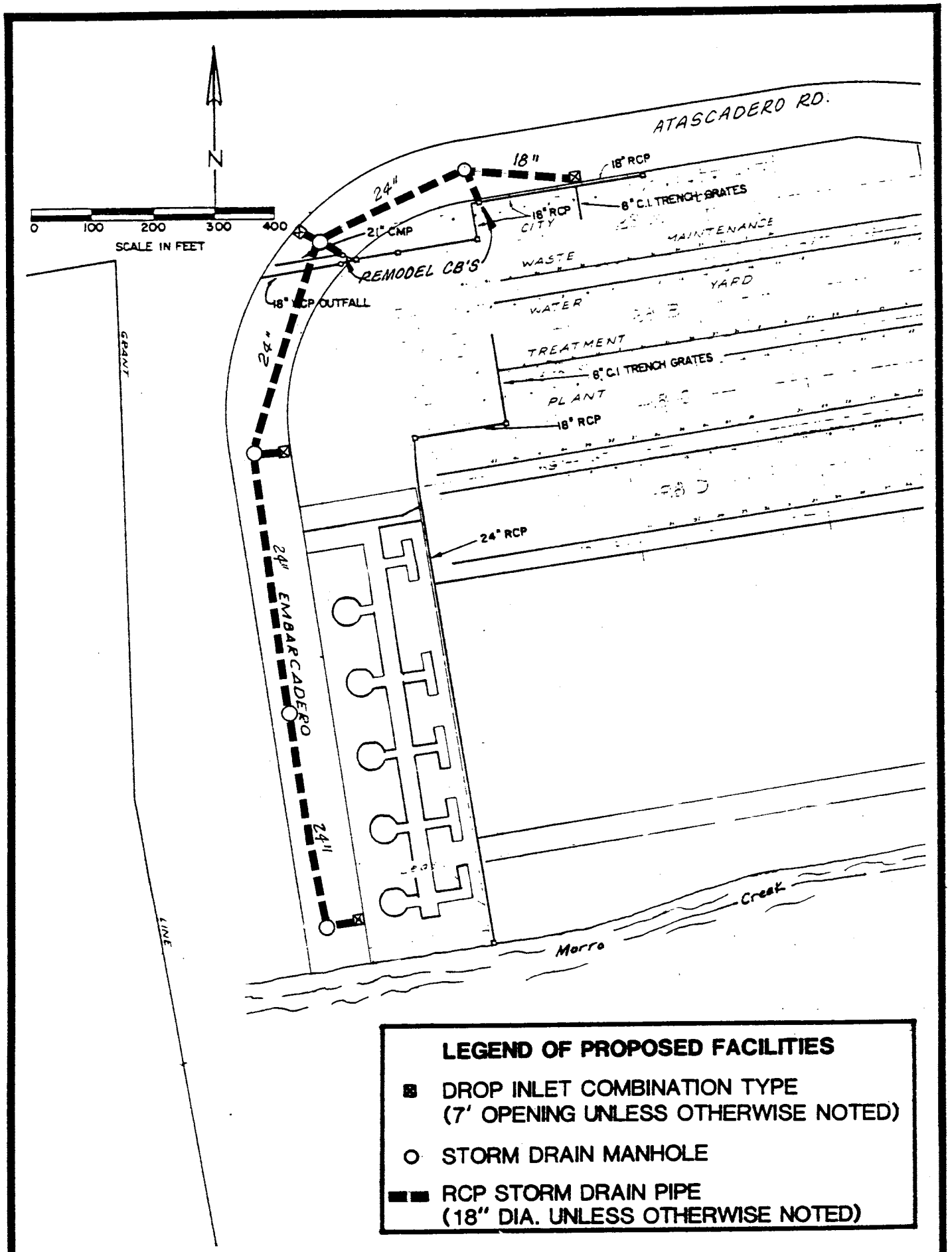
One solution for this problem is to construct a storm drain system draining to Morro Creek by gravity flow during small storms, with the provision for a pumped system to operate during high flows. To lower costs, the pump station can be designed to operate at less than peak flow rates, allowing for some temporary ponding. This solution is shown in the following figure and cost estimate.

Brown and Caldwell, the Consulting Engineering firm for the Treatment Plant expansion, also studied this problem. Based on their study, the City installed an overflow pipe on the old outfall line. This provides the capacity to drain the Treatment Plant site, but not the additional flow from the streets.

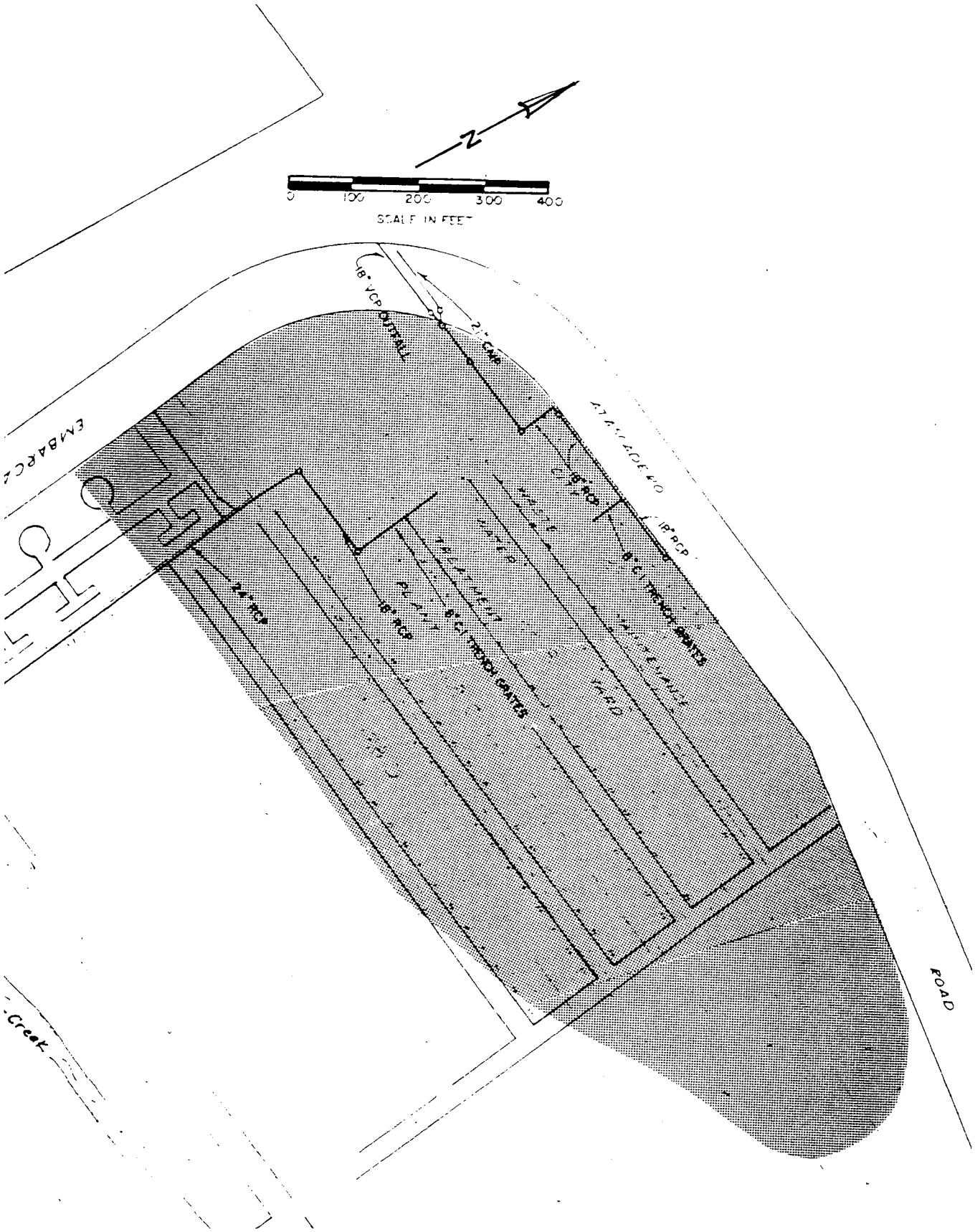
A project designed to drain the streets could also be designed to drain the Treatment Plant site, relieving the old outfall line.

HYDROLOGY:

Q10 = 12 cfs Q25 = 14 cfs Q100 = 17cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-16
	WASTEWATER TREATMENT PLANT	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN WASTEWATER TREATMENT PLANT	FIGURE VIII-17

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 8
WASTEWATER TREATMENT PLANT
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	365	Lin. Ft.	$60.00	$21,900.00
2	24" RCP STORM DRAIN PIPE	1485	Lin. Ft.	$68.00	$100,980.00
3	CATCH BASINS - TYPE I	4	Each	$1,700.00	$6,800.00
4	REMODEL EXISTING CATCH BASINS	2	Each	$2,500.00	$5,000.00
5	STORM DRAIN MANHOLE	5	Each	$2,750.00	$13,750.00
6	REMOVALS, ABAND. STR'S., GRADING, X-GUT., SWK. CUL.	1	Each	$15,000.00	$15,000.00
7	CREEK OUTLET STRUCTURE	1	Each	$3,000.00	$3,000.00
8	220 GPM SUBMERSIBLE PUMPS	2	Each	$5,000.00	$10,000.00
9	PIPING, INSTALLATION, CONC. WORK, OUTFALL, MISC.	1	Each	$5,000.00	$5,000.00
10	STANDBY GENERATOR, ELEC. POWER, PANEL CONTROLS, HOUSING	1	Each	$17,000.00	$17,000.00
	CONSTRUCTION SUBTOTAL				$181,430.00
	DESIGN @ 10% OF CONSTRUCTION SUBTOTAL				$18,143.00
	SUBTOTAL				$199,573.00
	CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL				$29,935.95
	PROJECT SUBTOTAL				$229,508.95
	PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL				$22,950.90
	TOTAL PROJECT COST				$252,459.85

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 9

MORRO CREEK AT MAIN STREET

The study area includes the land bordered on the north by Morro Creek, on the west by Highway 1, on the south by Radcliffe Avenue and on the east by Little Morro Creek Road (see Figure 1). Preston Lane is a local cul-de-sac street within the immediate study area connecting to Main Street. The area is composed of a flat, low elevation flood plain with the drainage to the west limited by Highway 1.

EXISTING DRAINAGE CONDITIONS

Drainage generally flows north to Morro Creek or to the south to culverts draining underneath Hwy 1 to Willow Camp Creek (Figure 1). Because of the flat terrain, some of the runoff ponds in localized sump areas adjacent to Main Street. Morro Creek at Main Street flows beneath 4 bridges in series; a bridge located at Main Street, a Highway 1 offramp bridge, the Highway 1 bridge and a Highway 1 onramp bridge. 100 year flows shown on the 1985 flood insurance map (firm) impinge on the Main Street bridge causing a backwater condition. This backwater and overbank flow from Morro Creek contributes to major flooding in large storms.

There is an existing corrugated metal pipe storm drain along Main Street which flows south to an open field near the inlet of a Caltrans culvert east of Main Street. The Caltrans culvert is virtually flat and the water from the existing Main Street drain does not flow to the Caltrans culvert but accumulates in an undeveloped lot. Thus, the existing storm drain system does not effectively drain the Main Street area. There are also existing 6 inch and 10 inch culverts near the end of Preston Lane which drain to Morro Creek. Because of their grade and capacity, they do not effectively drain the area and are a maintenance problem. The Atlas of Storm Drainage compiled as a part of this study indicates the location of these culverts.

Morro Creek and Little Morro Creek converge upstream of Main Street at the northeast corner of the study area. The Creek corridor is designated by the City as a Sensitive Resource Area because of the riparian habitat. The stream bed between the confluence of Little Morro Creek and Morro Creek and the Main Street bridge is a natural channel with a relatively flat slope. The south bank is lined with large trees and most of the north bank is lined with local improvements constructed piecemeal by mobile home owners. The mobile homes are very close to the stream in some locations and are threatened with erosion in large storms.

There is commercial zoning along Main Street and Preston Lane and there are a few residences near Morro Creek in the northeast corner of the study area.

HYDROLOGY

The Morro Creek drainage basin area, including Little Morro Creek, is approximately 13,878 acres or 21.68 square miles (See Figure 1). Flows at the mouth of Morro Creek have been calculated as part of this study by John L. Wallace & Associates, and previously, by the Federal Emergency Management Agency's engineering contractor (USGS) as part of the flood insurance studies, and also by the U.S. Corps of Engineers and CALTRANS. The flows occurring along the reach adjacent to the study area are slightly less than the flows at the mouth of the stream at the ocean. The predicted flows are listed below.

MORRO CREEK AT MAIN STREET

PEAK DISCHARGES (CUBIC FEET PER SECOND)

	10-Year	50-Year	100-Year
J.L.W. & Associates	3,200		8,152
CALTRANS[1]			5,400
Corps of Engineers[2]	2,400	7,800	11,200
FEMA[3]	2,200	9,200	14,900

The FEMA report shows the water surface as being above the bottom of the Main Street bridge but below the Highway 1 bridge. It is likely that if the JLWA flow prediction of 8,152 cfs was used, the 100 year flow water surface would be below the deck of the bridge, and less flooding would result than the Flood Insurance

---

1 State of California Department of Transportation, San Luis Obispo office.

2 U.S. Army Corps of Engineers, "San Luis Obispo County Streams, Hydrology for Survey Report for Flood Control and Allied Purposes", November 1978, revised February 1980, unpublished.

3 Federal Emergency Management Agency, "Flood Insurance Study, City of Morro Bay, California, San Luis Obispo County, Community Number 060307", revised November 1, 1985.

Rate Map (FIRM) indicates. The City may be able to benefit by requesting that FEMA review the hydrology of Morro Creek, and if necessary, revise the FIRM.

DRAINAGE PROBLEM

The Flood Insurance Rate Map 100 year flood boundary encompasses the whole study area and extends north beyond Morro Creek to Highway 41. The 100 year flood will overtop Highway One adjacent to the study area from near Highway 41 on the north to near Radcliffe Avenue on the south (see Figure III-2). Most of the structures in the area have been constructed below the 100 year flood level and some of the commercial areas are even below Main Street. The Main Street bridge is inadequate to accommodate a 100 year flood and severe backwater conditions have been reported as a result of debris piling up at the bridge even during 10 year runoff events. An examination of the stream section approximately 100 feet upstream from the Main Street Bridge indicates that the current stream channel is not adequate for a 10 year flood. The rest of the channel length within the study area appears to be adequate for a 10 year event. Creek flooding can be expected relatively frequently, probably at less than 20 year intervals. The extent of flooding will vary with the size of the runoff event. Several factors influence the potential for creek flooding.

The channel is narrow and confined, it descends along a relatively flat slope and has relatively low banks. The Main Street bridge is a constraint to large flows, due to inadequate cross section area, and is poorly aligned with the piers of the Highway One bridges immediately downstream. The flow capacity under the Main Street bridge's north bay is not being used because the existing Creek channel is centered on the south bay. Approximately eight mobile homes are currently located along the Creek alignment leading to the north bay. Whether or not the full use of the hydraulic capacity of the north bay was assumed in the FEMA study or the original design of the bridge is uncertain. Debris piling up on the Main Street bridge has historically resulted in a substantial rise in water surface elevation immediately upstream from the bridge.

There is frequent local flooding along Main Street and the ponding of water is common because of this localized sump area. There have been complaints concerning the lack of positive drainage from this sump area. Two levels of problem solutions must be pursued in this area, one related to the lack of positive drainage for localized rainfall runoff and one related to overbank flooding from Morro Creek. Consideration of solutions for reducing or eliminating the flood potential from Morro Creek must also include the recognition of the flood plain area north of Morro Creek, between the Creek and Highway 41.

POTENTIAL SOLUTIONS

LOCAL FLOODING

Low Frequency Storm Drain

Local flooding can be best alleviated by installing a low frequency storm drain system. However, because of the flat terrain and its low elevation relative to the potential water surface levels in the Creek, it is not likely that a culvert system can be installed to drain the Main Street area towards Morro Creek and still locate the pipe outlet above the 10 year flood level. If this is the case, a flap gate would be required to prevent the water from flowing backwards through the culvert in larger frequency storms. Existing sites too low to drain to the new storm drain system would have to install pumps to pump site runoff to the storm drain. A new storm drain system extending approximately 950 feet south of Morro Creek, along Main Street, will cost approximately $190,000 (See Figure VII-18).

Storm Drain and Pumping Station

An alternative solution is to lower the proposed Main Street storm drain discussed in the previous paragraph and drain to a pump station located near the Creek that could lift the water to the Creek. The cost for a storm drain system extending approximately 950 feet south of Morro Creek, along Main Street, and a 10 cubic foot per second pump station system with a standby generator will be approximately $420,000. It would appear that this solution would be prohibitively expensive and would offer little increased protection during the times when the Creek overflows its banks.

CREEK FLOODING

Non-Structural Measures

It is likely that Morro Creek will flood beyond its banks in 10 year runoff events and above. The depth of submergence of the neighboring terrain will depend on the magnitude of the runoff event and the performance of the Main Street bridge as a drainage facility which will be partially influenced by the nature of the debris in the Creek.

Most of the solutions to eliminate or reduce the potential for severe flooding when the Creek overflows its banks involve large projects. The least expensive alternative may be to require flood insurance as a condition for all future development and for the issuance of permits within the flood plain. This is a requirement now for projects obtaining financing from Federally insured lending institutions. A comprehensive flood plain management plan could be developed including the acquisition of more accurate topographic mapping, implementing a policy concerning the filling of lots, installing stream bank erosion protection and creating a stream bank buffer zone, along with the requirement for flood insurance. A stream buffer can be established that would restrict development along both sides of the Creek. This will allow some stream bank erosion and the maintenance of the stream as a sensitive riparian habitat. The current practice of allowing developments to front directly on the stream bank severely restricts future options and restricts the viability of maintaining a sensitive riparian habitat.

Structural Measures

The Creek can be widened and lined to facilitate flow. This would have to be done in conjunction with the clearing of the northerly bay under the Main Street bridge to accommodate increased flows. However, some of the mobile homes adjacent to the north bank would have to be removed. It is recognized that there are different levels of channel modification that could be implemented to accommodate different levels of flood protection. Widening the channel approximately 100 feet upstream from the bridge would help to accommodate a 10 year flood. To eliminate the threat of a 100 year flood event the Creek would have to be channelized from the confluence of Morro Creek and Little Morro Creek to the Main Street bridge. Creek channelization is inconsistent with the current policy of treating creeks as sensitive habitat.

An alternative solution is to provide flood control dikes along both sides of the stream and to raise the Main Street

bridge approaches to go over the dikes. This alternative would require the removal of many mobile homes along the Creek and the installation of a storm water pumping system to pump water over the dikes. An earthen dike system would not be inconsistent with the current policy of treating creeks as sensitive habitat areas but a wide channel section would be needed to contain the flow with adequate freeboard and to flow at an acceptable velocity. This wide section would necessitate the acquisition of considerable right of way, the temporary removal of much of the existing riparian habitat, and the removal of structures.

A detention dam could be constructed upstream to reduce the peak flows reaching the study area. This solution is assumed to be too expensive considering the small amount of land that would benefit. A detention dam could also disrupt the agricultural activities currently conducted in the flood plain above the study area.

RECOMMENDATIONS

LOCAL FLOODING

1. Construct a gravity storm drain system in the study area that will drain to Morro Creek. Design the storm drain system to drain to the bottom of Morro Creek and install a flap gate on the discharge end of the pipe. The storm drain should be sized for peak rainfall events equal to the minimum rainfall event that will cause the Creek to overflow its banks. (Overflow occurs in approximately a 10 year event.)

2. Establish a site specific flood plain management plan that will require the elevating of structures above the 100 year base flood and construct lots so as to drain to the proposed storm drain system. Existing establishments can either raise their lots to drain to the proposed storm drains or can install private sump pumps where necessary. Major filling of lots is not considered to be feasible because of the serious implications for the flood plain north of the Creek.

3. The flood plain management plan should be developed to include accurate topography, a specific policy concerning the filling of lots, a policy concerning stream bank erosion protection, development of a stream bank buffer zone along each side of the Creek, and the requirement of flood insurance as a condition of all future permits issued for the flood plain area. As part of the management plan a resolution of the various flood flow predictions can be accomplished with

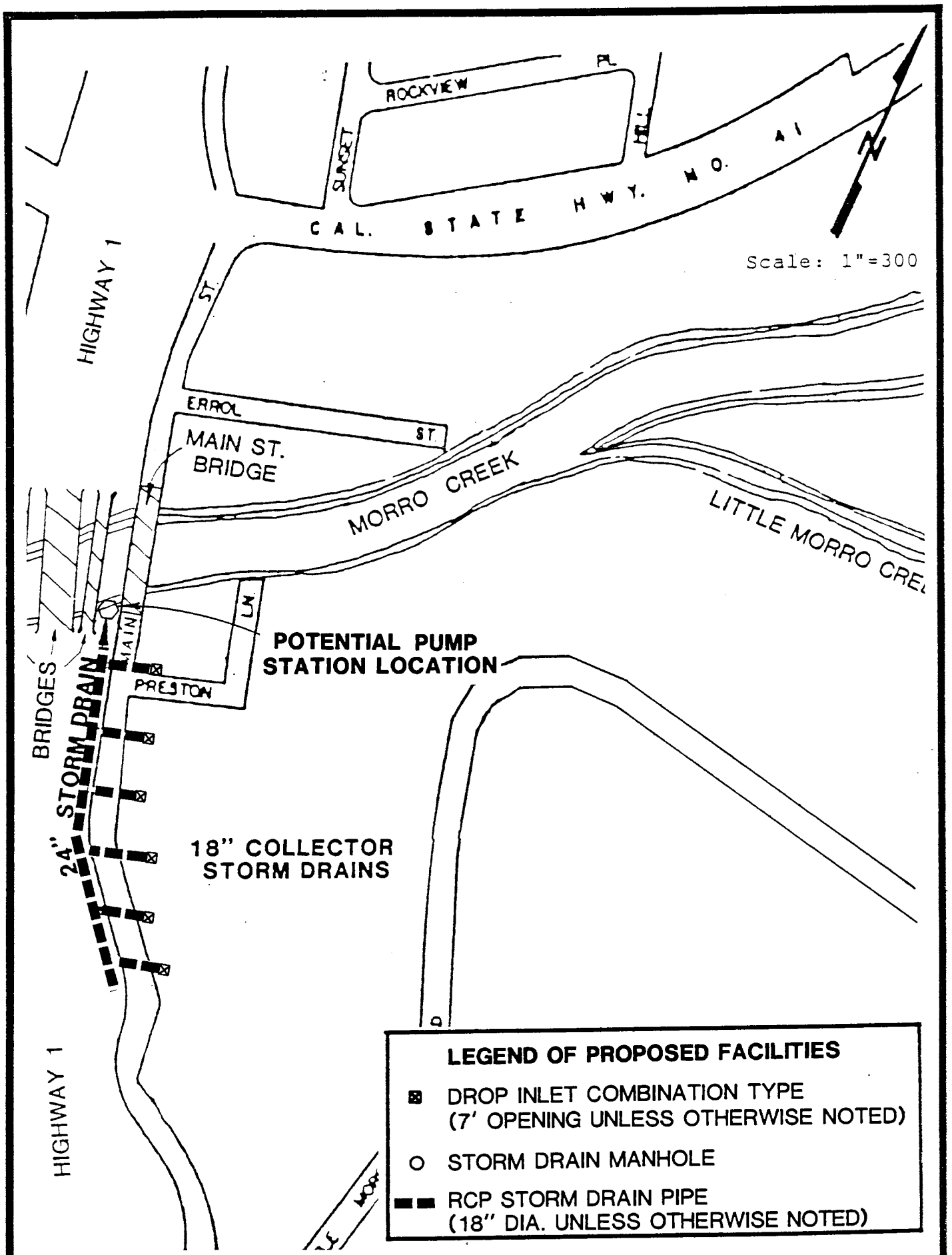
more accurate topographic information and further hydrologic studies in conjunction with FEMA.

CREEK FLOODING

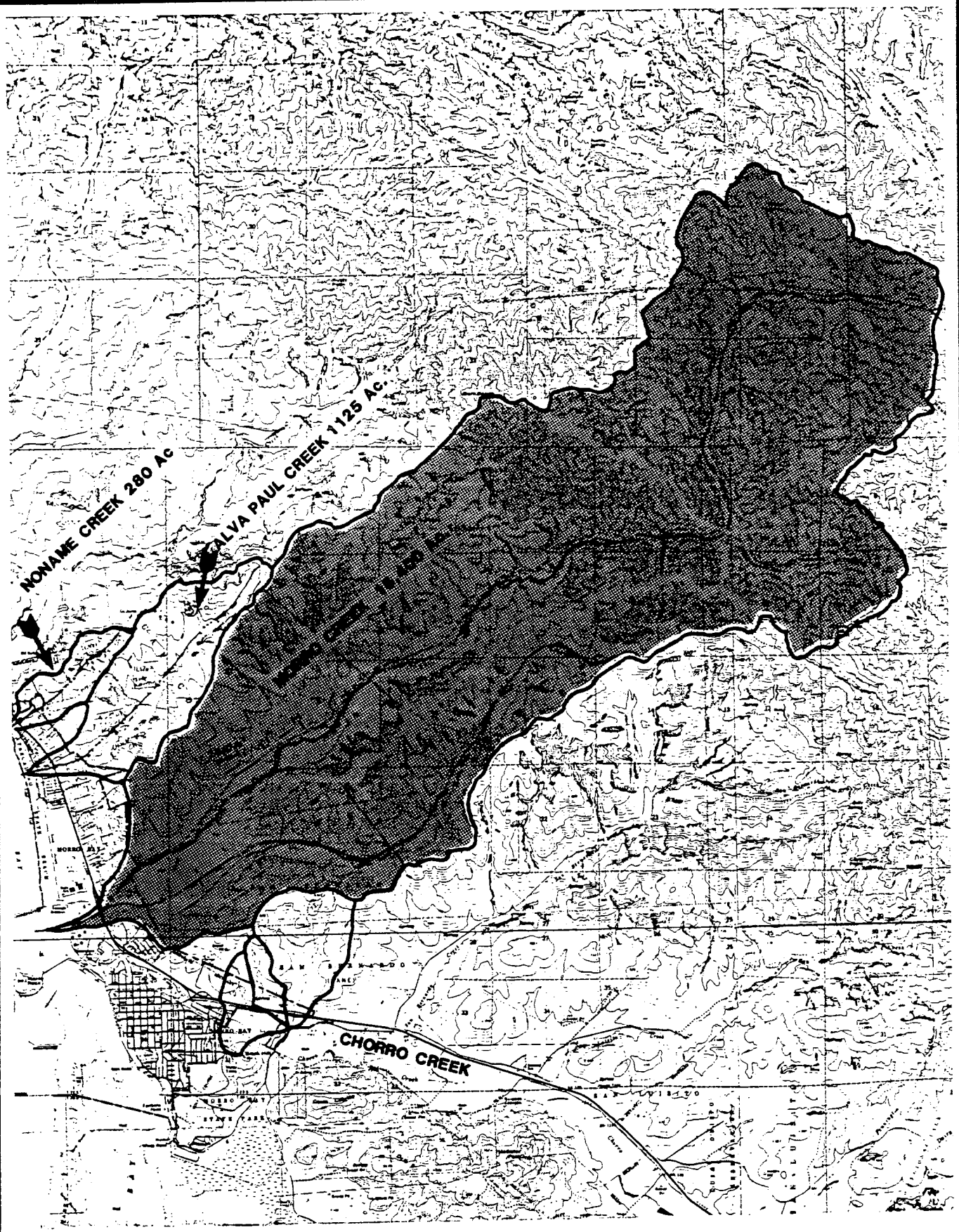
Most of the alternative projects for eliminating flooding resulting from a 100 year flood event are assumed to be too expensive relative to the value and acreage of the land that would benefit. Some projects can be accomplished that will significantly decrease the potential for flooding but the threat cannot be completely eliminated.

1. A comprehensive flood plain management plan should be developed to include accurate topography, a policy concerning the filling of lots, a policy concerning stream bank erosion protection, the development of a stream bank buffer zone along each side of the Creek, and the requirement of flood insurance as a condition of all future permits issued for the flood plain area. As part of the management plan a resolution of the various flood flow predictions should be accomplished and the corresponding adequacy of the Main Street bridge should be determined.

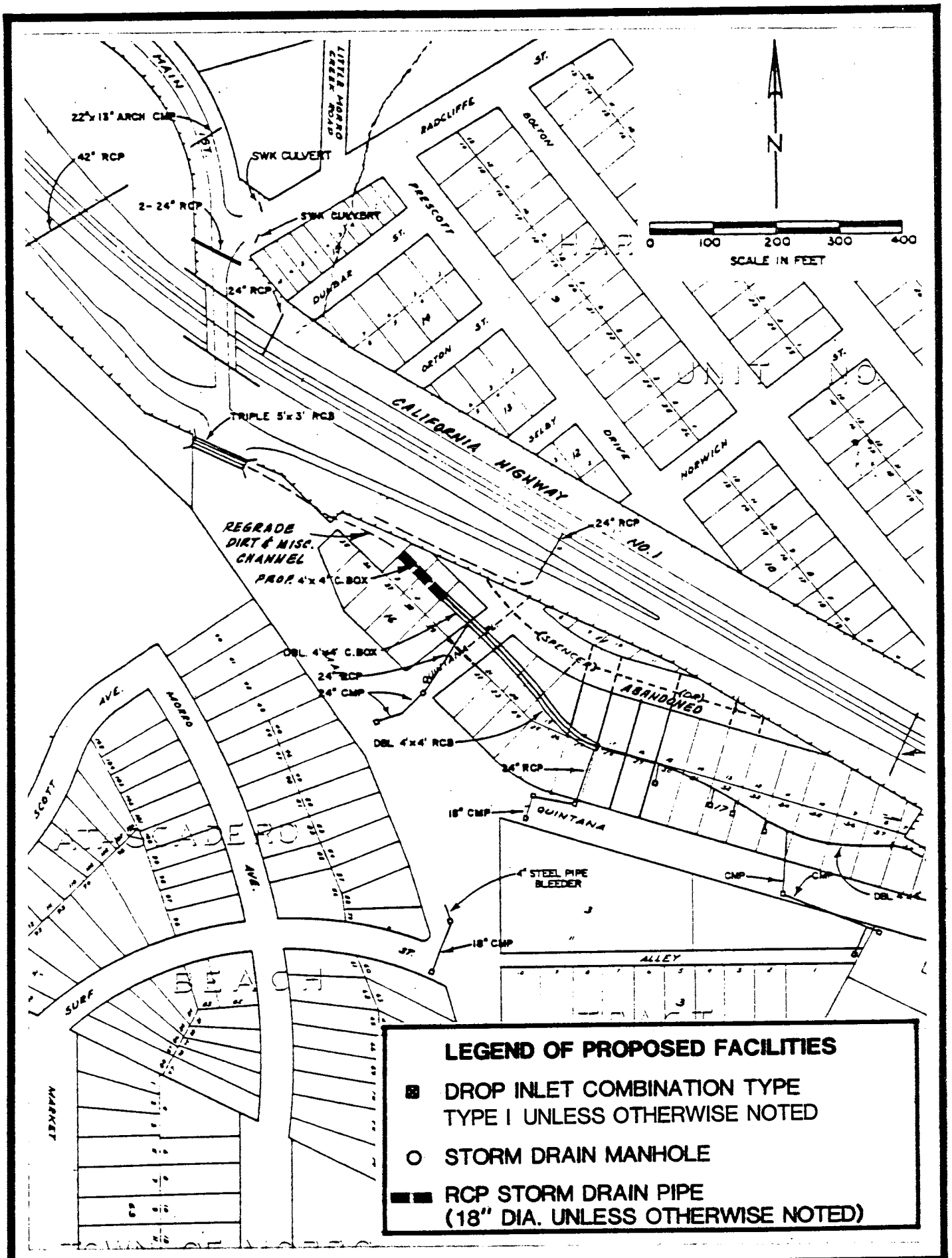
2. Develop a project for the excavation of a wider, deeper channel for the north bay of the Main Street bridge. Acquire the necessary right of way and remove approximately three mobile homes located immediately upstream from the bridge and widen the channel approach to the bridge. Once a flood level prediction has been accepted as part of a flood plain management plan, identify the adequacy of the Creek channel to accommodate different flood levels. Complete minor Creek bed widening between the confluence of Morro Creek and Little Morro Creek and the Main Street bridge in order to establish a uniform level of protection. It is anticipated that minor channel widening can be completed so that the stream will at least accommodate a 10 year flood. Consider the installation of pipe and wire channel revetment in order to stabilize the banks and to increase the flow characteristics of the channel.



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-18
	MORRO CREEK AT MAIN STREET	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN MORRO CREEK AT MAIN STREET	FIGURE VIII-19



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-20
	WILLOW CAMP CREEK	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 10

WILLOW CAMP CREEK

Willow Camp Creek is a major drainage path receiving flows from the hills northeast of the freeway and as far south as Black Hill. Drainage area characteristics include grassland hills, brush covered mountain slopes, residential areas and commercial areas. The Willow Camp Creek drainage route is parallel to the freeway. It is composed of natural, trapezoidal, and box culvert cross-sections.

There are several buildings constructed over Willow Camp Creek along the east side of Quintana Road near the intersection of Quintana Road and Main Street. Double box culverts (4'x 4') direct the flow under all of these buildings except the building located behind the BT& The Duck Restaurant, which has a single box culvert (4'x4').

DRAINAGE PROBLEM:

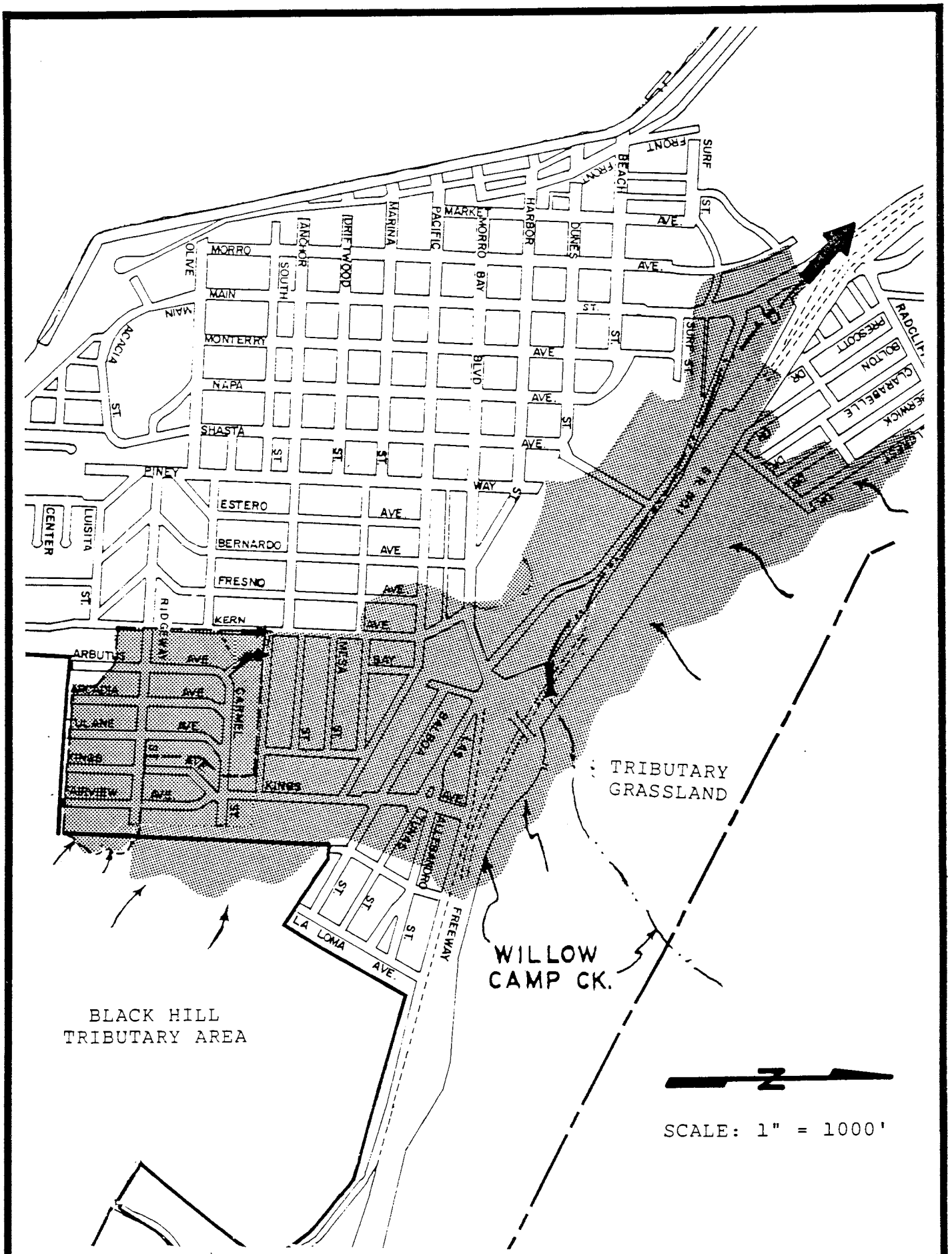
This region has important significance for any future growth that is planned for areas located in the watershed. The commercial buildings constructed over the channel limit the ability to increase channel capacity, and therefore the increased runoff from upstream development is a particular concern.

Furthermore, the single 4'x 4' box culvert is not sufficient to convey a 10 year flow. Eventually, this section should be increased to provide the capacity of a double 4'x 4' box culvert. However this cannot be easily done until the existing building is removed.

HYDROLOGY:

The flows in the box culvert region include the following.

Q10 = 182 cfs Q25 = 209 cfs Q100 = 264 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN WILLOW CAMP CREEK	FIGURE VIII-21

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 10
WILLOW CAMP CREEK
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" REMOVE EXISTING BUILDING	1	Each	$10,000.00	$10,000.00
2	REMOVE EXISTING 4'x 4' BOX	1	Each	$12,000.00	$12,000.00
3	DOUBLE 4'x 4' BOX	100	Lin. Ft.	$400.00	$40,000.00
4	CLEAN AND GRADE CHANNEL	100	Lin. Ft.	$50.00	$5,000.00
5					
6					
7					
8					
9					
10					
CONSTRUCTION SUBTOTAL					$67,000.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$6,700.00
SUBTOTAL					$73,700.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$11,055.00
PROJECT SUBTOTAL					$84,755.00
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$8,475.50
TOTAL PROJECT COST					$93,230.50

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 9
MORRO CREEK AT MAIN STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	700	Lin. Ft.	$60.00	$42,000.00
2	24" RCP STORM DRAIN PIPE	950	Lin. Ft.	$68.00	$64,600.00
3	CATCH BASINS - TYPE I	8	Each	$1,700.00	$13,600.00
4	INLET STRUCTURE	1	Each	$3,000.00	$3,000.00
5	FLAP GATE - OUTLET STRUCTURE	1	Each	$3,000.00	$3,000.00
6	STORM DRAIN MANHOLE - SMALL	2	Each	$2,500.00	$5,000.00
7	CLEARING AND GRUBBING	1	Lump Sum	$3,000.00	$3,000.00
8					$0.00
9					$0.00
	CONSTRUCTION SUBTOTAL				$134,200.00
	DESIGN @ 10% OF CONSTRUCTION SUBTOTAL				$13,420.00
	SUBTOTAL				$147,620.00
	CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL				$22,143.00
	PROJECT SUBTOTAL				$169,763.00
	PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL				$16,976.30
	TOTAL PROJECT COST				$186,739.30

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 11

BEACH STREET - EMBARCADERO TO MORRO AVENUE

This watershed contains commercial, residential, and other uses. There is presently a storm drain system in Main street which drains a sump and conveys/stores the water in a pipeline that extends south and then west in Beach Street. This pipeline is 36" in diameter with a 6" bleeder line extending westward below the Beach St. and Morro Street intersection. In Embarcadero Road North of Beach Street is an existing storm drain system which functions adequately. Beach Street is a heavily traveled thoroughfare to the Embarcadero, Morro Rock, and the beach.

DRAINAGE PROBLEM:

Storm water leaves the bleeder line at excessive velocity and flow for street conveyance. There is also evidence of poor drainage in other parts of Beach Street as indicated by the condition of the paving on much of the roadway. Market Street and Morro Avenue have poor drainage where there is almost a sump condition in each street about 200' north of Beach St. In addition, heavy flows sometimes bypass the existing inlets and sheet across Embarcadero to the Bay or to the south along Embarcadero.

POTENTIAL SOLUTION:

1. Provide a storm drain system which extends along Beach Street to Morro Avenue and outlets to the Bay. Inlets draining the sump areas should be provided, as well as a connection to the existing 36" pipe , eliminating the 6" bleeder outlet.

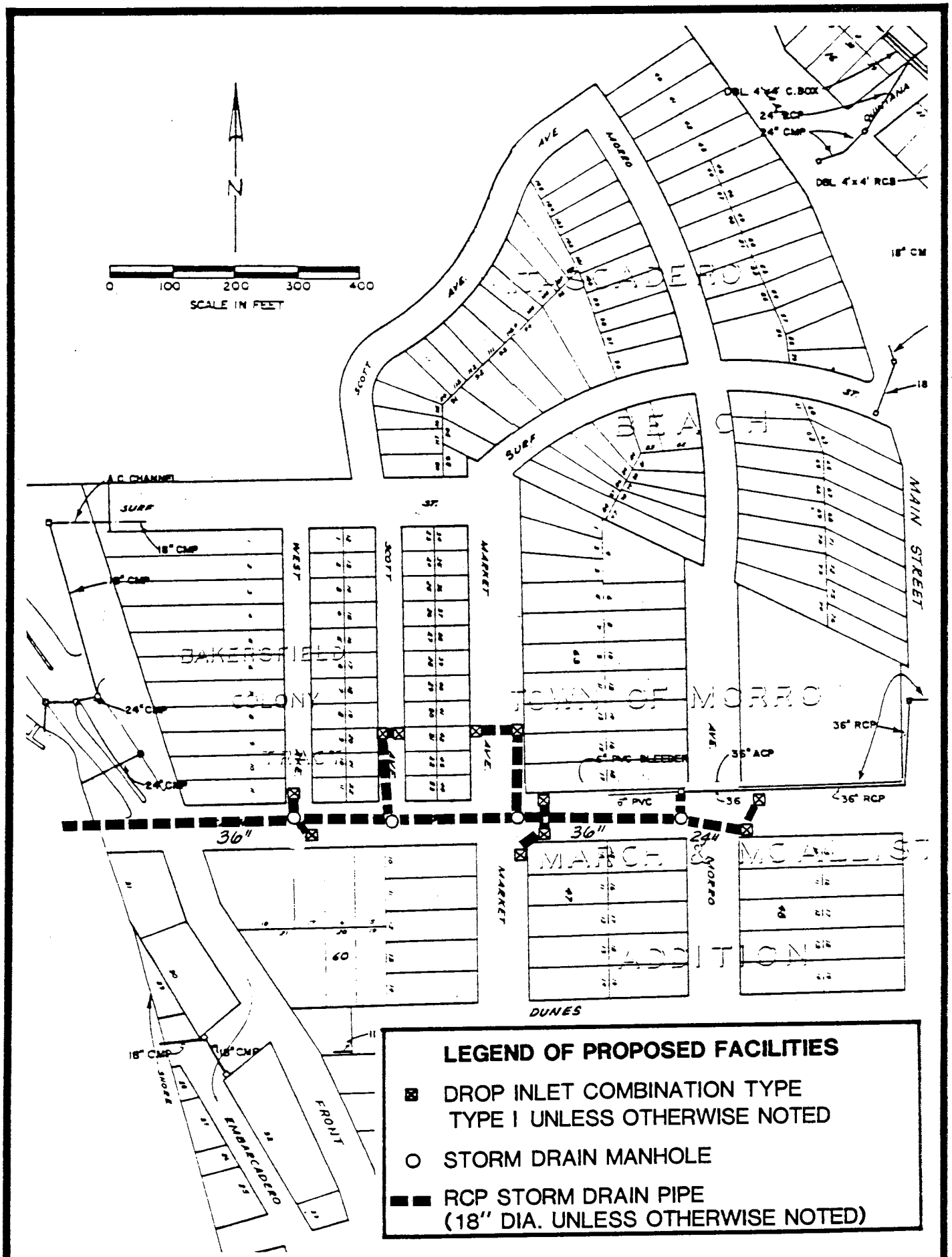
HYDROLOGY:

Beach St. & Embarcadero St.:

Q10 = 46 cfs Q25 = 53 cfs Q100 = 67 cfs

Beach St. & Morro Ave.:

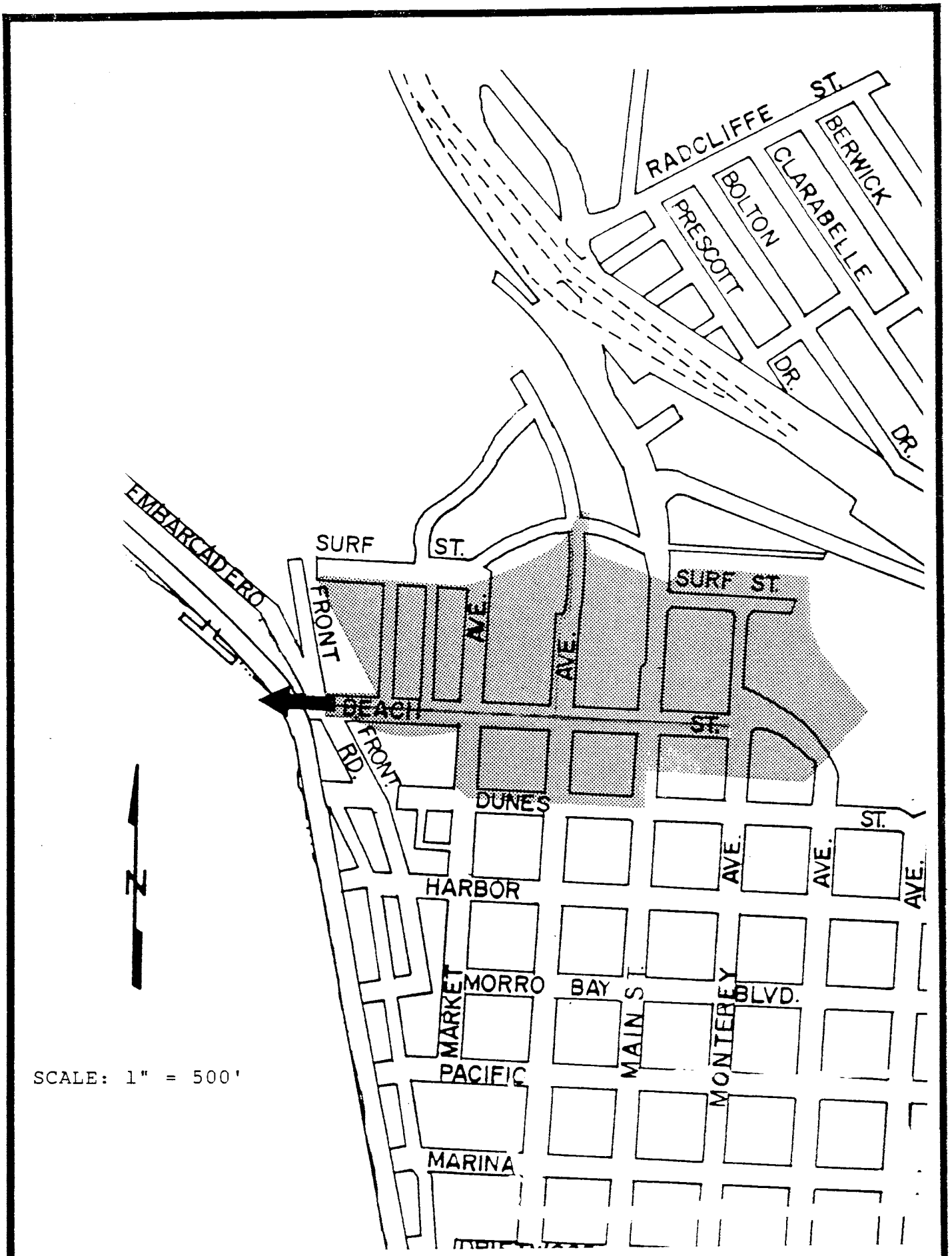
Q10 = 24 cfs Q25 = 28 cfs Q100 = 35 cfs



LEGEND OF PROPOSED FACILITIES

- ⊠ DROP INLET COMBINATION TYPE TYPE I UNLESS OTHERWISE NOTED
- ○ STORM DRAIN MANHOLE
- ▬ RCP STORM DRAIN PIPE (18" DIA. UNLESS OTHERWISE NOTED)

JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-22
	BEACH ST. - EMBARCADERO TO MORRO AVE	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN BEACH ST. - EMBARCADERO TO MORRO AVE.	FIGURE VIII-23

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 11
BEACH STREET - EMBARCADERO TO MORRO AVENUE
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	670	Lin. Ft.	$60.00	$40,200.00
2	24" RCP STORM DRAIN PIPE	105	Lin. Ft.	$68.00	$7,140.00
3	36" RCP STORM DRAIN PIPE	1000	Lin. Ft.	$103.00	$103,000.00
4	CATCH BASINS - TYPE I	11	Each	$1,700.00	$18,700.00
5	REMODEL EXISTING CATCH BASIN	1	Each	$3,000.00	$3,000.00
6	STORM DRAIN MANHOLE - LARGE	3	Each	$3,300.00	$9,900.00
7	STORM DRAIN MANHOLE - LARGE(CONNECT TO EXISTING)	1	Each	$3,000.00	$3,000.00
8	STORM DRAIN MANHOLE - SMALL	0	Each	$2,500.00	$0.00
9	OCEAN OUTLET	1	Each	$3,000.00	$3,000.00
10					$0.00
CONSTRUCTION SUBTOTAL					$187,940.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$18,794.00
SUBTOTAL					$206,734.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$31,010.10
PROJECT SUBTOTAL					$237,744.10
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$23,774.41
TOTAL PROJECT COST					$261,518.51

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 12

HARBOR STREET AT EMBARCADERO DRIVE

This area is part of the commercial hub of the City. It experiences considerable automobile and pedestrian traffic. Most of the watershed is composed of commercial activities. This area is next to a similar watershed along Morro Bay Boulevard.

DRAINAGE PROBLEM:

Surface runoff arrives at the intersection of Harbor and Main Streets via Harbor St. The capacity of Harbor Street just east of the intersection appears to be great enough to contain the calculated 10 year storm flow. However because of their volume flows arriving to this point from the east could cause considerable inconvenience to pedestrians and vehicles. At this same intersection, an existing culvert pipe system under the paved street walkway areas directs the flow around the corner to the easterly gutter area in Main Street. Here it flows southerly toward the Main Street and Morro Bay Boulevard intersections. The cross-slope of Morro Bay Boulevard and the small capacity of the gutter causes the water to sheet flow across the street. This causes problems at the Morro Bay Boulevard intersection and beyond.

POTENTIAL SOLUTIONS:

1. Direct the flow along Harbor Street across Main Street and permit the water to continue down Harbor Street on the surface to the existing under sized drain.

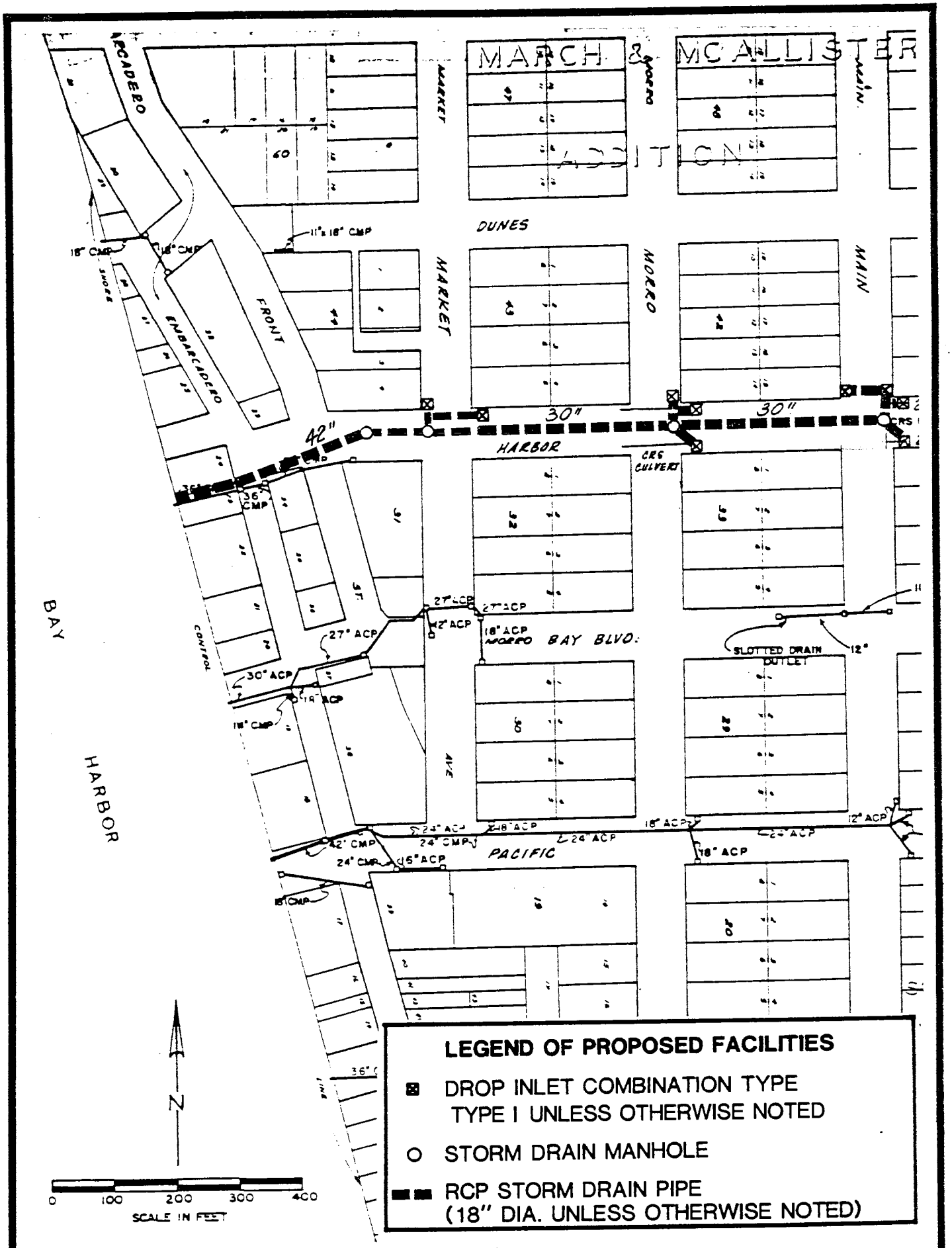
2. Construct a new storm drain in Harbor Street draining to the Bay from the Main Street intersection.

The second of the alternatives is more attractive because it will remove storm flows which could flood streets in and west of Main Street.

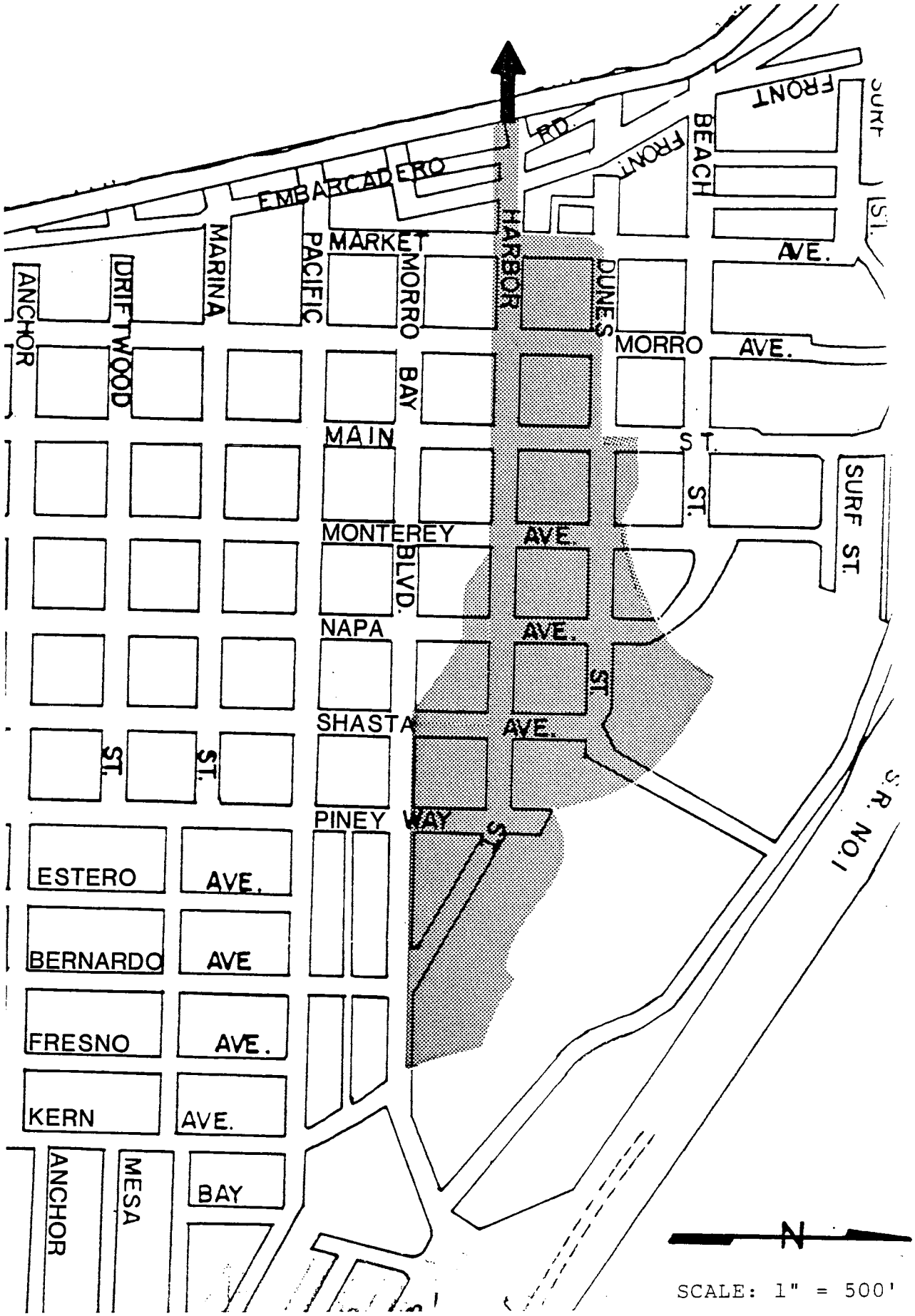
HYDROLOGY:

Flow that can be expected at the intersection of Harbor Street at Main Street include the following:

Q10 = 49 cfs Q25 = 56 cfs Q100 = 72 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN HARBOR STREET AT EMBARCADERO	FIGURE VIII-24



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN HARBOR STREET AT EMBARCADERO	FIGURE VIII-25

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 12
HARBOR STREET AT EMBARCADERO DRIVE
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	475	Lin. Ft.	$60.00	$28,500.00
2	24" RCP STORM DRAIN PIPE	0	Lin. Ft.	$68.00	$0.00
3	30" RCP STORM DRAIN PIPE	845	Lin. Ft.	$85.00	$71,825.00
4	42" RCP STORM DRAIN PIPE	330	Lin. Ft.	$120.00	$39,600.00
5	CATCH BASINS - TYPE I	7	Each	$1,700.00	$11,900.00
6	CATCH BASINS - TYPE II	2	Each	$2,100.00	$4,200.00
7	STORM DRAIN MANHOLE	4	Each	$3,300.00	$13,200.00
8	OCEAN OUTLET	1	Each	$3,000.00	$3,000.00
9					$0.00
10					$0.00
CONSTRUCTION SUBTOTAL					$172,225.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$17,222.50
SUBTOTAL					$189,447.50
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$28,417.13
PROJECT SUBTOTAL					$217,864.63
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$21,786.46
TOTAL PROJECT COST					$239,651.09

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 13

MORRO BAY BOULEVARD, MARKET TO MAIN STREET

This area represents a major part of the commercial hub of the City above the Embarcadero. It experiences considerable automobile and pedestrian traffic. Most of the watershed is composed of commercial activities. This area receives additional flow from a similar watershed along Harbor Street.

DRAINAGE PROBLEM:

An excess amount of runoff is directed to this area, particularly the intersection at Morro Bay Boulevard and Main Street. All of the drainage in the vicinity of Harbor Street west of Main Street is directed to this intersection. The flow along Harbor Street is directed to the south at Main Street where it sheet flows across Main Street just north of the Morro Bay Boulevard intersection.

Some of the flow is collected in drop inlets at the intersection and reappears at the surface a short distance to the west on Morro Bay Boulevard on the north side of the road. This surfacing water emerges from a small cast iron lined box. There is a gap in the existing storm drain system between this point and Market Avenue. The emerging flow travels along the north gutter, crosses Morro Avenue, and is collected in a drop inlet at Morro Bay Boulevard and Market Avenue.

The problems associated with this arrangement include extensive sheet flow across Main Street at the intersection of Main Street and Morro Bay Boulevard, and sidewalk flooding along the north and south sides of Morro Bay Boulevard between Market and Morro Avenue. The sheet flow is caused by an excessive quantity of water and poor road grade design. The sidewalk flooding is the result of an excessive amount of water and high velocities, resulting in the jumping of curb returns and driveways. Flooding has been reported at Rileys and the businesses across Morro Bay Boulevard from Rileys. Normally, the gutters on Rileys side of the street are relatively dry because the south gutter flow of Morro Bay Boulevard is directed toward Pacific Street at Main Street. During high flow events the water sheet flows completely across the intersection at Main Street and Morro Bay Boulevard or sheet flows across Main Street and continues to travel along the south gutter toward Rileys.

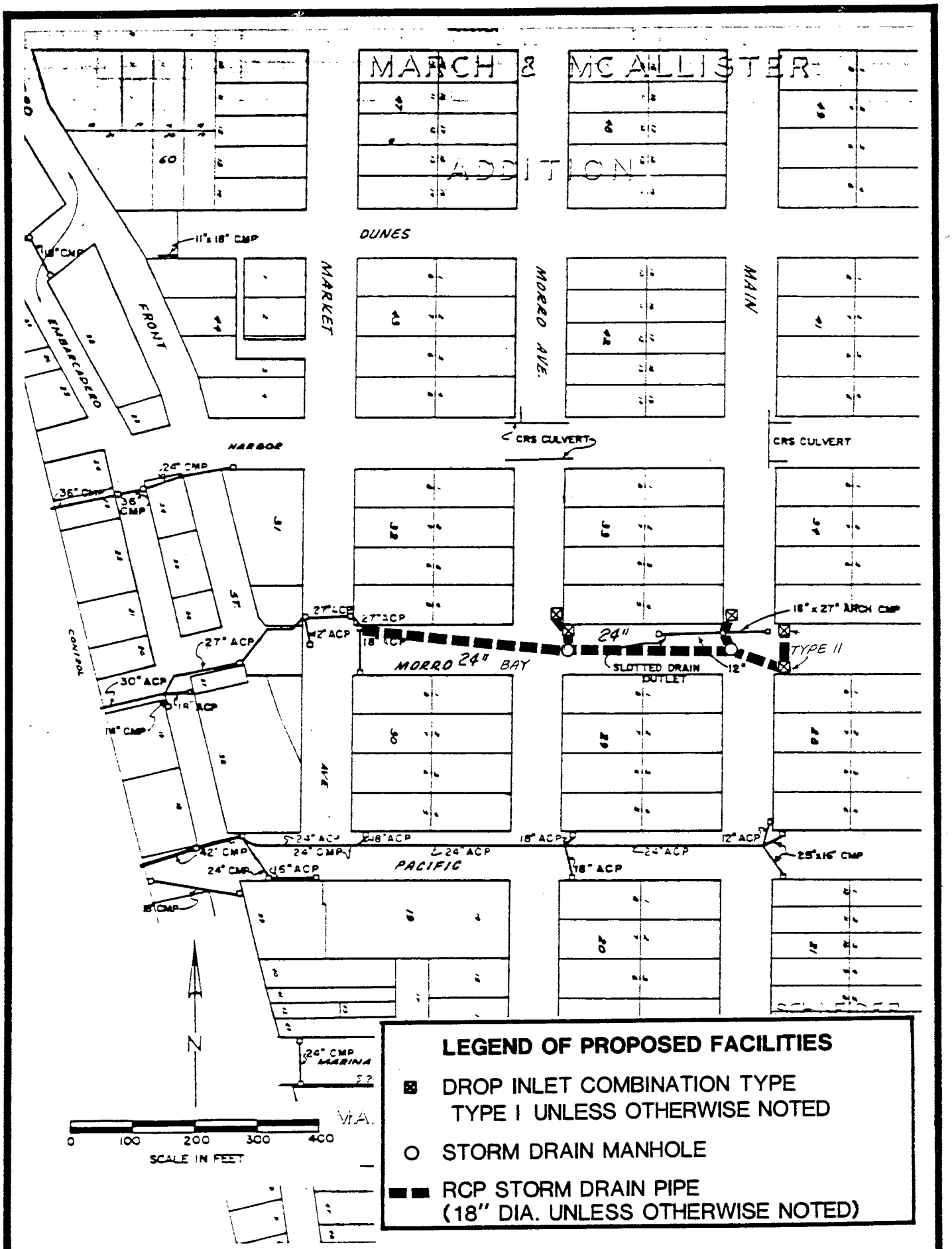
POTENTIAL SOLUTIONS:

Extend the existing Morro Bay Boulevard storm drain beyond Market Avenue to the East. Reconstruct the intersection and the existing drop inlets. The capacity of the existing 30 inch diameter storm drain located near the Embarcadero would be slightly exceeded in large storms. However, this would not be very serious because the slow flow velocities of any overflow near Embarcadero Road and the short distance to the Bay would preclude serious flood damage.

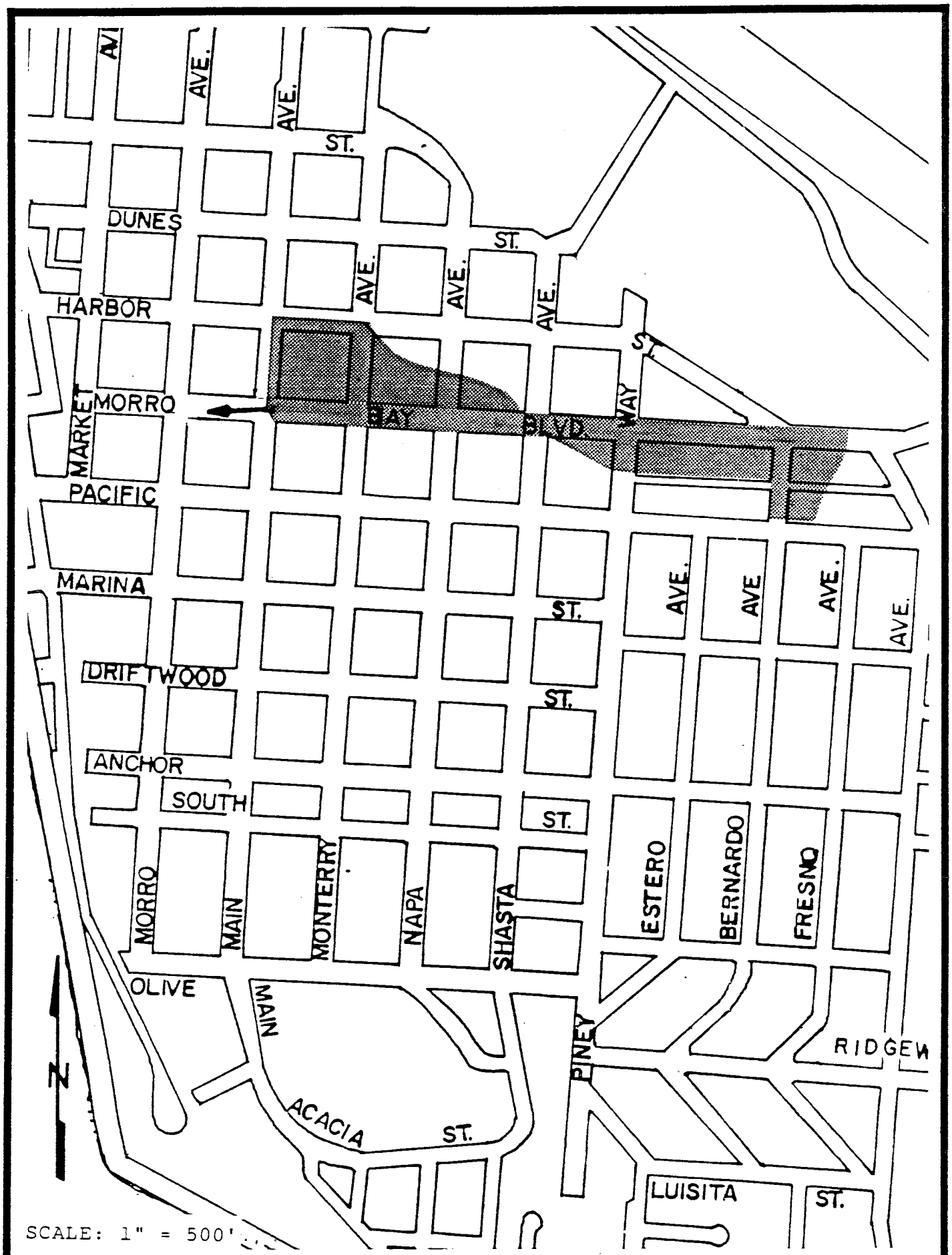
HYDROLOGY:

Flows that can be expected at the intersection of Morro Bay Boulevard and Main Street include the following:

Q10 = 59 cfs Q25 = 68 cfs Q100 = 86 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII-26
	MORRO BAY BLVD. - MARKET TO MAIN STREET	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN MORRO BAY BLVD. - MARKET TO MAIN STREET	FIGURE VIII-27

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 13
MORRO BAY BLVD. - MARKET TO MAIN STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	275	Lin. Ft.	$60.00	$16,500.00
2	24" RCP STORM DRAIN PIPE	600	Lin. Ft.	$68.00	$40,800.00
3	CATCH BASINS - TYPE I	3	Each	$1,700.00	$5,100.00
4	CATCH BASINS - TYPE II	2	Each	$2,100.00	$4,200.00
5	REMODEL EXISTING CATCH BASIN	1	Each	$6,500.00	$6,500.00
6	STORM DRAIN MANHOLE	2	Each	$2,500.00	$5,000.00
7					$0.00
8					$0.00
9					$0.00
10					$0.00
CONSTRUCTION SUBTOTAL					$78,100.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$7,810.00
SUBTOTAL					$85,910.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$12,886.50
PROJECT SUBTOTAL					$98,796.50
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$9,879.65
TOTAL PROJECT COST					$108,676.15

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 14

PACIFIC STREET - MAIN TO NAPA AVENUE

Pacific Street has an existing storm drain system which outlets to the Bay. The drain extends east of Main Street and is adequately sized to handle the present watershed area flows. The character of the drainage area includes residential, commercial, motels, and waterfront.

DRAINAGE PROBLEM:

Excessive amounts of runoff occurs in Pacific Street upstream of the existing storm drain system.

POTENTIAL SOLUTIONS:

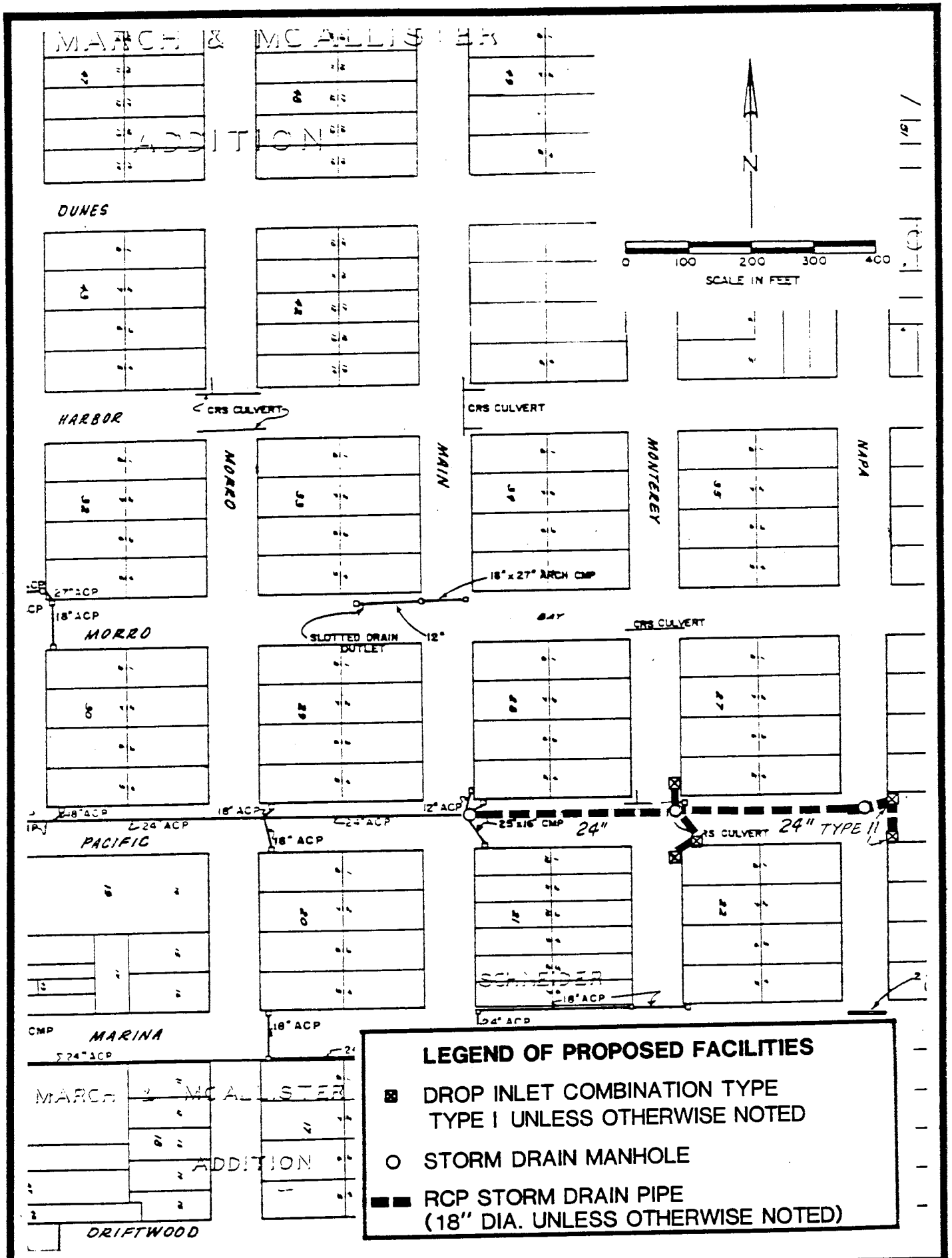
1. The existing storm drain should be extended up Pacific Street to decrease the amount of street flow. The drop inlets at the intersections should be sized to accommodate most of the watershed flow and curbs and gutters should be installed along Pacific Street because of its role as a drainage route. Additional flows should not be directed toward the watershed east of Market Street without increasing the size of the storm drain. Additional flows can be accommodated west of Market Street.

The project proposed here extends the existing storm drain system from Main Street two blocks to Napa Street. A policy of requiring curbs and gutters in Pacific Street in the downtown area is recommended, but not included in this storm drain project.

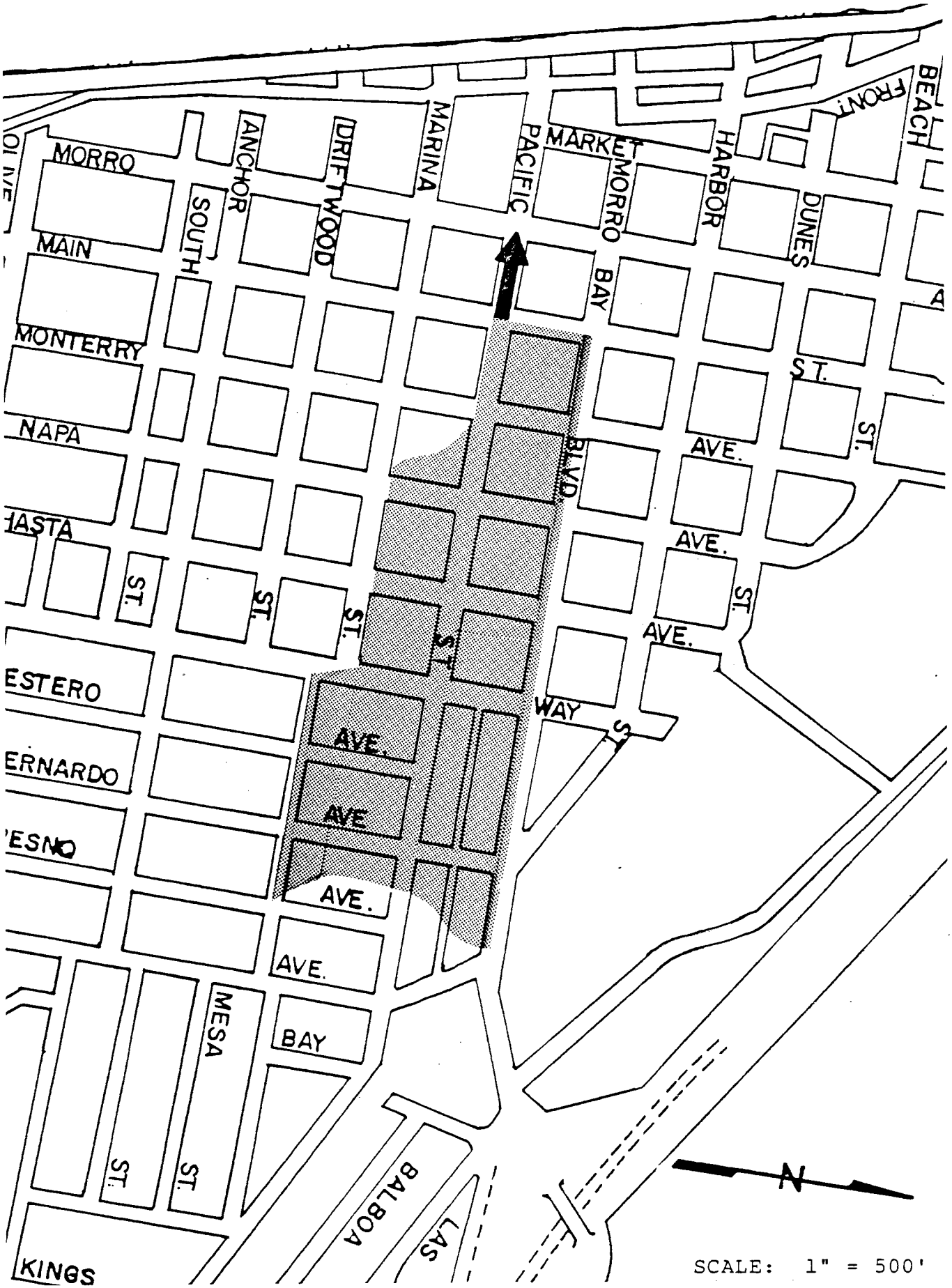
HYDROLOGY:

Flows that are directed toward this area include the following.

Q10 = 41 cfs Q25 = 46 cfs Q100 = 60 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN PACIFIC STREET – MAIN TO NAPA AVENUE	FIGURE VIII-28



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN PACIFIC STREET - MAIN TO NAPA AVENUE	FIGURE VIII-29

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 14
PACIFIC STREET - MAIN TO NAPA AVENUE
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	220	Lin. Ft.	$60.00	$13,200.00
2	24" RCP STORM DRAIN PIPE	695	Lin. Ft.	$68.00	$47,260.00
3	CATCH BASINS - TYPE I	3	Each	$1,700.00	$5,100.00
4	CATCH BASINS - TYPE II	2	Each	$2,100.00	$4,200.00
5	REMODEL EXISTING STORM DRAIN MANHOLE	1	Each	$1,000.00	$1,000.00
6	STORM DRAIN MANHOLE	2	Each	$2,500.00	$5,000.00
7					$0.00
8					$0.00
9					$0.00
10					$0.00
CONSTRUCTION SUBTOTAL					$75,760.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$7,576.00
SUBTOTAL					$83,336.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$12,500.40
PROJECT SUBTOTAL					$95,836.40
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$9,583.64
TOTAL PROJECT COST					$105,420.04

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 15

MARINA STREET - MAIN TO SHASTA AVENUE

Marina street has an existing storm drain system which outlets to the Bay. The pipeline extends to Monterey Street. The drainage area is mostly of residential and commercial character. It is a relatively extensive drainage area and includes areas east of Kern Avenue.

DRAINAGE PROBLEM:

The actual allocation of flows to this system is difficult to quantify because the runoff flow pattern from small storms is probably significantly different from the flow pattern that occurs during larger storm events. The drainage pattern for low flow events flows across town toward the southeast, extending all of the way to Black Hill in the vicinity of Ridgeway Street. Runoff that could flow to the west down Ridgeway Street, Olive Street, South Street, Anchor Street, and Driftwood Street is diverted to the north along Kern Avenue and Piney Way toward Marina. In a large flow event it is probable that much of the flow would cross Piney Way and Kern Avenue, before reaching Marina Street, and flow down the streets mentioned above.

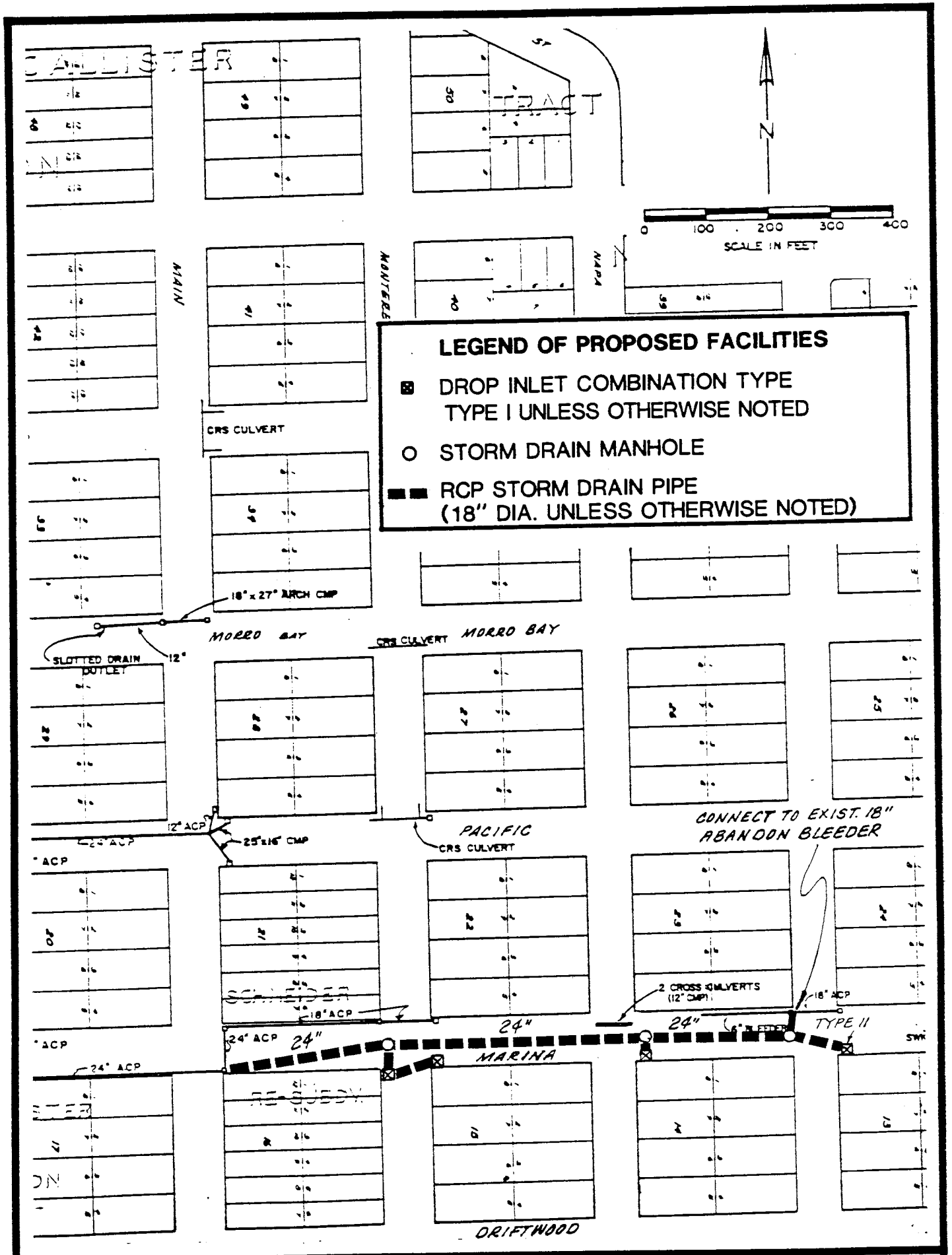
Assuming that a similar flow pattern to that described for large flow events, Marina would be flooded in the vicinity of Monterey Avenue. Some of the tributary streets would be flooded as well. Monterey Avenue between Marina Street and Driftwood Street and Driftwood Street between Monterey Avenue and Piney Way must accommodate heavy flows with the existing system. Some of the streets along the route do not have curbs and gutters. Water sheet flows across the intersection of Piney Way and Driftwood Street and other intersections.

POTENTIAL SOLUTIONS:

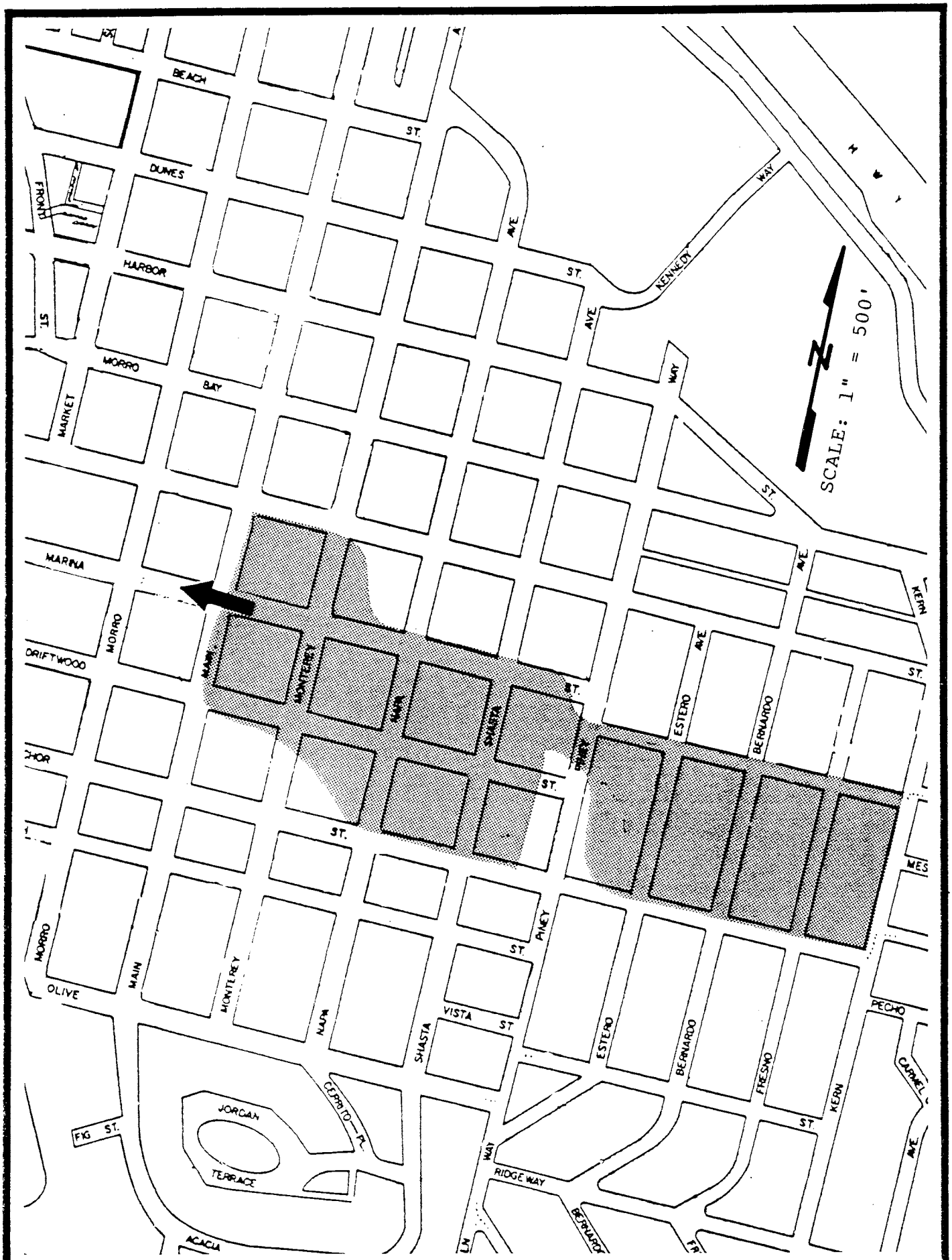
The storm drain pipe in Marina Street should be extended towards the east to decrease the amount of street flow. Drop inlets having the capacity to fill the existing 24" diameter storm drain pipe should be installed at the upper end of the storm drain extending up Marina Street from the Bay, particularly on the south side of the street. Curbs and gutters should be installed along Driftwood Street between Monterey Avenue and Piney Way, and along Marina Street from Kern Avenue to Monterey.

HYDROLOGY:

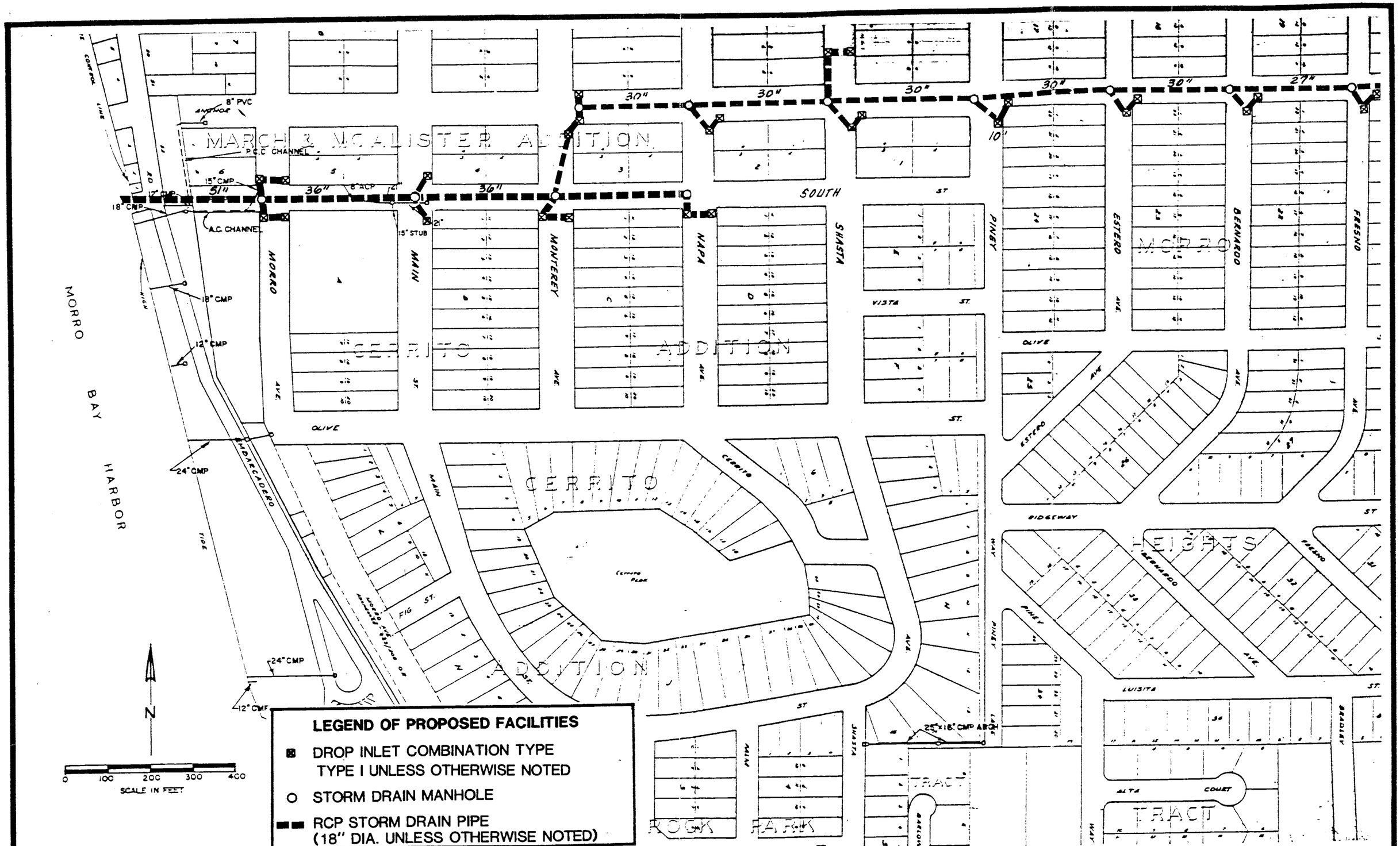
Q10 = 41 cfs Q25 = 46 cfs Q100 = 60 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN MARINA STREET – MAIN TO SHASTA STREET	FIGURE VIII 30



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN MARINA STREET – MAIN TO SHASTA STREET	FIGURE VIII 31



JOHN L. WALLACE & ASSOCIATES

MORRO BAY STORM DRAIN MASTER PLAN

ANCHOR STREET – EMBARCADERO TO ARBUTUS

FIGURE VIII 32

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 16

ANCHOR STREET - EMBARCADERO TO ARBUTUS AVENUE

This is a large watershed draining through both commercial and residential areas. There are no existing storm drain facilities East of Main Street.

DRAINAGE PROBLEM:

The are several problem locations within this watershed. Runoff flows larger than can be accommodated via street flow occur in the watershed, causing minor flooding and nuisance problems along the way. Problem locations within this watershed include the following:

1. SOUTH STREET AND MORRO AVENUE:

   The flow converging at the intersection of South Street from the west and Morro Avenue from the north is not adequately contained. Some of it flows down South Street, crossing Morro Avenue, and is directed at a large eucalyptus tree. Sand bags are installed across an adjacent residential driveway to prevent the flow split from the tree from entering the driveway and home area. The water flows around the south side of the eucalyptus tree and then flows to the west down an asphalt ditch. Part of the flow on Morro Avenue enters a small culvert in front of this same house and is conveyed to the paved ditch.

2. MONTEREY AVENUE, SOUTH TO ANCHOR STREET

   A localized sump condition exists on Monterey Ave. by water flowing from Anchor St. and the flow on Monterey from the south. The water forms a pond and when it gets deep enough either spills to private property or flows northerly toward Anchor St.. Although the flows are relatively small this is an area that should be corrected.

3. ANCHOR STREET AT PINEY WAY

   This intersection experiences flows which move fairly rapidly and turn corners. These flows eventually reach the Morro/South Street and the Marina Street problem areas.

4. DRIFTWOOD STREET AND PINEY WAY

   Piney Way at this location drains both from the north and south. The flow gathers at about the center of the

intersection on the east side and flows across the intersection to the west down Driftwood. This flow disrupts traffic even during small storms. It would be better to provide a basin on the east side of Piney Way and build up the crown section of the street to improve the street section. The basin outlet could be below just west of the intersection.

5. **ANCHOR STREET AND KERN AVENUE - PECHO STREET**

After combining with flow from Pecho Street, the storm flow from Kern Avenue sheet flows across the roadway just prior to the Anchor Street intersection. This creates a traffic hazard because of its considerable flow volume. Some of the storm flow splits at the intersection of Kern and Anchor and goes west while the rest continues north. Subsequently the flows end up in the Pacific, Marina, and Willow Camp Creek drainage structures.

Flows that can be expected at South and Morro in this intersection include the following.

Q10 = 29 cfs Q25 = 33 cfs Q100 = 42 cfs

Driftwood and Piney:

Q10 = 52 cfs Q25 = 59 cfs Q100 = 76 cfs

Anchor and Kern

Q10 = 30 cfs Q25 = 35 cfs Q100 = 44 cfs

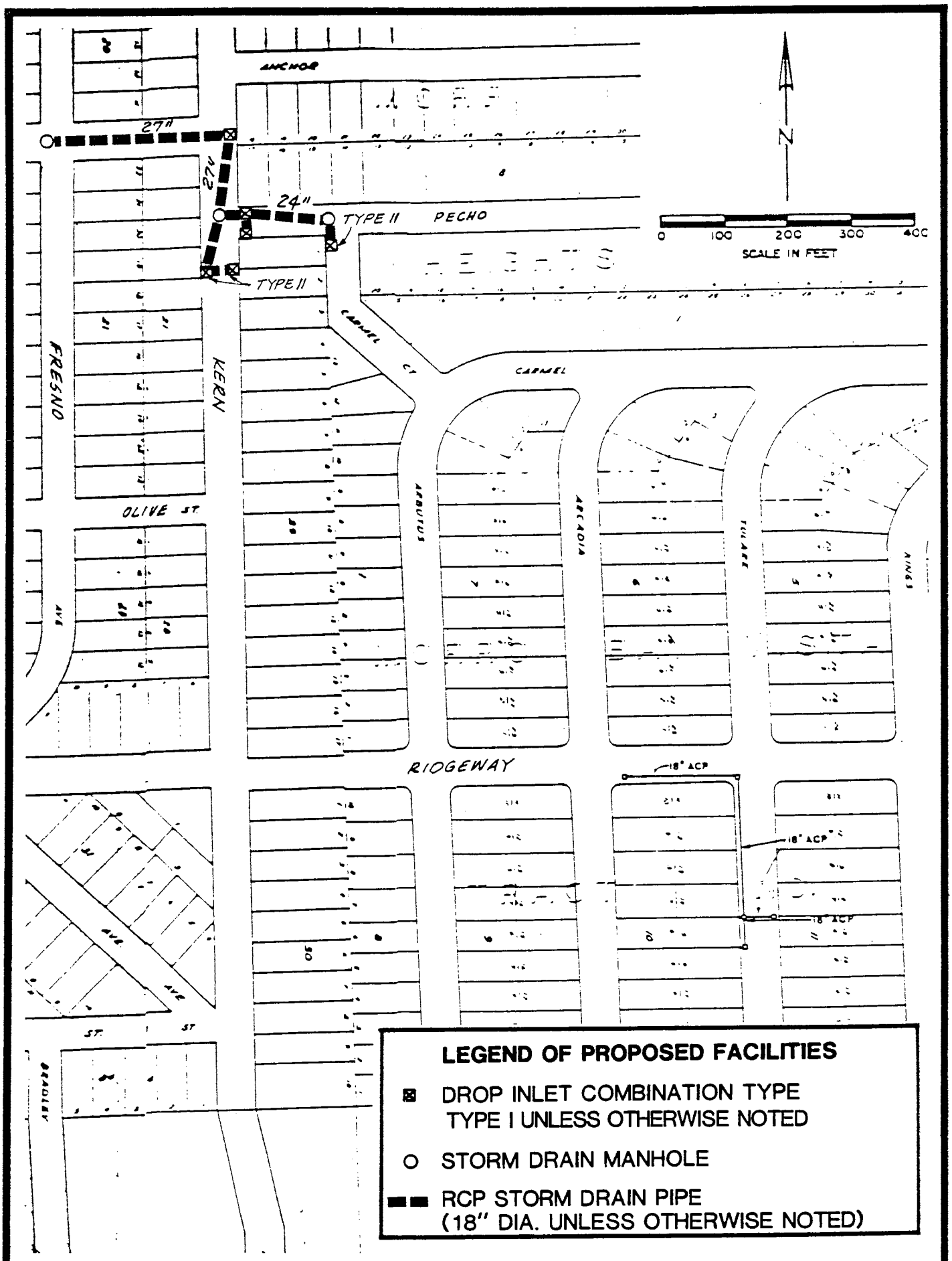
CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 16
ANCHOR STREET - EMBARCADERO TO ARBUTUS AVENUE
COST ESTIMATE

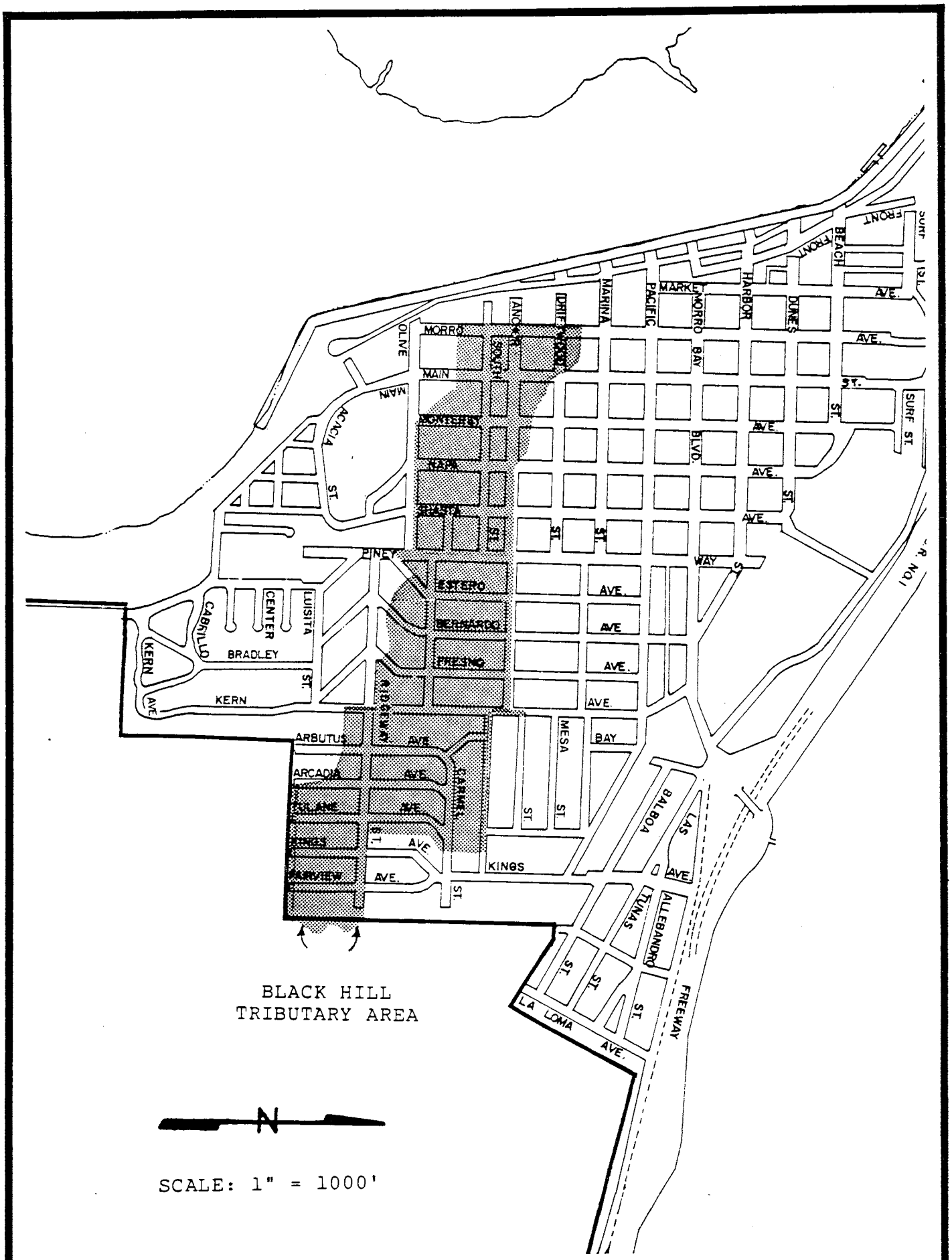
July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	1810	Lin. Ft.	$60.00	$108,600.00
2	24" RCP STORM DRAIN PIPE	170	Lin. Ft.	$68.00	$11,560.00
3	27" RCP STORM DRAIN PIPE	730	Lin. Ft.	$73.00	$53,290.00
4	30" RCP STORM DRAIN PIPE	1545	Lin. Ft.	$85.00	$131,325.00
5	36" RCP STORM DRAIN PIPE	850	Lin. Ft.	$103.00	$87,550.00
6	51" RCP STORM DRAIN PIPE	335	Lin. Ft.	$150.00	$50,250.00
7	CATCH BASINS - TYPE I	29	Each	$1,700.00	$49,300.00
8	CATCH BASINS - TYPE II	4	Each	$2,100.00	$8,400.00
9	STORM DRAIN MANHOLE - SMALL	4	Each	$2,500.00	$10,000.00
10	STORM DRAIN MANHOLE - LARGE	9		$3,300.00	$29,700.00
11	OCEAN OUTLET	1		$6,000.00	$6,000.00
CONSTRUCTION SUBTOTAL					$545,975.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$54,597.50
SUBTOTAL					$600,572.50
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$90,085.88
PROJECT SUBTOTAL					$690,658.38
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$69,065.84
TOTAL PROJECT COST					$759,724.21

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 33
	ANCHOR STREET CONTINUED	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN ANCHOR ST - EMBARCADERO TO ARBUTUS AVE	FIGURE VIII 34

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 15
MARINA - MAIN TO SHASTA AVENUE
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	220	Lin. Ft.	$60.00	$13,200.00
2	24" RCP STORM DRAIN PIPE	1020	Lin. Ft.	$68.00	$69,360.00
3	CATCH BASINS - TYPE I	3	Each	$1,700.00	$5,100.00
4	CATCH BASINS - TYPE II	1	Each	$2,100.00	$2,100.00
5	REMODEL EXISTING CATCH BASIN	1	Each	$4,000.00	$4,000.00
6	STORM DRAIN MANHOLE	3	Each	$2,500.00	$7,500.00
7					$0.00
8					$0.00
9					$0.00
10					$0.00
CONSTRUCTION SUBTOTAL					$101,260.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$10,126.00
SUBTOTAL					$111,386.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$16,707.90
PROJECT SUBTOTAL					$128,093.90
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$12,809.39
TOTAL PROJECT COST					$140,903.29

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 17

OLIVE STREET - MORRO TO MAIN STREET

The watershed for this location is currently residential. Olive Street at this location has approximately a 15% slope toward Main Street. Water is presently conveyed from the east side of the intersection via a small culvert to an outlet point west of the intersection.

DRAINAGE PROBLEM:

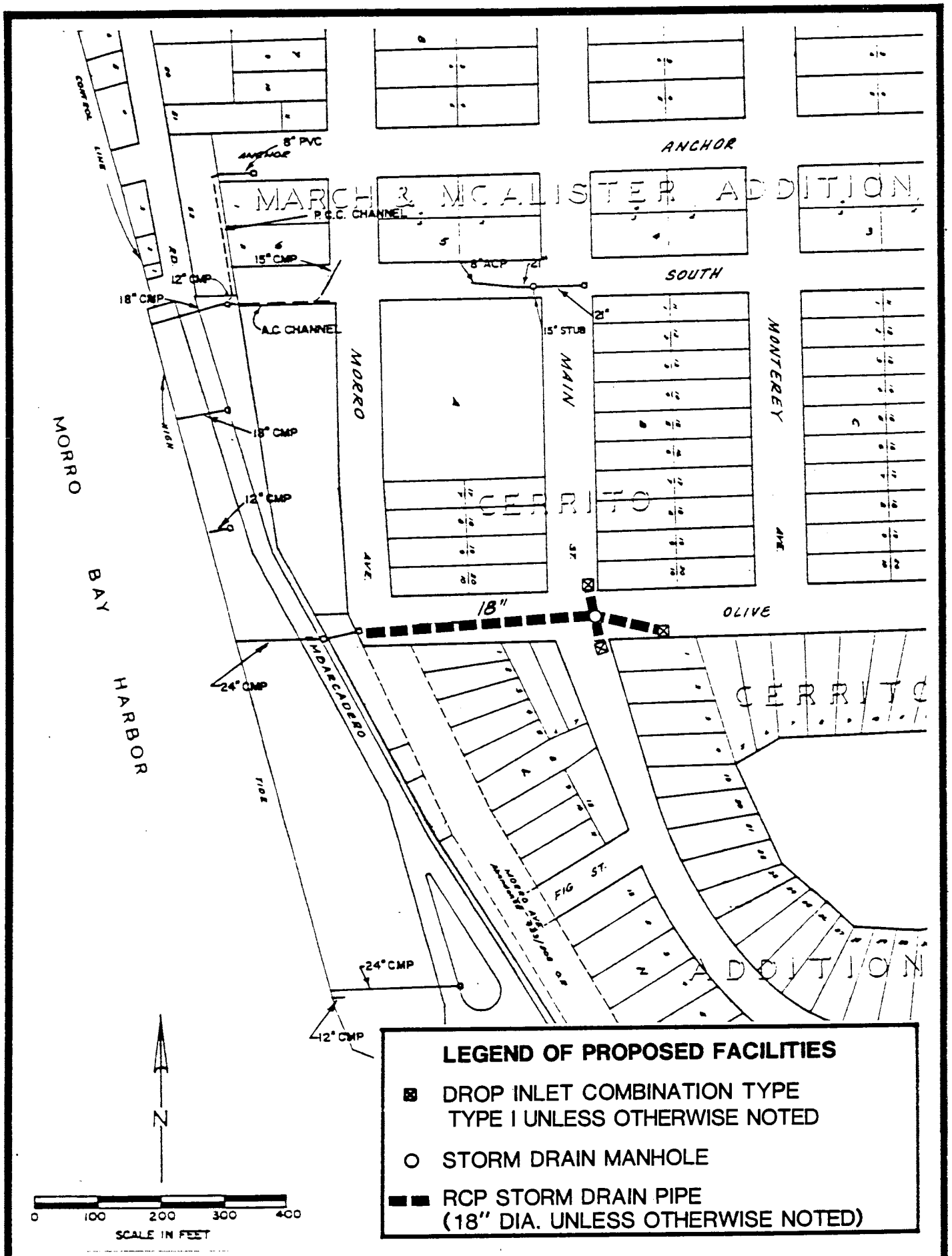
Water ponds on the east side of the intersection partly because the small size of the existing culvert, the condition of the intersection, and the amount of tree branches and leaves. Large flows can overflow the crown of the street potentially causing problems with traffic on one of the City's through streets.The City is currently looking at a project to improve the situation using a new larger culvert.

POTENTIAL SOLUTIONS:

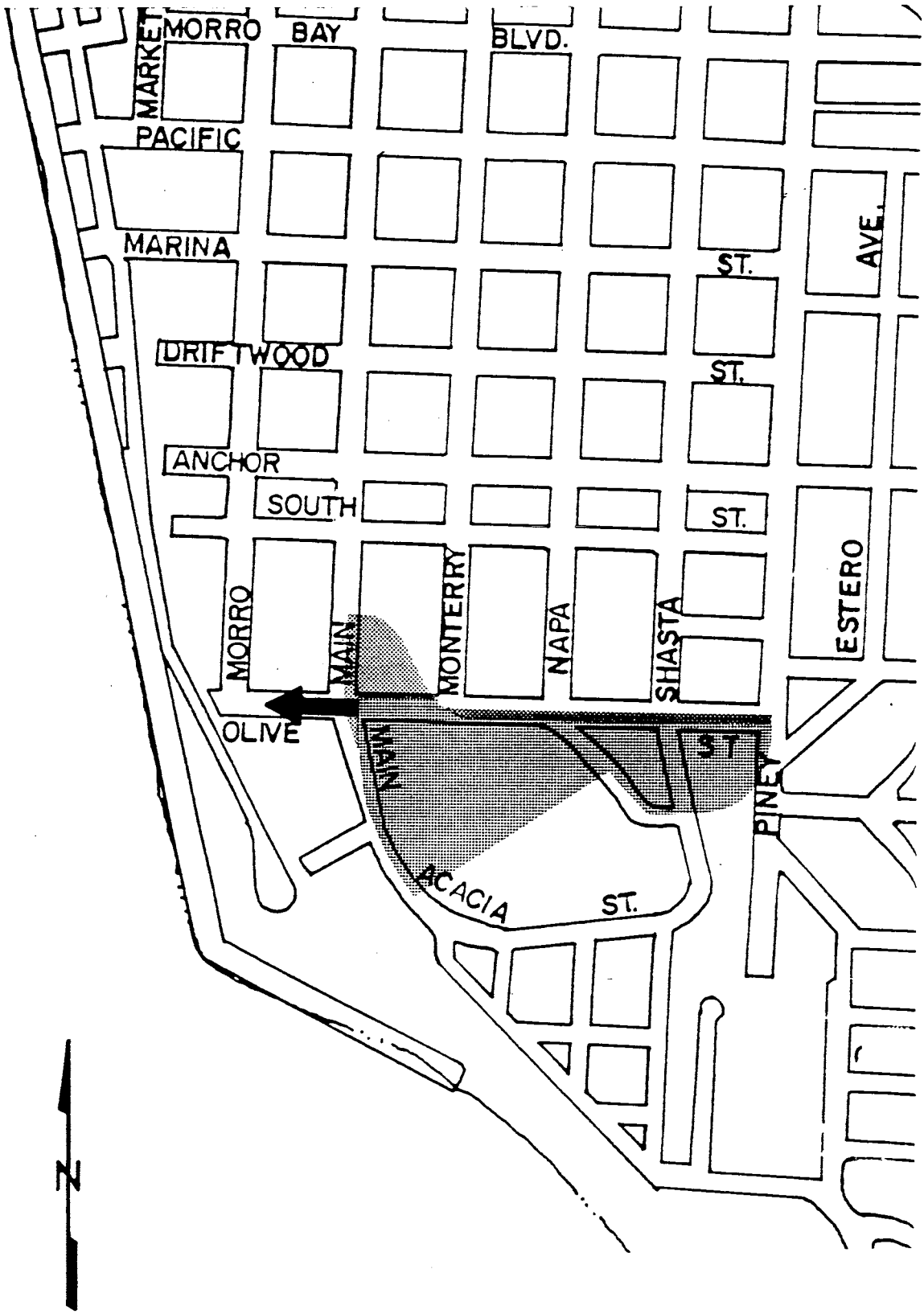
1. A storm drain system should be installed to drain the intersection. This system can tie into the existing system at Morro Avenue and Olive Street, which outlets to the Bay.

HYDROLOGY:

Q10 = 6 cfs Q25 = 7 cfs Q100 = 9 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 35
	OLIVE STREET - MORRO TO MAIN STREET	



SCALE: 1" = 500'

JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN OLIVE STREET – MORRO TO MAIN STREET	FIGURE VIII 36

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 17
OLIVE STREET - MORRO TO MAIN STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	600	Lin. Ft.	$60.00	$36,000.00
2	CATCH BASINS - TYPE I	3	Each	$1,700.00	$5,100.00
3	REMODEL EXISTING CATCH BASIN	1	Each	$800.00	$800.00
4	STORM DRAIN MANHOLE	1	Each	$2,500.00	$2,500.00
5					$0.00
6					$0.00
7					$0.00
8					$0.00
9					$0.00
10					$0.00
CONSTRUCTION SUBTOTAL					$44,400.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$4,440.00
SUBTOTAL					$48,840.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$7,326.00
PROJECT SUBTOTAL					$56,166.00
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$5,616.60
TOTAL PROJECT COST					$61,782.60

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 18

KERN AVENUE AT MAIN STREET

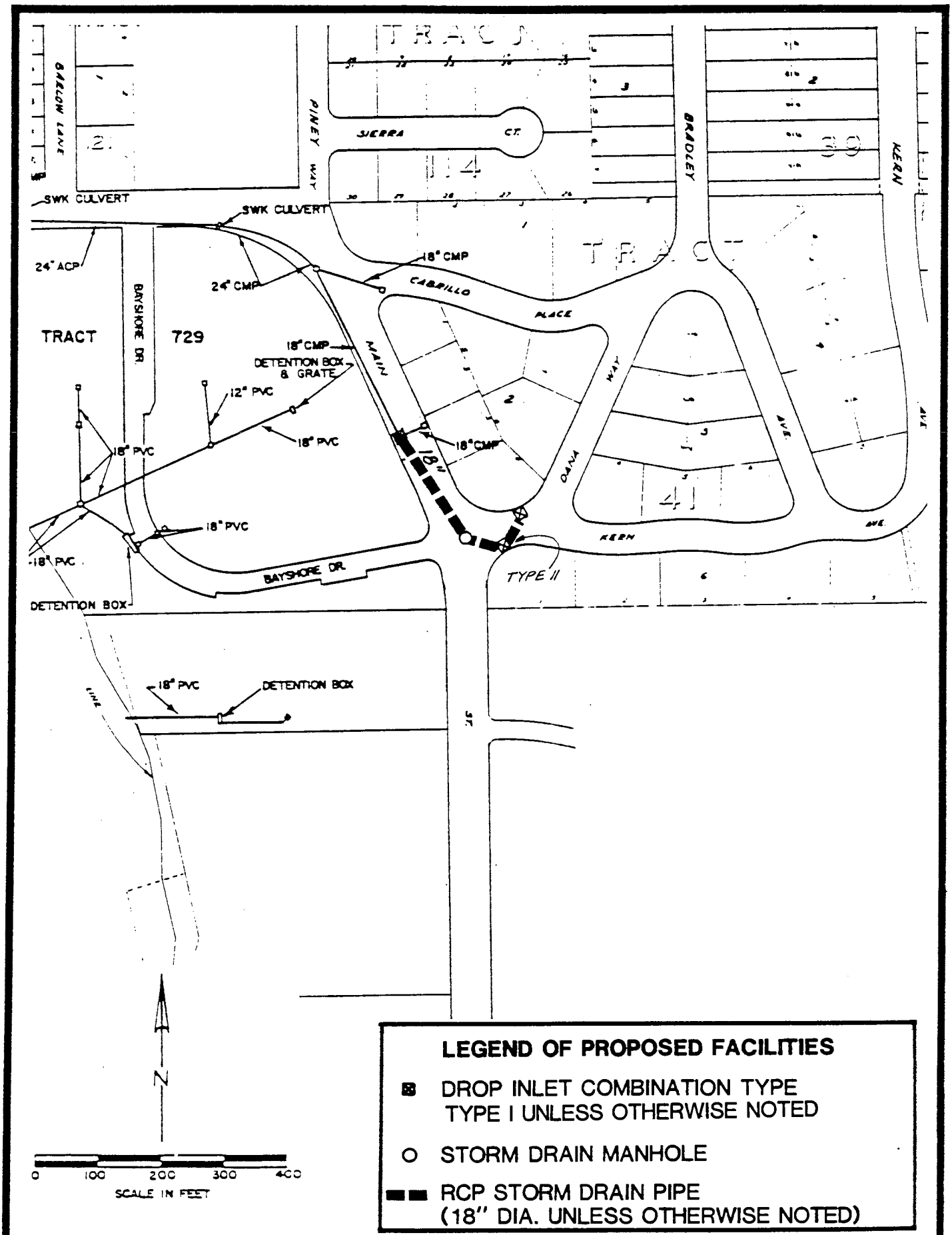
This watershed is residential and borders on and includes a small portion of the State Park property. On Main Street near this area is an existing storm drain system. The catch basins are not sufficient in either location and or size.

DRAINAGE PROBLEM:

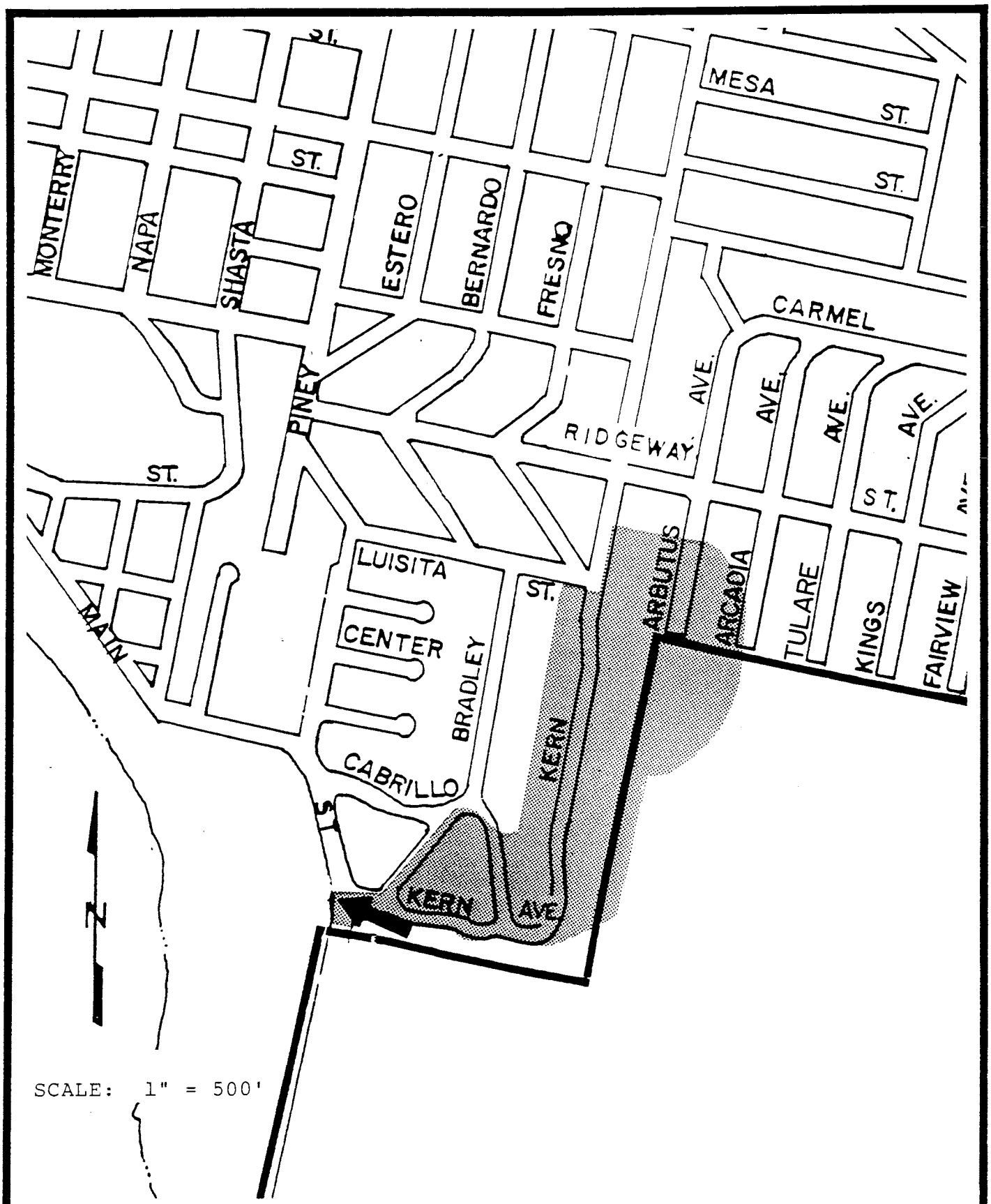
Storm flows on Kern Avenue approach Main Street from the East. As the flow nears the intersection it divides to the north and the southwest. The northward flow travels to a small basin along the eastside of Main Street which has no curbs and gutters. The southwest flow goes across Main Street with some of it flowing into the State Park along the roadway before it spills over and flows on to private property on the west. The remainder of the flow changes direction and continues to an existing basin on the westside of Main Street North of Kern.

HYDROLOGY:

Q10 = 18 cfs Q25 = 21 cfs Q100 = 26 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 37
	KERN AVENUE AT MAIN STREET	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN KERN AVENUE AT MAIN STREET	FIGURE VIII 38

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 18
KERN AVENUE AT MAIN STREET
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	315	Lin. Ft.	$60.00	$18,900.00
2	CATCH BASINS - TYPE I	1	Each	$1,700.00	$1,700.00
3	CATCH BASINS - TYPE II	1	Each	$2,100.00	$2,100.00
4	REMODEL EXISTING CATCH BASIN	1	Each	$800.00	$800.00
5	CURB AND GUTTER	100	Lin. Ft.	$12.00	$1,200.00
6	STORM DRAIN MANHOLE	1	Each	$2,500.00	$2,500.00
7					$0.00
8					$0.00
9					$0.00
10					$0.00
CONSTRUCTION SUBTOTAL					$27,200.00
DESIGN @ 10% OF CONSTRUCTION SUBTOTAL					$2,720.00
SUBTOTAL					$29,920.00
CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL					$4,488.00
PROJECT SUBTOTAL					$34,408.00
PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL					$3,440.80
TOTAL PROJECT COST					$37,848.80

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 19

LAS TUNAS AVENUE - BUTTE TO KINGS AVENUE

This watershed contains commercial type functions in the lower reaches, residential areas in the middle, and some State Park property in the upper reaches. This intersection is comprised of three streets. There is a cross gutter in Butte Ave. and a depressed swale in the paving of Las Tunas parallel to Quintana Rd.

DRAINAGE PROBLEM:

The intersection at Las Tunas and Butte Avenue (and Quintana Road) ponds frequently even in fairly small storms. The pond formed drains slowly onto Quintana Road and then flows westward to an existing inlet on the south side of Morro Bay Boulevard. The paving in the intersection is deteriorating and will continue to do so even if the area were repaved unless the standing water is removed.

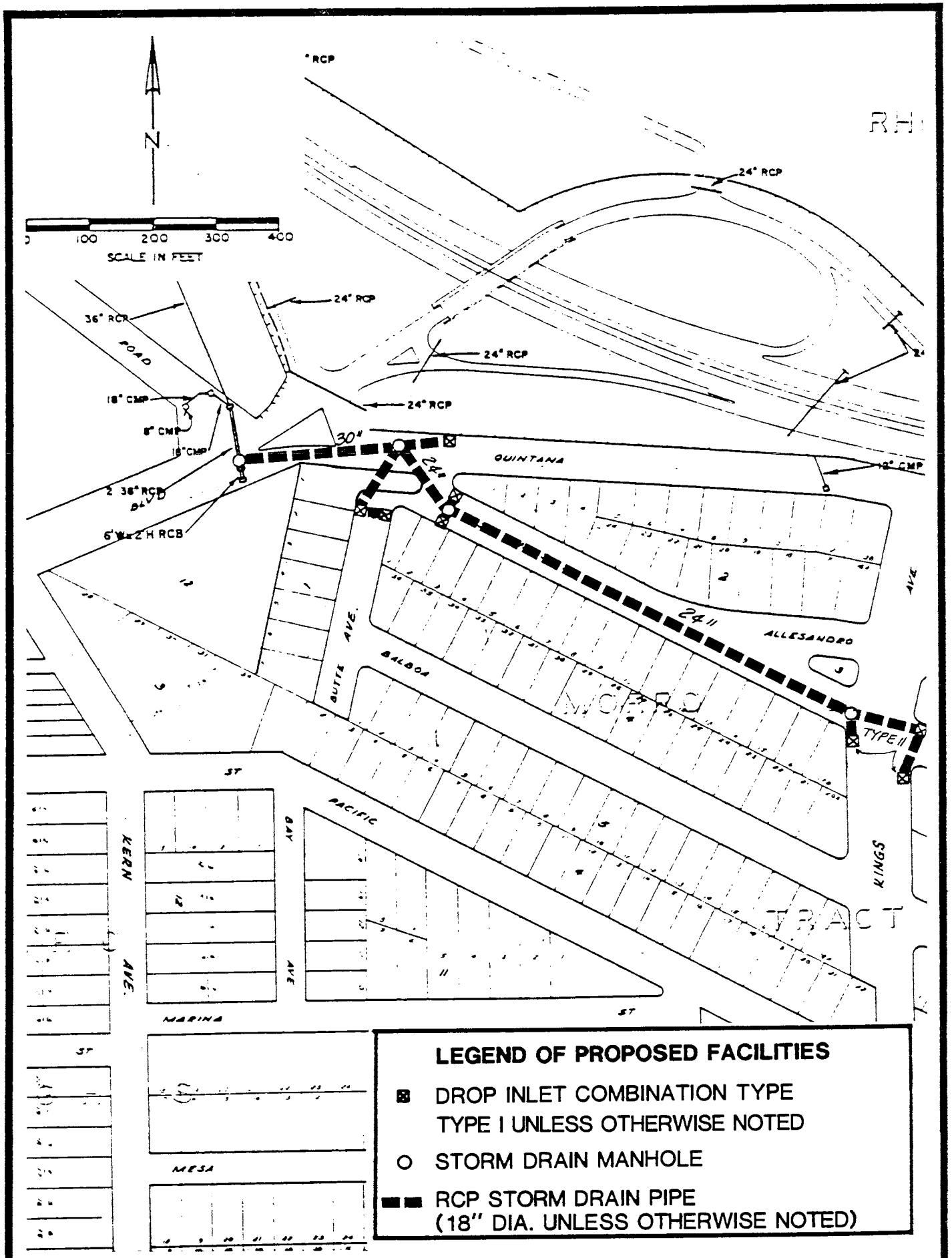
POTENTIAL SOLUTIONS:

1. The City has completed remodeling this intersection on the north side of Morro Bay Boulevard at Quintana to change the traffic pattern. Drainage will also probably be altered at this location. It may be possible for City to construct at the same time a drain over to the Quintana - Las Tunas-Butte intersection to relieve the flooding.

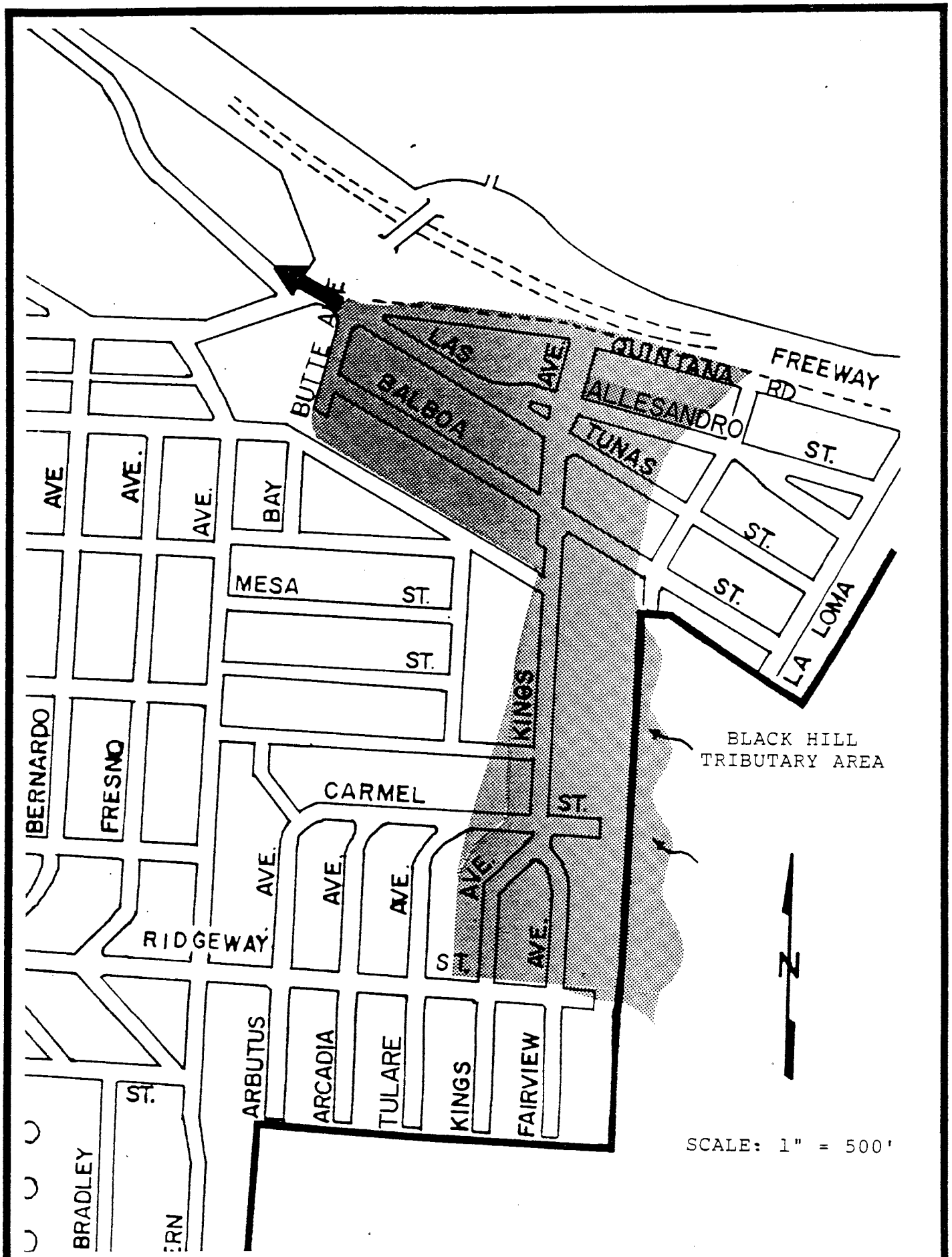
2. A more comprehensive solution would include building a storm drain from Willow Camp Creek to Kings Avenue and picking up the flows from this intersection in the process.

HYDROLOGY:

Q10 = 26 cfs Q25 = 30 cfs Q100 = 38 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 39
	LAS TUNAS AVENUE – BUTTE TO KINGS AVENUE	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 40
	LAS TUNAS AVENUE - BUTTE TO KINGS AVENUE	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 19
LAS TUNAS STREET - BUTTE AVENUE TO KINGS AVENUE
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	360	Lin. Ft.	$60.00	$21,600.00
2	24" RCP STORM DRAIN PIPE	915	Lin. Ft.	$68.00	$62,220.00
3	30" RCP STORM DRAIN PIPE	485	Lin. Ft.	$85.00	$41,225.00
4	CATCH BASINS - TYPE I	5	Each	$1,700.00	$8,500.00
5	CATCH BASINS - TYPE II	2	Each	$2,100.00	$4,200.00
6	STORM DRAIN MANHOLE	2	Each	$2,500.00	$5,000.00
7	STORM DRAIN MANHOLE JUNCTION STRUCTURES	2	Each	$3,300.00	$6,600.00
8	REMODEL	1		$1,500.00	$1,500.00
9					
10					
	CONSTRUCTION SUBTOTAL				$150,845.00
	DESIGN @ 10% OF CONSTRUCTION SUBTOTAL				$15,084.50
	SUBTOTAL				$165,929.50
	CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL				$24,889.43
	PROJECT SUBTOTAL				$190,818.93
	PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL				$19,081.89
	TOTAL PROJECT COST				$209,900.82

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 20

QUINTANA ROAD - BELLA VISTA TO LA LOMA AVENUE

This watershed contains State Park property, residential, and commercial uses. A new commercial complex has just been constructed on Quintana beginning at the corner of Bella Vista and proceeding east. At the easterly terminus of this facility storm drain structures were constructed which collect flow and carry it to an old existing drain. This drain outlets a few feet to the east just beyond a driveway. The surface flow proceeds then to a small grate basin, through a small culvert pipe, into a small very shallow concrete channel, into another grate basin, and then through another small pipe to a natural watercourse with a new headwall outlet at the corner of La Loma and Quintana Road.

DRAINAGE PROBLEM:

The facilities described above are for the most part unsightly, and inefficient. They result in drainage patterns which are a nuisance, and a potential traffic hazard. The newly constructed facilities are adequate but should be connected to newer drainage structures which are placed properly to pickup street flows.

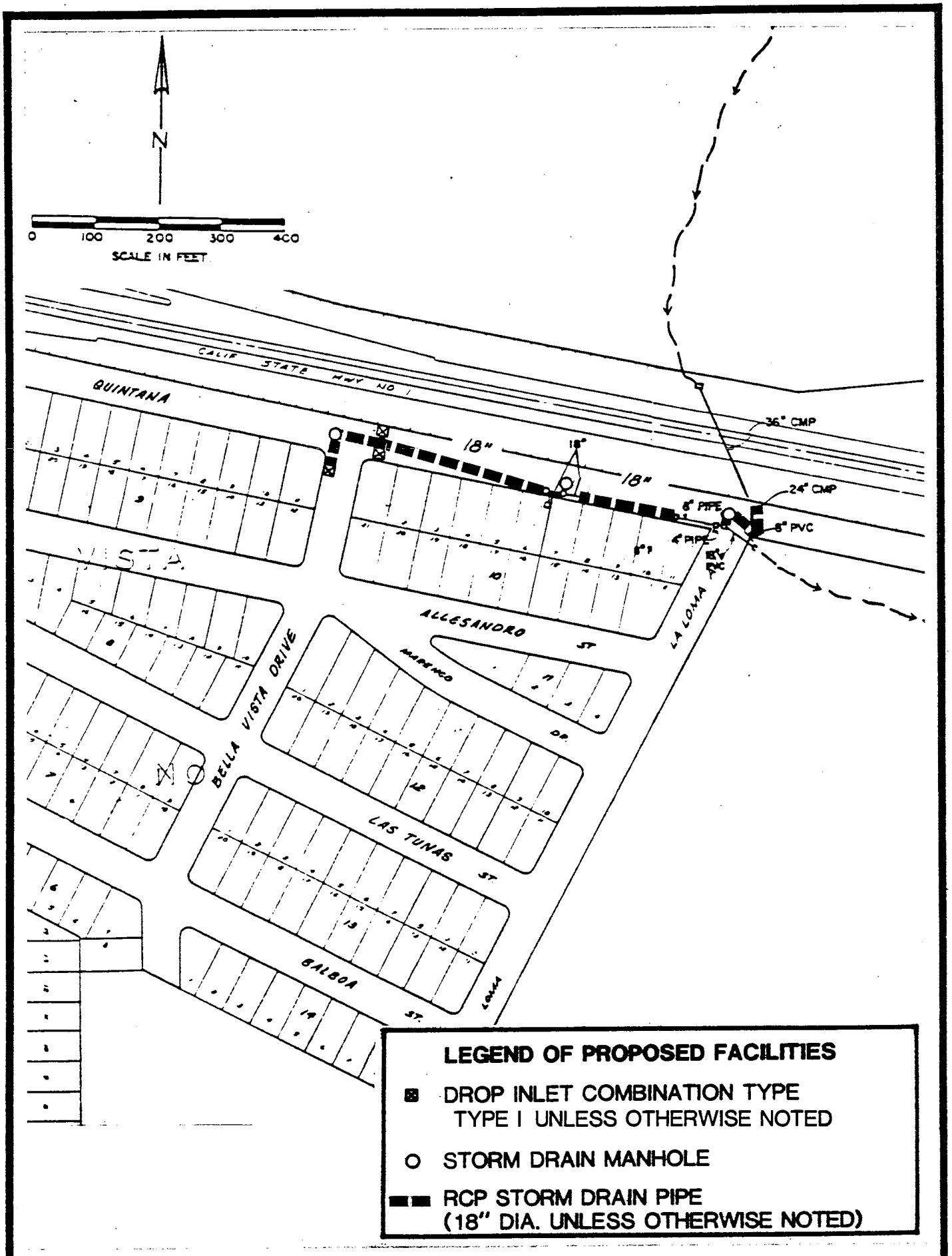
POTENTIAL SOLUTION:

1. Construct a new storm drain system connecting to the newer facilities.

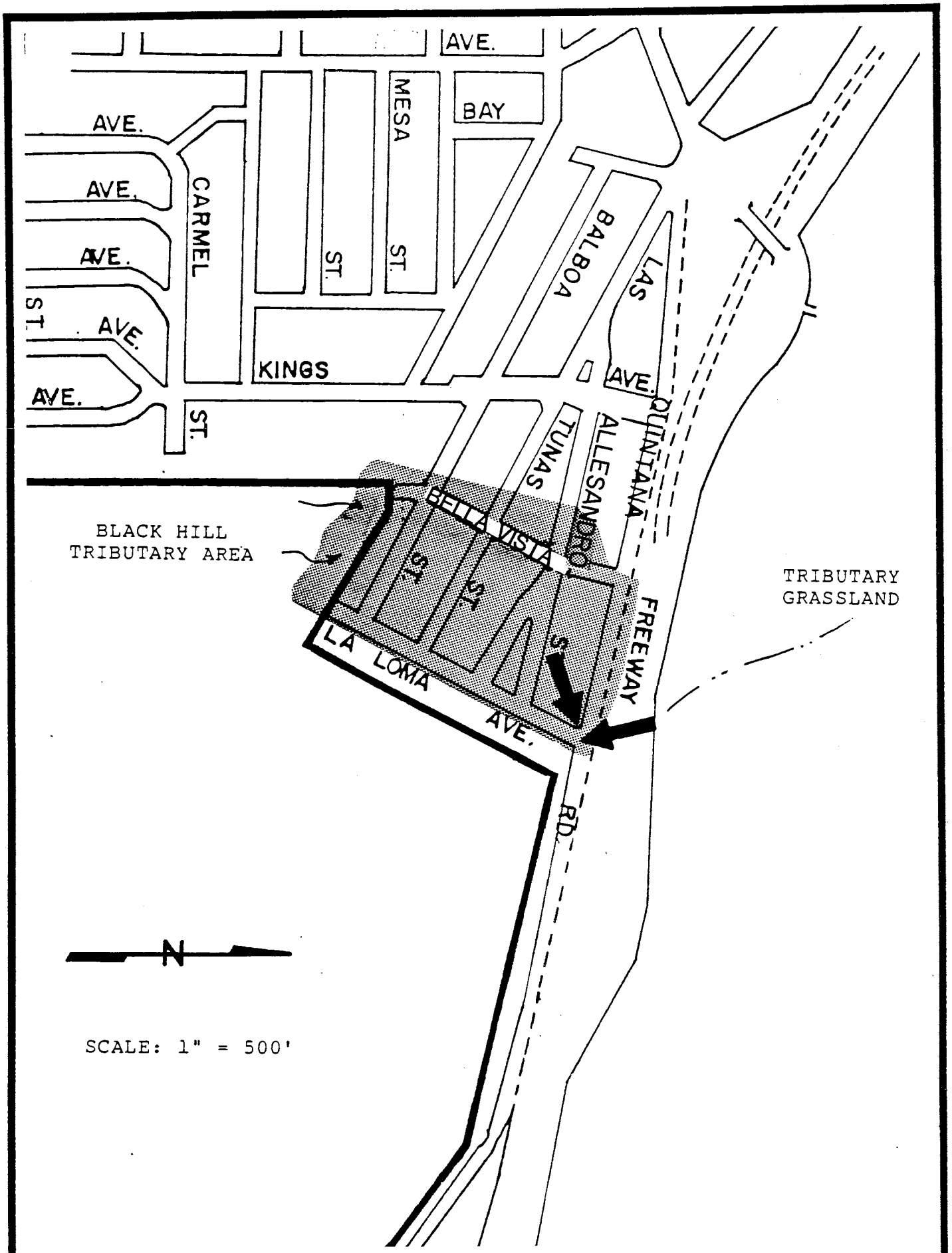
HYDROLOGY:

Quintana Road:

Q10 = 15 cfs Q25 = 17 cfs Q100 = 22 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 41
	QUINTANA ROAD – BELLA VISTA TO LA LOMA AVE	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 42
	QUINTANA RD – BELLA VISTA TO LA LOMA AVE	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 20
QUINTANA ROAD - BELLA VISTA TO LA LOMA
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	18" RCP STORM DRAIN PIPE	790	Lin. Ft.	$60.00	$47,400.00
2	27" RCP STORM DRAIN PIPE	50	Lin. Ft.	$73.00	$3,650.00
3	33" RCP STORM DRAIN PIPE	30	Lin. Ft.	$95.00	$2,850.00
4	CATCH BASINS - TYPE I	3	Each	$1,700.00	$5,100.00
5	CATCH BASIN - TYPE II	1	Each	$2,100.00	$2,100.00
6	REMOVE EXISTING CATCH BASINS AND PIPES	1		$800.00	$800.00
7	STORM DRAIN MANHOLE	2	Each	$2,500.00	$5,000.00
8	HEADWALL	1	Each	$3,000.00	$3,000.00
9	GRADE AND CLEAR CHANNEL	1		$2,500.00	$2,500.00
10					
	CONSTRUCTION SUBTOTAL				$72,400.00
	DESIGN @ 10% OF CONSTRUCTION SUBTOTAL				$7,240.00
	SUBTOTAL				$79,640.00
	CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL				$11,946.00
	PROJECT SUBTOTAL				$91,586.00
	PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL				$9,158.60
	TOTAL PROJECT COST				$100,744.60

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 21

QUINTANA ROAD - WEST OF SOUTH BAY BOULEVARD

This watershed is composed of mostly undeveloped rangeland north of the freeway. The flow is picked up and carried under the freeway via a 48" culvert which outlets to a natural channel and flows toward Quintana Road. At Quintana Road is a 24" culvert and driveways on the north side of the street both above and below this crossing. The driveways are from a funeral home and a church parking lot respectively. These are the only building improvements in the watershed. The area on the south side of Quintana Road is State Park land and contains a natural drainage course.

DRAINAGE PROBLEM:

The narrow area between the freeway and Quintana lacks defined drainage courses and flow spills across the roadway to the south. Erosion is taking place along the northerly edge of the shoulder. The culvert under Quintana Road at this location is inadequate. It is silted up halfway and sits in a hole below the elevation of the confluence of the two drainage courses a few feet away. In addition, the driveways from the church and funeral home send sheet flow across the paving of Quintana road instead of into the drainage way and culvert adjacent to them. As a result, more water than is necessary flows easterly along Quintana toward South Bay Boulevard or across the roadway to the south.

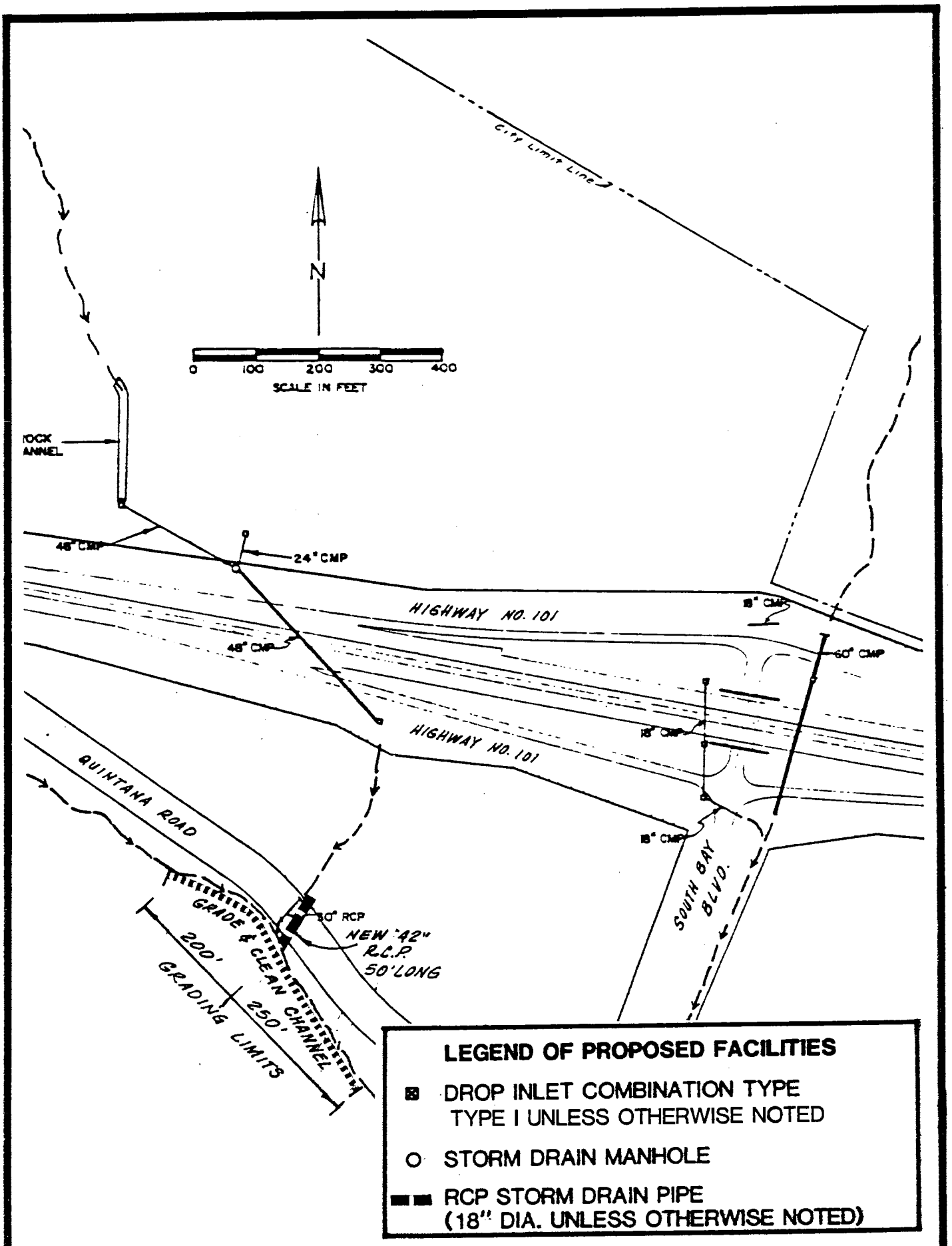
POTENTIAL SOLUTIONS:

1. Replace the existing 30" culvert with a 42" RCP and rebuild the channel confluence. This vegetated area would need to be cleaned out and rip-rap or gabion channel lining used to define and contain the flow. Grading along the north shoulder of Quintana can reduce spill over and erosion. Slight modifications of the driveways directing flow into the drainage way can reduce sheet flow across the roadway.

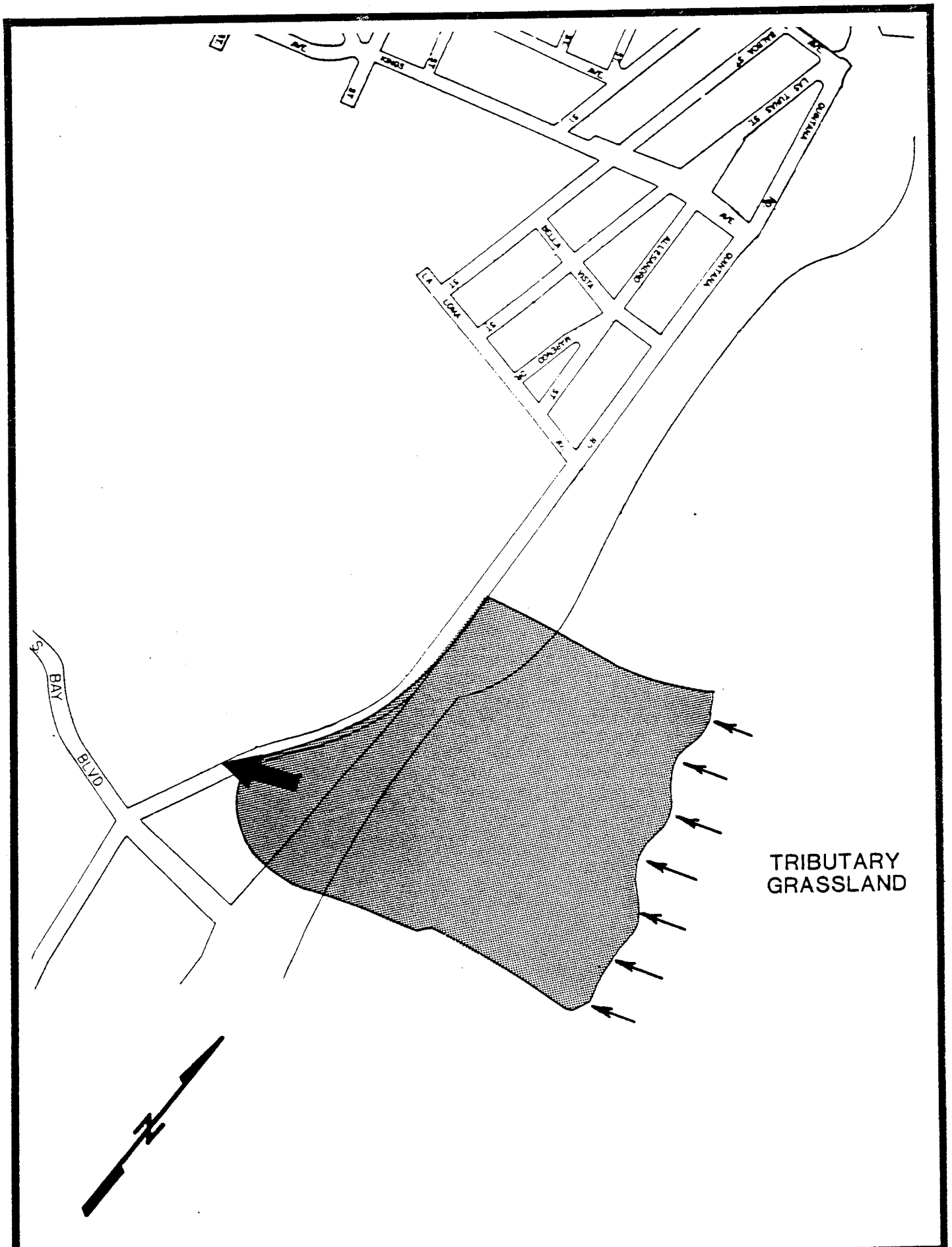
HYDROLOGY:

CROSSING AT QUINTANA RD.:

Q10 = 65 cfs Q25 = 74 cfs Q100 = 95 cfs



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 43
	QUINTANA RD. - WEST OF SOUTH BAY BLVD.	



JOHN L. WALLACE & ASSOCIATES	MORRO BAY STORM DRAIN MASTER PLAN	FIGURE VIII 44
	QUINTANA RD. - WEST OF SOUTH BAY BLVD.	

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 21
QUINTANA ROAD WEST OF SOUTH BAY BOULEVARD
COST ESTIMATE

July 1987

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
1	42" RCP STORM DRAIN PIPE CULVERT AND HEADWALLS	50	Lin. Ft.	$180.00	$9,000.00
2	CLEAN AND GRADE CHANNELS	1	Each	$12,000.00	$12,000.00
3	ROADWORK SHOULDERS AND SLOPE DRIVEWAYS TO CHANNEL	1		$4,000.00	$4,000.00
4					
5					
6					
7					
8					
9					
10					
	CONSTRUCTION SUBTOTAL				$25,000.00
	DESIGN @ 10% OF CONSTRUCTION SUBTOTAL				$2,500.00
	SUBTOTAL				$27,500.00
	CONTRACT ADMINISTRATION @ 15% OF SUBTOTAL				$4,125.00
	PROJECT SUBTOTAL				$31,625.00
	PROJECT CONTINGENCIES @ 10% OF PROJECT SUBTOTAL				$3,162.50
	TOTAL PROJECT COST				$34,787.50

ENR INDEX = 4387 (BASE YEAR, 1913 = 100)

CITY OF MORRO BAY
STORM DRAIN MASTER PLAN

PROJECT NUMBER 22

TWIN BRIDGES AT SOUTH BAY BOULEVARD

This watershed is drains an area generally east of the City which contribute a very large portion of the flow to the Morro Bay estuary via Chorro Creek. As the creek nears the easterly edge of the City it changes direction and flows to the south around Black Hill. Parallel to the base of Black Hill is South Bay Boulevard, a major thoroughfare between Highway One and the State Park and the Los Osos-Baywood Park community. Chorro Creek crosses under South Bay Boulevard at a location called Twin Bridges. This road is frequently closed to traffic because of flooding during the larger storms. Presently, there is a County bridge replacement project under consideration which will reduce flooding, improve road alignment, and increase storm water carrying capacity. However, this project area is in an Environmentally Sensitive Habitat and therefore requires extensive studies and environmental review before any design can be implemented. The design will be done by the County Engineering Department and the project financing will be from Federal, County, and City funds. Because there are many governmental agencies involved it is expected that it will be at least two or three years before the project is built.

DRAINAGE PROBLEM:

Besides the problem of inadequate capacity at Twin Bridges as described above, there are two situations that have begun to occur in the Chorro Creek flow routing. One, Chorro Creek appears to have moved part of its main channel closer to South Bay Boulevard upstream of the Twin Bridges location. If this movement continues it could endanger the roadway itself. Secondly, the meandering creek appears to have rerouted its flow to only the most northerly of the Twin Bridges. After it flows under the northerly bridge it reverses direction and flows back toward the abutment of the southerly bridge. This may not be a problem when the above mentioned project is completed but in the meantime the City should observe the situation in case it worsens.

POTENTIAL SOLUTIONS:

The Twin Bridges - South Bay Boulevard problem area analysis is considered outside the scope of this report because of the pending involved studies and County project. However, it is presented here so that the City is aware of the situation and can present these concerns as design considerations in the overall project. The City should be cognizant that if these items are

not taken care of in the pending bridge/roadway alignment project then it may have a considerable cost expense to protect South Bay Blvd. in the future.