Master Drainage Plan for the City of Palm Desert

March 1993

Prepared by :

NBS LOWRY

ENGINEERS & PLANNERS

EXECUTIVE SUMMARY

This Master Drainage Study has been prepared for the City of Palm Desert to achieve the following objectives:

- To document the status of existing runoff and flooding conditions within a 26-square-mile study area of the existing City Boundary and sphere of influence.
- To identify and evaluate alternatives for providing 25-year flood protection.
- To identify improvements needed to implement the recommended alternative facilities and investigate retention basins for 10-, 25-, 50-, and 100-year storms.
- To develop cost estimates and preliminary engineering design data for the recommended flood protection plan.

I. EXISTING RUNOFF AND FLOODING CONDITIONS

Runoff modeling was performed using the Rational Method under the guidelines of the Riverside County Flood Control and Water Conservation District Hydrology Manual. A runoff analysis was developed for the study area for both the 25-year and the 100-year storms.

II. 25-YEAR FLOOD PROTECTION ALTERNATIVES

Alternatives were then considered for providing 25-year flood protection. These alternatives included:

1. Cast-in-place concrete pipe. Due to the nature of soils in the study area, this alternative was not recommended,however if the situation warrants,this alternative should be investigated.

2. Concrete-lined corrugated steel pipe. Available engineering data indicated a short life expectancy for this type of pipe. Therefore, its use was not recommended.

3. Reinforced concrete pipe. Recommended for the 25-year flood protection. The combination of reinforced concrete pipe and concrete-lined channels (designed for a 100-year flood) represents the most cost effective system.

III. REQUIRED IMPROVEMENTS TO IMPLEMENT RECOMMENDED ALTERNATIVE FACILITIES

Improvements were then identified and developed based on the selection of the reinforced concrete "multi-type" conveyance system. A complete system of pipelines, a major channel, and retention basins along with their costs were developed for budgetary and preliminary layout purposes. Within the study area two distinct areas of special attention have been encountered: the hillside area west of the Palm Valley Channel and the area south of the Deep Canyon Channel.

Installation and maintenance of facilities in the hillside area west of the Palm Valley Channel could become costly and very difficult to maintain because of the terrain. This area, unlike the remaining portion of undeveloped land in the City, does not possess the potential for major development.

Each development in the hillside area shall be responsible for handling their on-site and off-site drainage to the satisfaction of the City. The need for protection of downstream properties and developments is paramount, and a storm water mitigation plan must be reviewed and approved by the City prior to construction. The cost of such facilities must be borne entirely by the developer.

In areas where it is expected that a high debris load or other special flood hazards will be encountered, special design criteria must be considered by the City. Those criteria

may include (1) 100-Year storm runoff; (2) design capacity of drains, channels and other facilities increased by 100%; (3) maximum allowable flow velocity of 15 feet per second; and (4) open channel flow conditions throughout the system.

The construction of debris basins within this area will not only have to answer the questions of safety and maintenance, but also the potential of pollutants settling in the debris basin. The EPA and the State Department of Water Resources criteria must also be met in regards to debris basin discharge.

The southern area also presents a dilemma for proposed facilities in that the Deep Canyon Channel, the major conveyance system in this area, will not accept any additional runoff generated from development. Consequently, any further development in this area will be forced to retain all the incremental runoff produced within that specific development.

IV. COST ESTIMATES AND PRELIMINARY ENGINEERING DESIGN DATA

To facilitate the development of system alternatives and their costs, the study area was divided into four zones. These four zones are delineated by the following boundaries; Zone 1: Deep Canyon, Palm Valley and Whitewater Channels and the westerly City limits, Zone 2: The Whitewater Channel, The Palm Springs Ridge Line and the easterly and westerly City limits, Zone 3: The Palm Springs Ridge Line, Interstate 10, Monterey Avenue and the easterly limits of the Sphere of Influence, Zone 4: The area north of Interstate 10 and the east line of sections 22, 27 and 34.(Reference Only)

The construction cost of the recommended facilities to provide 25-year flood protection and, in a unique circumstance, 100-year flood protection in Zones 1, 2 and 3 and

excluding the Mid-Valley Channel is estimated at $23,295,129. The area south of I-10 and north of the Palm Springs Ridge Line has been studied for a 100-year storm based upon the design criteria developed by the Coachella Valley Water District. This area will accommodate the Mid-Valley Regional Channel. A 100-year storm event is the criterion for design of this regional facility and its tributaries. Within the study area two distinct drainage basins exist. The area south of the Palm Springs Ridge Line and north of the Deep Canyon Storm Channel drains to the Whitewater Channel. The area north of the Palm Springs Ridge Line drains to the proposed Mid-Valley Channel. The total assessable acres within the study area is 4890 acres.

The drainage fee established by Resolution 92-51 and Ordinance 653 for Zone 1 is $4,000 per acre, for Zone 2, $1,500 per acre and for Zone 3, $1,000 per acre. This cost is tied to the Engineering News-Record 20 cities index for January 1, 1992. Drainage Fees will become effective by September 1, 1992.

CONCLUSIONS

The recommendations made in this report are based on the following conclusions:

1. The Master Drainage Plan Description summarizes runoff quantities computed using Rational Method of Hydrology for a 25-year storm, with the exception of the area tributary to the Mid-Valley Storm Channel which was analyzed for a 100-year storm.

2. The Master Drainage Plan Description shows the recommended alternative, including design flows for all proposed drainage facilities.

3. The Recommended Master Plan facilities and their costs are itemized in the Master Drainage Plan Description.

4. The total drainage fee per acre for all recommended facilities for a 25-year design frequency (with a 100-year design frequency for the Mid-Valley Channel) is $4,000 per acre for Zone 1, $1,500 per acre for Zone 2 and $1,000 per acre for Zone 3.

RECOMMENDATIONS

The following recommendations are made:

1. Adopt revised fee schedules as supported by this Master Plan of Drainage.

2. Capital improvement plans for drainage improvements be developed using the Master Drainage Plan Description.

3. Construction of Master Plan facilities associated with the proposed Mid-Valley Channel be incorporated in the design of the Mid-Valley Channel.

4. The problem areas in the southern region bounded by the Whitewater Channel, the Palm Valley Channel, the Deep Canyon Channel and Indian Wells on the east of the City be the highest priority with the implementation of the Master Drainage Plan.

RESOLUTION NO. 92-51

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF PALM DESERT, CALIFORNIA, APPROVING A MASTER DRAINAGE PLAN FOR THE CITY OF PALM DESERT AND AUTHORIZING IMPLEMENTATION OF SAID MASTER DRAINAGE PLAN.

WHEREAS, in May of 1990, the City Council authorized NBS/Lowry, Incorporated, to develop a citywide master drainage plan studying both the incorporated areas of the city and its spheres of influence; and

WHEREAS, the City Council did on the 11th day of July, 1991, hold a duly noticed public hearing and a continued public hearing on the 23rd day of January, 1991, in order to consider said citywide master drainage plan; and

WHEREAS, after considering testimony and arguments presented at the public hearing, the City Council found that the following facts and reasons justify approval of the drainage plan.

1. The City's growth requires an updated citywide master drainage plan.

2. The proposed drainage plan expands and modifies the results of previous studies, and provides a means of coordinating drainage aspects of pending developments and also creates a mechanism for evaluating the impact of storm water runoff.

3. The proposed drainage plan is consistent with the goals, objectives, and policies of the City's general plan, its current zoning and land use regulations, and modern engineering practice.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Palm Desert, California, as follows:

1. That the 1992 citywide master drainage plan prepared by NBS/Lowry, and described above, is hereby approved and adopted for the reasons set forth in this resolution.

2. Immediate implementation of said master drainage plan is necessary to ensure a comprehensive and sufficiently funded program for the development of adequate drainage facilities to serve the city and its spheres of influence.

3. Funding sources for completion of the citywide master plan will be established as part of the budget process.

4. The City may impose additional or reduced fees on a case-by-case basis where a need for such additonal or reduced fee is demonstrated as required by Government Code Section 66001.

PASSED, APPROVED AND ADOPTED at a regular meeting of the Palm Desert City Council, held on this 11 day of June, 1992, by the following vote, to wit:

AYES:	Benson, Crites, Snyder, Kelly
NOES:	None
ABSENT:	Wilson
ABSTAIN:	None

RICHARD S. KELLY, Mayor
City of Palm Desert, California

ATTEST:

SHEILA R. GILLIGAN, City Clerk
City of Palm Desert, California

EACH DOCUMENT TO WHICH THIS CERTIFICATE IS ATTACHED, IS CERTIFIED TO BE A FULL, TRUE AND CORRECT COPY OF THE ORIGINAL ON FILE AND ON RECORD IN MY OFFICE.

Dated: 07/31/92

SHEILA R. GILLIGAN, City Clerk
City of Palm Desert, California

By Mary S. Hays Deputy

ORDINANCE NO. 653

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF PALM DESERT, CALIFORNIA, AMENDING SECTION 26.49.050 OF THE PALM DESERT MUNICIPAL CODE RELATING TO DRAINAGE FEES.

WHEREAS, Section 26.49.050 of the Palm Desert Municipal Code provides for drainage fees by area, as authorized by Section 66483 of the Government Code; and

WHEREAS, changes in construction costs have occurred since drainage fees were last adjusted by the City Council on the 9th day of July, 1987; and

WHEREAS, notice of the public hearing at which this ordinance is considered has been given accordance with Government Code Section 66016(a).

NOW THEREFORE, the City Council of the City of Palm Desert, California, DOES ORDAIN as follows:

SECTION 1: The City Council finds and determines as follows:

a. The amount of the drainage fees adopted pursuant to this ordinance does not exceed the estimated cost of providing the services for which the fees are imposed.

b. The subdivision and development of property within the City's drainage areas will require construction of the facilities described in the City's master drainage plan.

c. The fees recommended by the master drainage plan, which was adopted by the City Council on the 23rd day of January, 1991, are fairly apportioned within the City's drainage areas both on the basis of benefits conferred on property proposed for subdivision and on the need for such facilities created by the proposed subdivision and development of other property within such areas.

d. The City Council makes these findings based on the estimated cost of constructing the facilities for which such drainage fees are imposed and that, in accordance with Government Code Section 66016(a), this data has been on file for at least 10 days prior to the public hearing at which this ordinance is considered.

SECTION 2: That Section 26.49.050 of the Palm Desert Municipal Code be amended to provide as follows:

"26.49.050 Establishment of Off-site Drainage Fees. There is hereby established on off-site drainage fee of four thousand dollars ($4,000) per acre for land in the areas of the City designated as Zone 1, one thousand five hundred dollars ($1,500), in Zone 2 by the City's master drainage plan, which is incorporated herein by this reference.

There also is established an off-site drainage fee of one thousand dollars ($1,000) per acre for land in the areas of the City designated as Zone 3, and by the City's master drainage plan. The amount of fee shall be calculated on full and partial acres, carried to the nearest 100th of a percentage. In the case of land to be subdivided, the fee shall apply for any and all uses to which the land may be put. In the case of construction or improvement of subdivided land, the fee shall apply only to new commercial, industrial, professional, group dwelling, or community facility use (see Section 25.56.080 of this code). Said fees shall be collected, deposited, and expended pursuant to Section 66483 of the Government Code of the State of California and all other applicable laws of the State of California. All necessary drainage fees established by the City of Palm Desert shall be deposited with the City prior to approval of the final map in the case of land being subdivided, or prior to issuance of a building permit in the case of construction or improvement or subdivided land. The City shall have the right, in lieu of accepting cash, to accept any other proper and valid consideration as may be determined by the City." Fees imposed pursuant to this section are the amounts necessary for the purposes set forth in the City's master drainage plan. The City may impose additional or reduced fees on a case-by-case basis where a need for such additional or reduced fee is demonstrated as required by Government Code Section 66001.

SECTION 3: The City Clerk shall certify to the passage and adoption of this ordinance and shall cause the same to be published once in the Palm Desert Post, a newspaper of general circulation, printed, published, and circulated within the City of Palm Desert, and the fees imposed by this ordinance shall become effective sixty (60) days after its adoption.

PASSED, APPROVED, and ADOPTED on the 25th day of June, 1992, by the City Council of the City of Palm Desert, California, by the following vote, to wit:

AYES: BENSON, CRITES, SNYDER, KELLY
NOES: NONE
ABSENT: NONE
ABSTAIN: WILSON

RICHARD S. KELLY, Mayor
City of Palm Desert, California

ATTEST:

SHEILA R. GILLIGAN, City Clerk
City of Palm Desert, California

THE DOCUMENT TO WHICH THIS CERTIFICATE IS ATTACHED IS CERTIFIED TO BE A FULL, TRUE AND CORRECT COPY OF THE ORIGINAL ON FILE AND OF RECORD IN MY OFFICE

Dated: 07/31/92

SHEILA R. GILLIGAN, City Clerk
City of Palm Desert, California

By: Mary C. Hazi, Deputy

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GLOSSARY OF TERMS

CFS	Cubic Feet Per Second
Drainage Area	The area that contributes storm flows to a specific concentration point, or storm drain system
Hydrology	A multi-disciplinary subject dealing with the occurrence, circulation, and distribution of the waters of the Earth.
Peak Discharge	The highest rate of storm runoff expressed in cubic feet per second.
RCP	Reinforced Concrete Pipe
Sub Area	A smaller tributary area located within a drainage area.
25 & 100 year storm	An annual maximum event whose peak discharge is equaled or exceeded once, on the average, every 25 or 100 years, respectively.
Standard Project Flood	The discharge that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographical region involved.

INTRODUCTION

AUTHORIZATION

In 1990, the City of Palm Desert authorized NBS/Lowry, Incorporated to develop a Citywide Master Drainage Plan.

The purpose of the authorization was to provide a comprehensive long-range plan for the development of drainage facilities within the corporate limits of the City, as well as the areas within the City of Palm Desert's sphere of influence.

SCOPE OF WORK

The authorization given by the City of Palm Desert limited the scope of this study to the existing incorporated area of the City, as well as the areas within the City of Palm Desert's sphere of influence. These areas will be segregated into four distinct zones as follows:

Zone I	South of the Whitewater Channel
Zone II	North of the Whitewater Channel to the Palm Spring Ridge Line
Zone III	Palm Springs Ridge Line to Interstate 10
Zone IV	Interstate 10 to Ramon Road(Reference Only)

These zones have been studied on the basis of existing development and drainage facilities, drainage facilities as planned in the existing master drainage plans, and projects which our research indicates to be constructible in the immediate future.

The scope of the following investigation is intended to optimize the value of the previous studies through the expansion and modification of their results to develop a comprehensive drainage plan consistent with the City's adopted general plan, current zoning and land use, and with current engineering practice.

HISTORIC BACKGROUND

Historically, two generally distinct flood control problems have existed in the Coachella Valley. The first involves runoff from the storms occurring in adjacent mountain ranges. Stormwater from watersheds in the San Bernardino, San Jacinto, Santa Rosa and Little San Bernardino mountain ranges is carried into the valley via the Whitewater River and its tributaries. Heavy rainfall in these mountainous areas, combined with the spring

snowmelt, has contributed to major floods in 1916, 1927, 1938 and again in the late 1960's, 1970's, 1980's.

The second type of drainage problem is that resulting from storms occurring primarily over the valley floor. While runoff quantities from these storms are relatively small in comparison with those generated in the watersheds of the adjacent mountain ranges, they are of importance in planning a drainage system because of their intensity. This type of high-intensity, short-duration storm activity caused substantial damage in the Palm Desert area in 1948 and again in 1951.

There are three distinct types of storms that occur in the Coachella Valley. The summer storm poses a greater threat of flooding to the valley than a winter storm because of its high intensity and short duration of rainfall. The September 1976 storm that pounded Palm Desert was a summer type storm. The eccentricity of this type of storm can be illustrated by the fact that Rancho Mirage, Indian Wells and La Quinta suffered no significant damages during the September 1976 storm, while Palm Desert experienced extensive damage.

The winter storms are more evenly spread over a wide area and generally tend to drop more substantial rain than the summer type storms. The winter storms come primarily from the North Pacific; and if tropical disturbances are right, they can pick up moisture from the south. The 1916 flood was the most noticeable storm of this type. The third type of storm, the spring storm, stems from melting snow combined with rainfall to produce significant runoff down the canyons. This type of storm has limited impact on the City of Palm Desert.

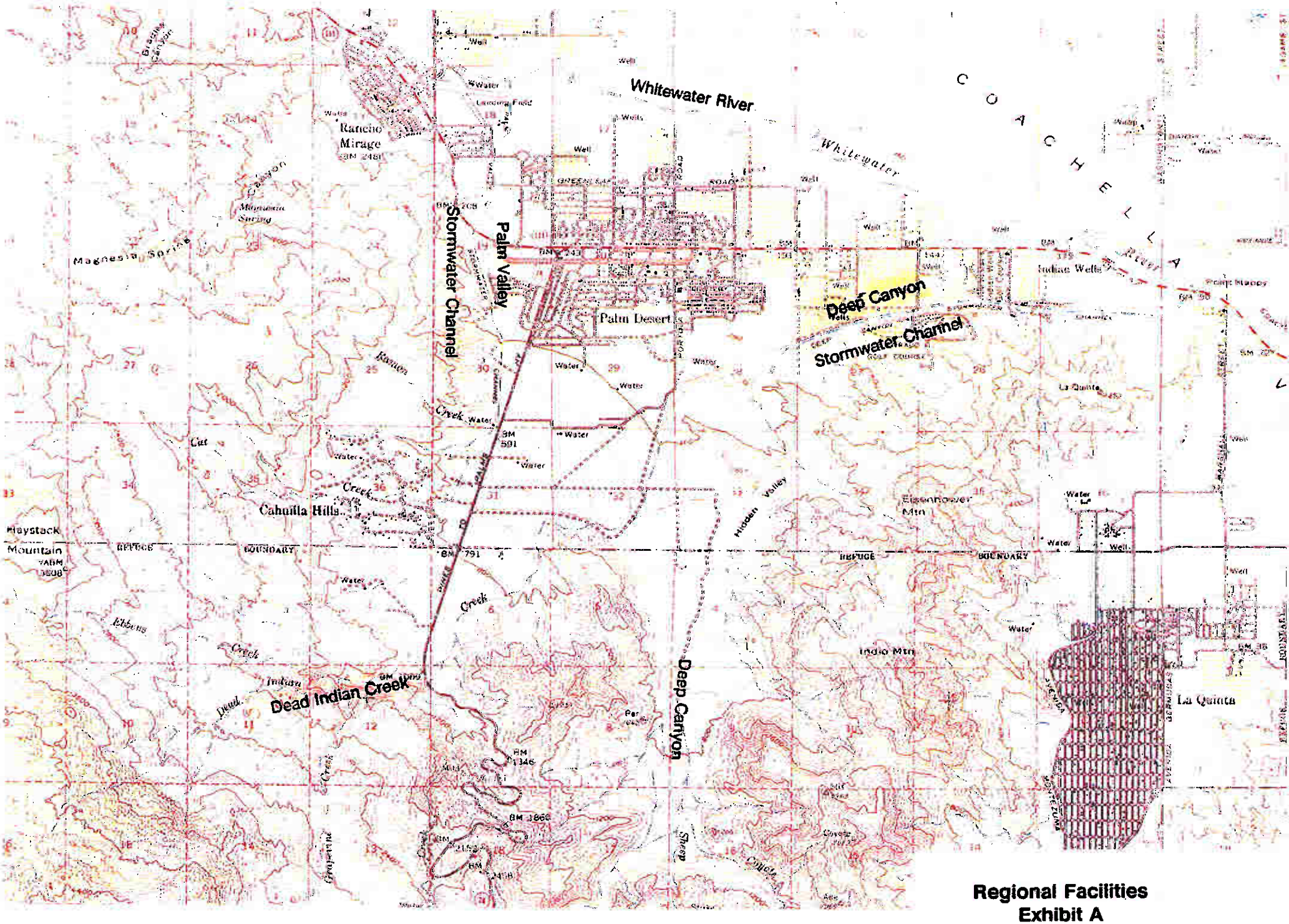
The first organized effort to control flooding in the Coachella Valley was made by the Indio Levee District. The merger of the Indio Levee District and the Coachella Stormwater District in 1915 resulted in the organization of the Coachella Valley Stormwater District. Three years later the Coachella Valley County Water District was formed as a vehicle to conserve local water resources and to contract for supplemental water from the Colorado River. The activities of the County Water District and the Stormwater District were in some respects duplicated and in conflict; consequently, in 1937 the two districts were merged. The Coachella Valley County Water District, as the surviving agency, assumed responsibility for regional flood control in the southern and central portions of the Coachella Valley.

As the Palm Desert area began to develop, the Coachella Valley County Water District, in conjunction with developers, constructed a number of facilities to protect the area from runoff generated in adjacent mountain canyons. In 1940, the Coachella Valley County Water District completed the Deep Canyon Stormwater Channel. This channel, along with a series of dikes and a spreading area, were constructed to divert major storm flows around Palm Desert to the Whitewater Channel near Point Happy about three and one-half miles east of the present City limits.

Construction of the Palm Valley Stormwater Channel was completed in December 1983. The construction of this facility, adjacent to the westerly City Limits of Palm Desert, provides for the diversion of stormwater produced in the mountain regions westerly of the channel. Prior to 1983, a dike was constructed south of the Ironwood Country Club to divert stormwaters from Dead Indian Canyon around Palm Desert.

Together, the Whitewater, Palm Valley and Deep Canyon Stormwater Channels and their appurtenant facilities serve as the City's primary protection against major flood damage. (See Exhibit A) No further development of regional facilities has occurred within the City limits with the exception of a planning study by the Coachella Valley Water District for the Mid-Valley Stormwater Channel paralleling Interstate 10.

In contrast, there has been an effort by the City to control localized flooding by implementing the recommendations of Master Drainage Plans prepared in 1976, 1979, and 1987.Examples of these efforts are the construction of the Fred Waring storm drain in 1985, the South Portola storm drain in 1987, the North Portola storm drain in 1989 as well as other local drainage facilities. Many of the provisions of these plans remain valid and have, to the extent applicable, been included in the current Citywide Master Drainage Plan.



Regional Facilities
Exhibit A

MASTER DRAINAGE PLAN BOUNDARIES

CITY BOUNDARY

The City of Palm Desert lies southerly of Interstate 10 to the base of the Santa Rosa Mountains. The east-west boundaries of the City vary from Monterey Avenue to Eldorado Drive, north of the Whitewater Channel, the Palm Valley Channel to the City of Indian Wells western boundary, south of the Whitewater Channel.

The sphere of influence extends beyond the City boundary in both the northern area and southern area of the City. A large portion of the sphere of influence extends well into the Santa Rosa Mountains with the Dead Indian Canyon and the Deep Canyon serving as major floodways in this area. The study area, which is divided into four drainage zones, encompasses a total area of approximately 16,700 acres.

WATERSHED BOUNDARY (See Exhibit 1)

The watershed boundaries are divided into four distinct zones. The zones are generally bounded by the City's corporate limits or sphere of influence and further geological or manmade boundaries.

- Zone 1. This region is located south of the Whitewater Channel. This area is considered the "original" City limits. Flows in this region generally tend to flow northeasterly to the Whitewater Channel, with the exception of areas west of Monterey Avenue which drain into the Palm Valley Channel. This region is dominated by residential development, both single-family and multi-family dwellings. There are some commercial developments in this zone located predominately along Highway 111 and El Paseo. There is approximately 580 acres of undeveloped land within Zone 1.

  Within the study area two distinct areas of special attention have been encountered: the hillside area west of the Palm Valley Channel and the area south of the Deep Canyon Channel. The hillside area has special interest due to the terrain. Installing and maintaining facilities in this area could become costly and very difficult to maintain. This area, unlike the remaining portion of undeveloped land in the City, does not possess the potential for major development. The lack of useable land and the rugged terrain limits the development potential in this area.

  Each development in the hillside area shall be responsible for handling their on-site and off-site drainage to the satisfaction of the City. The need for protection of downstream properties and developments is paramount, and a storm water mitigation plan must be reviewed and approved by the City prior to construction. The cost of such facilities must be borne entirely by the developer.

Any facility in a hazardous area or areas with a potential for high debris loads must be designed using special design criteria resulting in increased costs. This special design criteria recommends design of drainage facilities for the 100 year flood,the capacity of all facilities increased to a factor of 100 percent, velocities in these facilities should not be less than 15 feet per second, and the system should be designed for open channel flow.

The construction of debris basins within this area will not only have to answer the questions of safety and maintenance, but also the potential of pollutants settling in the debris basin. The EPA and the State Department of Water Resources criteria must also be met in regards to debris basin discharge.

The southern area also has a dilemma for proposed facilities. The Deep Canyon Channel, the major conveyance system in this area, will not accept any additional runoff generated from development. Any further development in this area will be forced to retain all the incremental runoff produced within that specific development.

- Zone 2. This region is located south of the Palm Springs Ridge Line and runs to the Whitewater Channel. Monterey Avenue serves as the western boundary and the mid-section line of section 10 & 15 as the eastern boundary. The flow pattern from this zone is basically southerly, with minor deviations from east to west. Within Zone 2, approximately 1660 acres remain undeveloped.

  Development within this area is largely planned residential communities, mainly country club type developments, with golf courses and paved streets serving as the major conveyance of runoff. Within this region the following developments contain all runoff within their sites: Marriott Desert Springs Hotel & Spa, Lakes Country Club, and Palm Desert Greens. Other developments within this zone drain directly to the Whitewater Channel: Monterey Country Club, the Chaparral Country Club, and the Portola Country Club.

- Zone 3. This region is located north of the Palm Springs Ridge Line to the proposed CVWD Mid-Valley Channel. The western boundary of Zone 3 is Monterey Avenue, and the eastern boundary is Washington Street. This region is primarily undeveloped, approximately 2650 acres at present, although some large planned residential developments have been completed within this region: Desert Falls, Avondale, and Palm Valley Country Clubs. The basic flow pattern in Zone 3 is northeasterly toward the proposed Mid-Valley Channel.

- Zone 4.(Reference Only) This region is located north of Interstate 10 with Ramon Road as the northern boundary and the eastern section line of sections 22, 27 and 34 as the eastern boundary. This region is primarily located on the large alluvial fan radiating from the Indio Hills to the north. Within Zone 4 approximately

1280 acres remain undeveloped. Development in this zone is, for the most part, planned residential, with country club type developments. Golf courses are surrounded by homes in these developments. The golf courses are used to contain the runoff for a 100-year storm within the development. The general flow pattern in this zone is to the south with I-10 serving as a levee prohibiting runoff from continuing southward. A retention basin will serve as a termination point for the runoff in this zone.

Zone 4 is located within an AO Flood Zone as designated on the National Flood Insurance Program, Flood Insurance Rate Map; panel 1625 of 3600, Riverside County, California as published by the Federal Emergency Management Agency. The flood depth within Zone 4 ranges from two feet at Interstate 10 to four feet at the mouth of Thousand Palms Canyon with velocities of flow ranging from six feet per second to nine feet per second within those same limits.

Any inquires in regards to drainage or development in this area or the Thousand Palms Study should contact CVWD for the appropriate information.

EXISTING DRAINAGE SYSTEM

EXISTING DRAINAGE STUDIES

Previous drainage studies have been performed for the City of Palm Desert at appropriate times of the city's expansion. A Master Drainage Plan conducted by I. Harold Housley and Willdan Associates in June 1976 encompassed the "original" City limits. These limits ranged from the Whitewater Channel south to the base of the Santa Rosa Mountains.

Some of the proposed facilities suggested in this study have been incorporated into drainage systems that exist today. In 1987, the $11 million South Portola Storm Drain facility with its tributaries was implemented, as was the Fred Waring Drive system in 1985. This study has incorporated these existing conditions with proposed additions.

A second study of Palm Desert was compiled in August 1979 by Willdan Associates. This study encompassed the northern limits of the City's expansion. The Whitewater Channel served as a southern boundary and Interstate 10 as a northern boundary. This area is divided into two distinct drainage areas by the Palm Springs Ridge Line that runs southeasterly through the City.

A third study was performed by Charles Haver and Associates in April 1987. This study involved the area south of the Palm Springs Ridge Line to the Whitewater Channel. At the time of the study much of this area had been developed, and the need for a drainage plan was evident.

A $2 million drainage facility completed in 1989, consists of a 96" Reinforced Concrete Pipe (RCP) north in Portola Avenue to Hovley Lane West,reducing to a 66" RCP. Future construction will extend a 36" RCP to Country Club Drive. An existing branch line on Hovley Lane West has been proven sufficient to convey the calculated flows.

REGIONAL DRAINS

The regional drains in the Palm Desert City limits include the Whitewater Channel, the Deep Canyon Channel, and the Palm Valley Channel. A proposed Mid-Valley Regional Channel by the Coachella Valley Water District will run parallel to the Southern Pacific Railroad tracks through the City of Palm Desert.

The Whitewater Channel is a major thoroughfare of runoff in the Coachella Valley. The Whitewater Channel is the primary outlet for runoff generated in drainage Zones 1 and 2.

The Palm Valley Channel runs in a northerly direction through the westerly part of Palm Desert. Its function is to drain areas to the southwest of the City limits and, for the most part, areas west of Monterey Avenue (State Route 74). This channel carries runoff into the Whitewater Channel.

The Deep Canyon Stormwater Channel runs northeasterly along the southeasterly edge of Palm Desert. Areas south of Haystack Road are drained into this channel, and the flows are carried northeasterly along the base of the mountains through Indian Wells to the Whitewater Channel.

A proposed regional drain, which will parallel the Southern Pacific Railroad, is the Mid-Valley Channel. This facility is designed to pick up runoff south of the Southern Pacific Railroad between Date Palm Drive in Catehdral City and Washington Street in Palm Desert. It will then continue along the same course collecting runoff south of the Southern
Pacific Railroad, between Washington Street and the Coachella Valley Storm Channel.

The Coachella Valley Water District, as the regional flood control agency, has the responsibility of maintaining and constructing these regional drains.

DRAINAGE SYSTEM ANALYSIS

METHODOLOGY

The hydrologic study performed in this Master Drainage Plan was completed under the guidelines of the Riverside County Flood Control and Water Conservation District (RCFC&WCD) Hydrology Manual. The procedures utilized are documented in the RCFC&WCD Hydrology Manual and incorporated into the computer Program RATRV.

The Rational Method is used to determine the peak discharge for drainage areas and is based on the equation:

$$Q = CIA$$

Where:

Q = Runoff (Cubic feet per second)
C = Coefficient of Runoff
I = Rainfall Intensity (Inches per hour)
A = Area of Land (Acres)

The Rational Method is a very conservative approach to runoff quantities due to the fact that the method calculates runoff using cumulative time of concentration in conjunction with individual sub-areas. This can be beneficial for its use in a Master Drainage Study; but for design calculations, a more precise hydrologic study should be used.

The coefficient of runoff is a ratio of storm water runoff rate to the rate at which rainfall occurs. The coefficient depends on the rainfall intensity, soil classification and cover, percentage of impervious areas, and antecedent moisture conditions.

PERCENT IMPERVIOUS AREA

LAND USE	RECOMMENDED RANGE	VALUE
Undeveloped	.00 - .10	0
Single Family - 1 acre lot	.10 - .25	.20
Single Family - 1\2 acre lot	.30 - .45	.40
Single Family - 1\4 acre lot	.45 - .55	.50
Multi - Family	.45 - .90	.75
Commercial	.80 - 1.00	.90

Rainfall intensity is a statistical result of recorded rainfall in a specific area. Rainfall research for the area in and around the City of Palm Desert yielded data from several rain gauges. The gauges in and around the City limits, however, only recorded long duration information. Therefore, short duration information from Cathedral City, Deep Canyon Lab, and the Thermal Airport was used to validate the assumption, by CVWD, that rainfall intensities for Cathedral City, as reported by the RCFC&WCD Hydrology Manual apply to the region.

HYDROLOGY STUDIES

This drainage study was developed using the Rational Method of Hydrology for the Riverside County Flood Control and Water Conservation District. The computer program RATRV was used to define pipe size and channel size for non-pressure flow. This analysis is based on the ratio of depth of flow to diameter of pipe being most efficient at 80%. The Manning's n value of .013 was used in this study which represents Reinforced Concrete Pipe.

Certain assumptions were made for drainage areas in the northern portion of the City based on Chapter 26.49 of the Palm Desert Municipal Code. Section 26.49.060, "Drainage Facilities," states:

> "Development of 10 gross acres or more shall provide sufficient on-site storm water retention and/or retardation so as to limit peak runoff occurring during a storm having 25-year intensity to a rate no greater than that which would have otherwise occurred under undeveloped conditions."

This report utilized Section 26.49.060 of the Palm Desert Municipal Code in the study of Zones 1 & 2; and, as a result, the quantities of flow were substantially reduced, thereby reducing drainage facility costs.

Zone 1, the area south of the Whitewater Channel, was studied to verify existing drainage facilities and to develop new facilities where needed. Upon development, land within this zone is currently subject to a drainage fee per acre of $3,200. Areas east of Portola Avenue have experienced some problems of flooding in the past. With this in mind, two new facilities, one along Deep Canyon Road and the other along the eastern City boundary, were developed to correct this problem and to reduce the amount of runoff into neighboring Indian Wells. Another problem in this zone occurs at Haystack Road and the open space east of Chia Drive. A sump condition exists in the open space. A culvert has been designed to alleviate this condition. A similar condition exists at Silver Spur Trail and Haystack Road. A culvert connecting to the Haystack Channel on the north side of Haystack Road has been designed to drain this area.

Zone 2, the area north of the Whitewater Channel and south of the Palm Springs Ridge Line, was studied utilizing the criteria of Chapter 26.49 of the Palm Desert Municipal Code. The existing drainage fee in this area is $4,000 per acre. The drainage areas in this region were studied as being of undeveloped nature. This assumption is justified by the fact that each development of 10 acres or more will retain the incremental difference in runoff quantities between developed and undeveloped conditions.

Zone 3, the area north of the Palm Springs Ridge Line and south of Interstate 10, drains northeasterly to I-10. This area has an existing drainage fee of $4,000 per acre. The proposed Mid-Valley Channel that parallels I-10 will pick up runoff in this region. The Coachella Valley Water District will be responsible for maintenance of this channel.

CVWD requires developments in this region to retain 100% of a 100- year storm. The Mid-Valley Channel is designed to collect only street runoff, however, on-site drainage may be released into the channel over a five day period. With this design requirement in mind, the City of Palm Desert must address the issue of the Palm Desert Municipal Code regarding incremental runoff retention. This drainage region was studied with street right-of-way serving as sub-area limits, to abide by the criteria set forth by CVWD.

Zone 4,(Reference Only) the area North of I-10 to Ramon Road, is another drainage area that was studied under the design criteria of CVWD. As required by CVWD, any development within a floodplain must not add to flows of a 100-year storm. Therefore, the incremental increase of a 100-year storm must be retained on-site. Developers in this zone designed facilities to retain 100% of the on-site runoff from a 100-year storm.

These developments, Tri-Palms, Ivey Ranch and the proposed North Star Development, all pass the historic flows through their sites but maintain complete retention of runoff accumulated on-site.

FUTURE DRAINAGE SYSTEM

ZONE 1

Zone 1 is bounded on the east and west sides by the City limits, on the north by the Whitewater Channel, and on the south by the Deep Canyon Storm Channel (see Exhibit 2).

- Drainage Area #1A (See Exhibit 2.1A)

  This drainage area runs north from Cahuilla Way to the Whitewater Channel, is bounded on the west by the Palm Valley Channel and on the east by Monterey Avenue (State Route 74). The proposed facilities south of El Paseo convey runoff, heading north on State Route 74, at intermittent pick-up points to the Palm Valley Channel. These lines are Line 1A-3, Line 1A-4, Line 1A-5 and Line 1A-6. Line 1A-2 conveys runoff from El Paseo, just south of Route 111 to the Palm Valley Channel. Line 1A-1 is a proposed system to carry runoff along Fred Waring Drive, west of Monterey Avenue, to the Palm Valley Channel. There are two existing drainage facilities in this area: a private line conveying flows from the Palm Desert Town Center to the Palm Valley Channel and a system along the southerly property line south of Hedgehog Street. Both lines are adequate for the conveyance of the 25-year storm.

- Drainage Area #1B (See Exhibit 2.1B)

  This drainage area is bounded on the east by the Palm Valley Channel and on the west by the City boundary. The northern boundary is Park View Drive and the southern boundary is at the intersection of the Palm Valley Channel and the western City limit. This area consists of relatively flat terrain in the north and hillside in the south. Two systems have been designed for this region. The Joshua Road storm drain (Line 1B-1) is a designed facility to convey runoff in the Joshua Road area to the Palm Valley Channel. The Paradise Palms Hotel storm drain carries flows from Painters Path to Fred Waring Drive. This designed system will head east in Fred Waring Drive and terminate in the Palm Valley Channel. Both of these systems are adequate to convey the 25-year storm to the Palm Valley Channel and will relieve this area of the troublesome runoff. No facilities have been developed for the hillside area due to the difficulty of maintenance and other factors, as previously discussed in this report.

- Drainage Area #1C (See Exhibit 2.1C)

  Drainage area #1C is located south of Haystack Channel and north of the Dead Indian Canyon. State Route 74 is the western boundary, and Indian Wells is the

eastern boundary of this drainage area. Lines 1C-3 and 1C-4 are existing facilities that convey runoff to the Haystack Channel from the western two-thirds of this drainage area. Proposed Lines 1C-1 and 1C-2 are culverts to convey the overland flows under Haystack Road to the Haystack Channel.

- Drainage Area #1 (See Exhibit 2.1)

This area's boundaries extend from just west of Monterey Avenue to just East of San Pascual Avenue, with the Whitewater Channel on the north and El Paseo on the south, with a small area along the Pines to Palms Highway in the south.

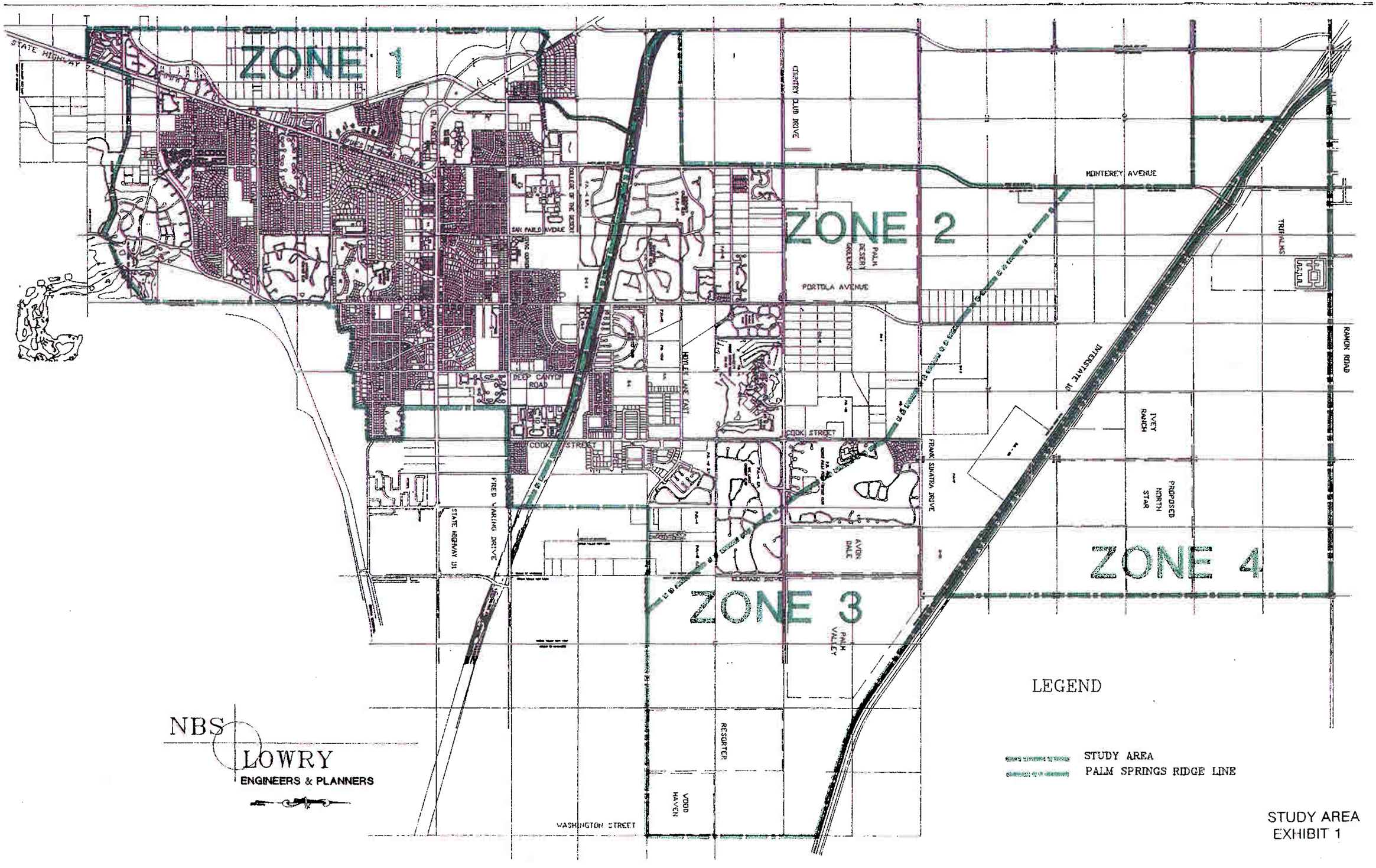
The facilities mentioned below are existing for this drainage area. The main line in this area is an existing facility designed to carry runoff down Fred Waring Drive (Line 1-2) to the San Pascual Channel (Line 1-7). Line 1-1 carries runoff on Monterey Avenue south to Line 1-2. Another tributary to Line 1-2 is Line 1-3 which conveys runoff north on San Anselmo Avenue. The largest tributary of Line 1-2 is Line 1-4. This line picks up runoff on Palm Desert Drive, conveys the flows to San Pablo Avenue, and continues north until it reaches Line 1-2. Line 1-5 conveys runoff from the College of the Desert south on San Pablo Avenue until it reaches Line 1-2. Flows from Catalina Avenue are conveyed through Line 1-6 which extends north on San Pascual Avenue to Line 1-7.

The proposed facilities in this area consist of a main line running south to north on Monterey Avenue, Line 1-9, which conveys the runoff to the Whitewater Channel. Line 1-9 has proposed tributaries along its length, contributing to the large diameter main line. The reason this line is directed north on Monterey Avenue past Fred Waring Drive is due to the fact that the existing facility on Fred Waring Drive is inadequate to convey this additional runoff. Additions to this existing facility were studied; but due to the conflicts with existing utilities in Fred Waring Drive, the proposed Line 1-9 was directed north along Monterey Avenue. At the present time a portion of Line 1-9 from the Palm Desert Town Center to Fred Waring Drive and along Fred Waring Drive to San Anselmo Avenue is being designed for construction.

Problem areas between El Paseo and Highway 111 from Lupine Lane to San Luis Rey Avenue called for proposed facilities connecting to the existing Line 1-4 in Highway 111.

- Drainage Area #2 (See Exhibit 2.2)

Drainage area #2 is located north of the Haystack Channel between the Pines to Palms Highway on the west and just east of Portola Avenue on the east. This area runs north of El Paseo and then follows Drainage Area #1's eastern boundary to the Whitewater Channel.



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LEGEND

STUDY AREA
PALM SPRINGS RIDGE LINE

STUDY AREA
EXHIBIT 1

The majority of facilities in Drainage Area #2 are in existence. Line 2-1 carries a large amount of the runoff produced in the southern portion of Zone 1. Line 2-1 consists of large drainage facilities that run from Grapevine Avenue north in Portola Avenue to the Whitewater Channel. Line 2-4 extends westward along Grapevine Avenue, picking up a tributary line on Desert Lily Drive. A proposed tributary to Line 2-4 is Line 2-6, which extends southward on the western boundary of the Marrakesh Country Club. Another existing tributary to Line 2-1 is Line 2-3, a large drainage facility extending west on Shadow Mountain Drive. This extension also picks up runoff on San Luis Rey Avenue to the south down to Ironwood Street.

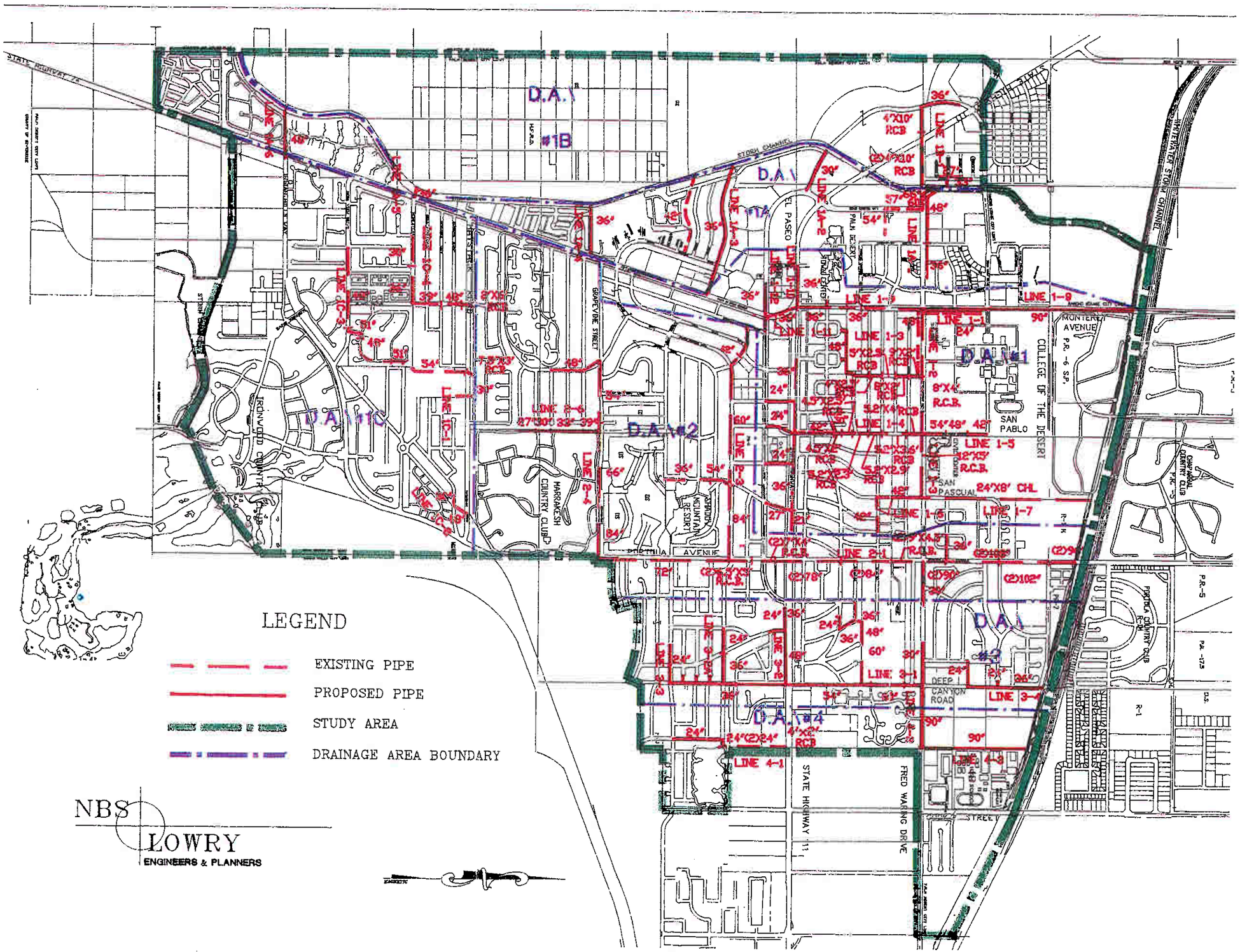
- Drainage Area #3 (See Exhibit 2.3)

Drainage Area #3 is confined to Portola Avenue on the west, Deep Canyon Road on the east, and the City Limit to the south and the Whitewater Channel on the north. Line 3-1 is the main line in this drainage area. It extends from Fairway Drive in Deep Canyon Road to Fred Waring Drive, then it heads east on Fred Waring Drive connecting to Line 4-1 at Phyllis Jackson Lane. Line 3-2 is a tributary, collecting flows west of Deep Canyon Road on Palm Desert Drive south. Line 3-3 extends Line 3-1 westward on Fairway Drive collecting runoff generated south of Fairway Drive. Line 3-2A is another tributary to line 3-1. This line collects flows on Candlewood Street and conveys them to the main line.

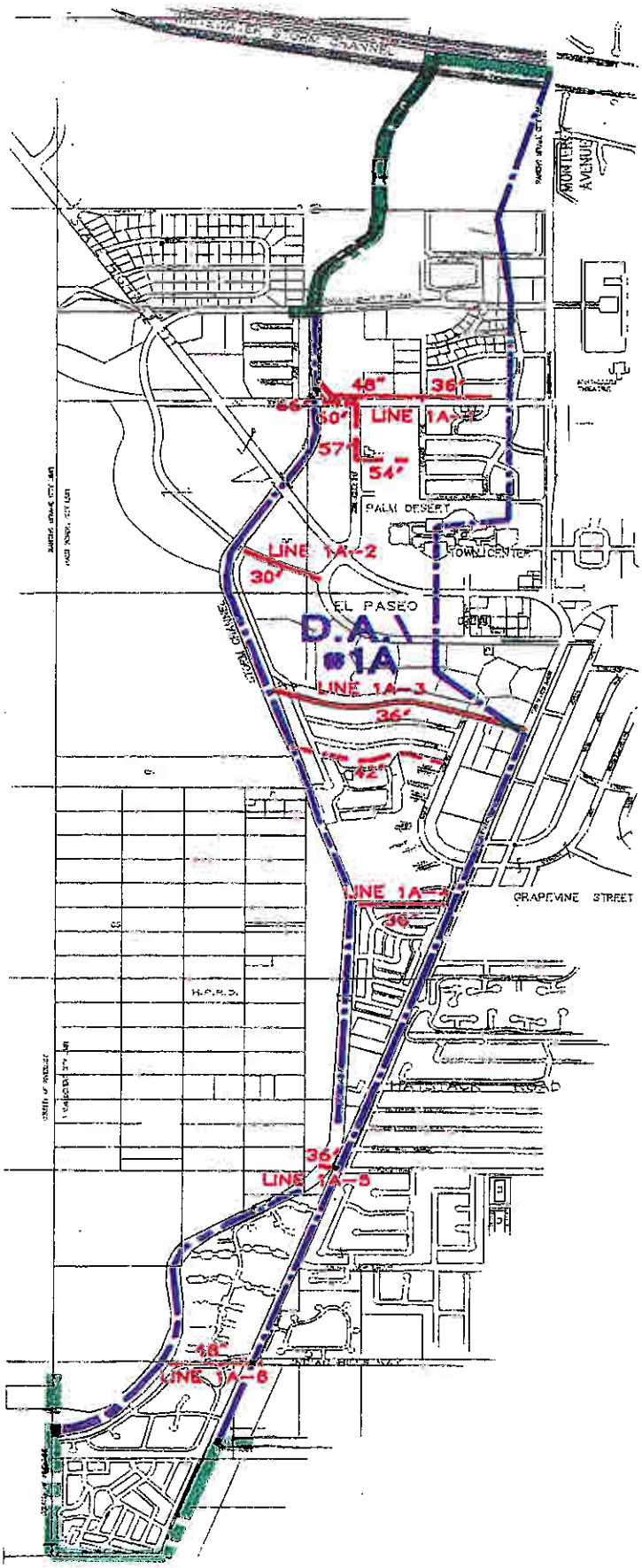
A small system on Deep Canyon north of Fred Waring Drive, Line 3-4, collects runoff from the interior streets south of Magnesia Falls Drive and west of Deep Canyon Road and conveys them north to the Whitewater Channel.

- Drainage Area #4 (See Exhibit 2.3)

The eastern boundary of Drainage Area #4 runs north along the City Limits of Indian Wells, the southern boundary is the City limit, the western boundary lies just east of Deep Canyon Road, and the northern boundary is the Whitewater Channel. Line 4-1 is proposed to run North from Fairway Drive along the City limit to Higghway 111. At present, a portion of Line 4-1 is being designed from just north of Candlewood to Highway 111. This drainage area tends to flow northeasterly to the City of Indian Wells; therefore, Line 4-1 is designed to intercept these flows.



MASTER PLAN FACILITIES
EXHIBIT 2



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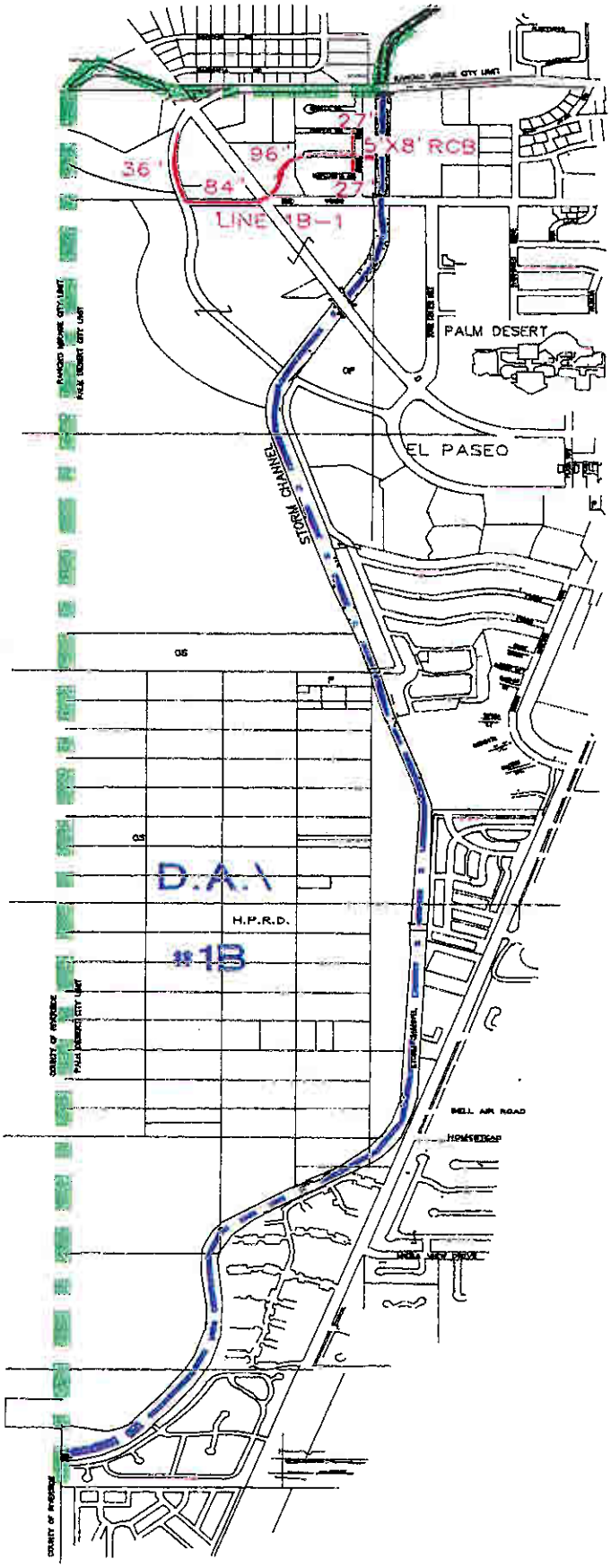
LEGEND

- EXISTING PIPE
- PROPOSED PIPE
- STUDY AREA
- DRAINAGE AREA BOUNDARY

MASTER PLAN FACILITIES
EXHIBIT 2.1A



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LEGEND

- EXISTING PIPE
- PROPOSED PIPE
- STUDY AREA
- DRAINAGE AREA BOUNDARY

MASTER PLAN FACILITIES
EXHIBIT 2.1B

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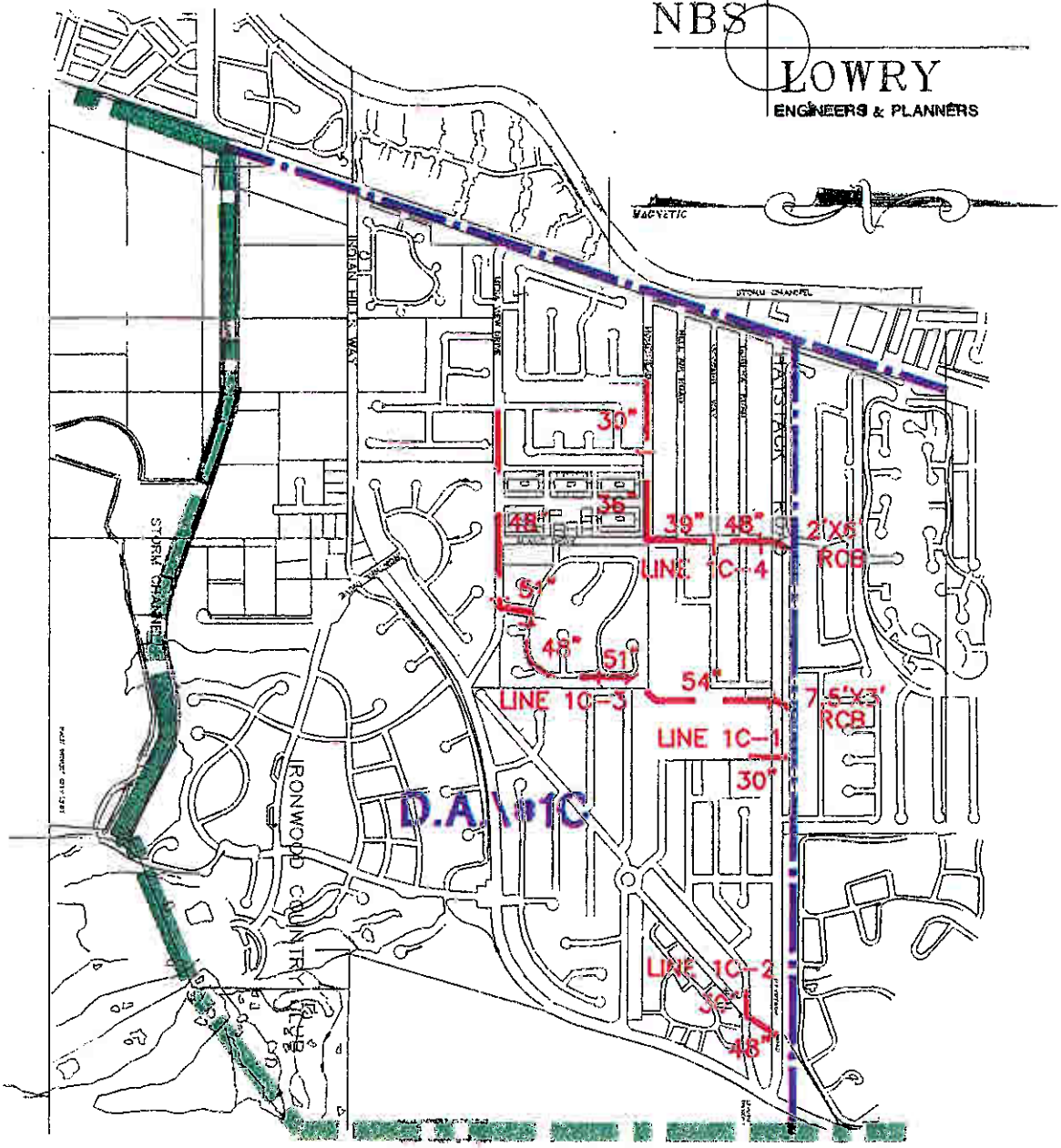

LEGEND

- EXISTING PIPE
- PROPOSED PIPE
- STUDY AREA
- DRAINAGE AREA BOUNDARY

MASTER PLAN FACILITIES
EXHIBIT 2.1C

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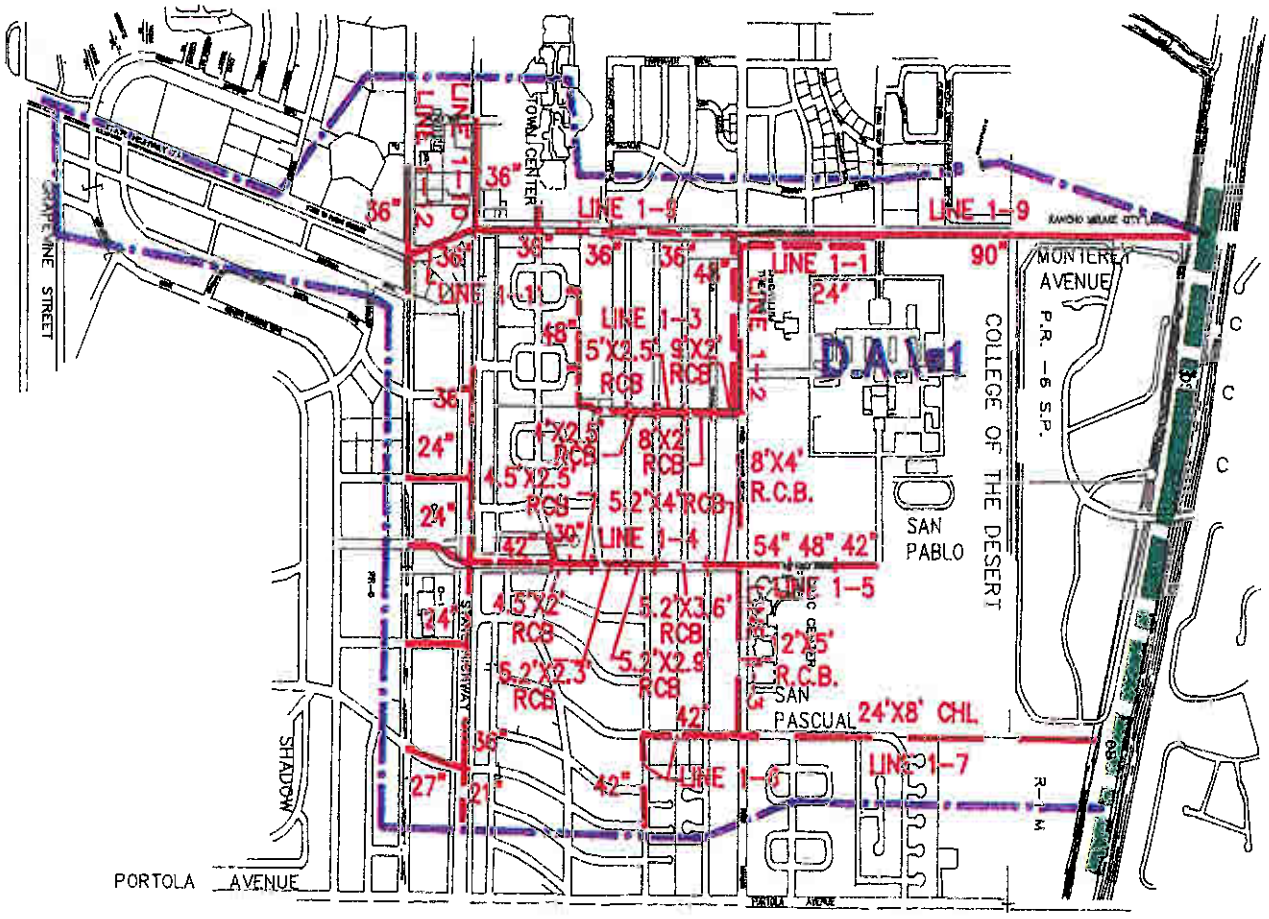
LEGEND

EXISTING PIPE

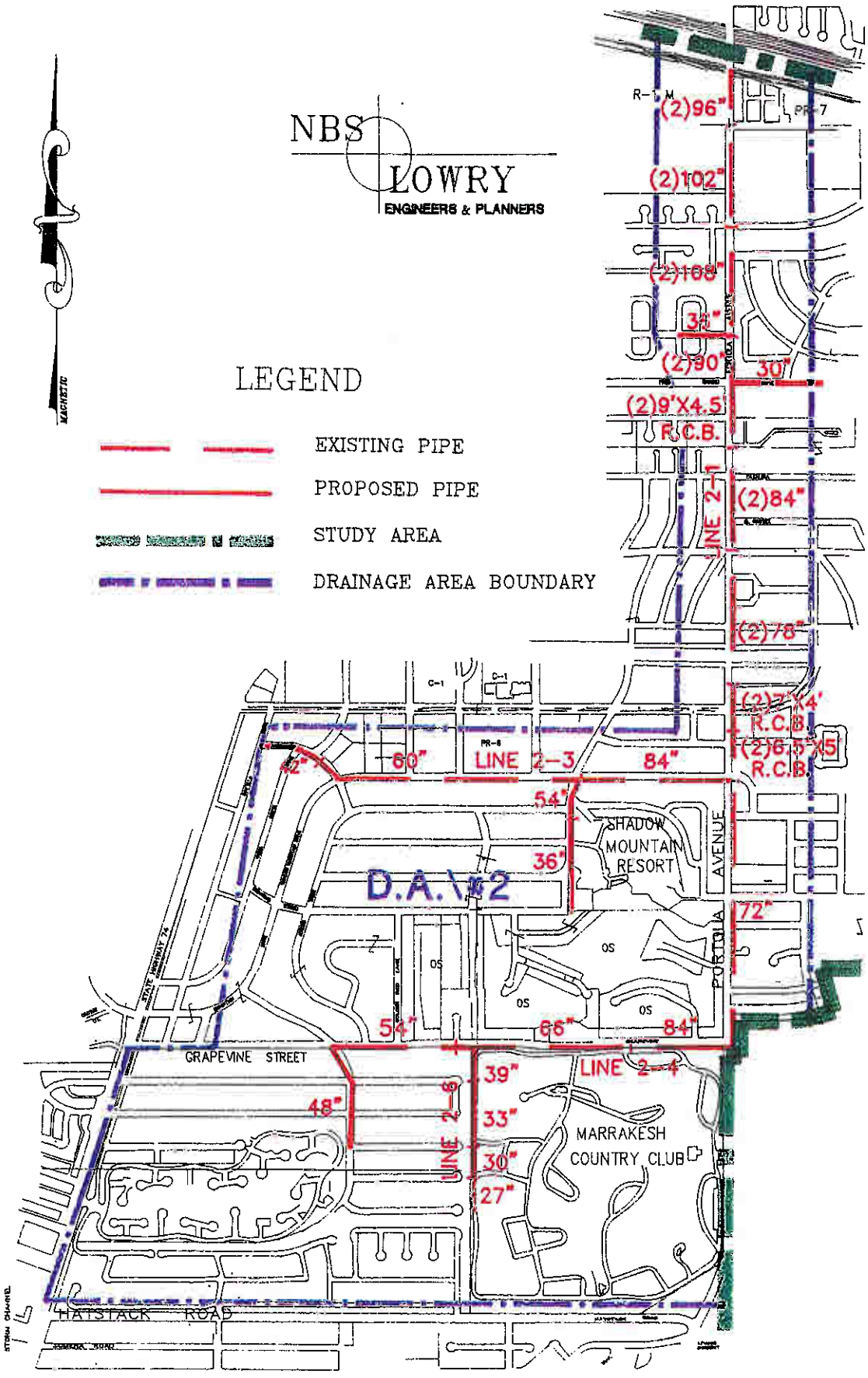
PROPOSED PIPE

STUDY AREA

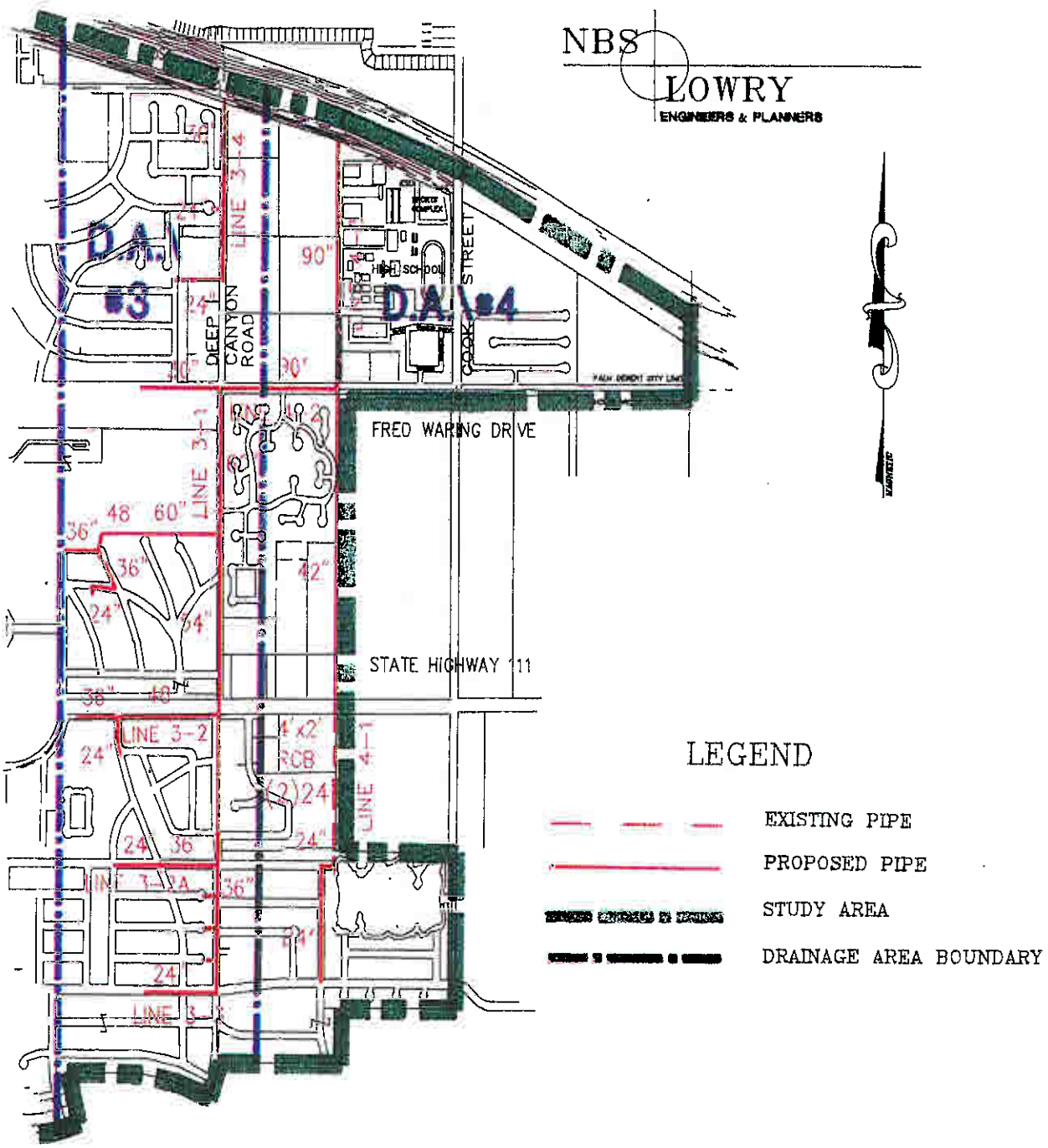
DRAINAGE AREA BOUNDARY



MASTER PLAN FACILITIES
EXHIBIT 2.1



MASTER PLAN FACILITIES
EXHIBIT 2.2



MASTER PLAN FACILITIES
EXHIBIT 2.3

ZONE 2

Zone 2 is bounded by the Whitewater Channel on the south, the Palm Springs Ridge Line on the north, and the City limits are the east and west boundaries (see Exhibit 3).

- Drainage Area #5 (See Exhibit 3.5)

  Drainage area #5 is bounded on the west by Monterey Avenue, on the north by the Palm Springs Ridge Line, and on the south by the Whitewater Channel. The eastern boundary extends north from the Whitewater Channel approximately 1/4 mile east of Portola Avenue to Country Club Drive, then heads east on Country Club Drive to the Palm Springs Ridge Line.

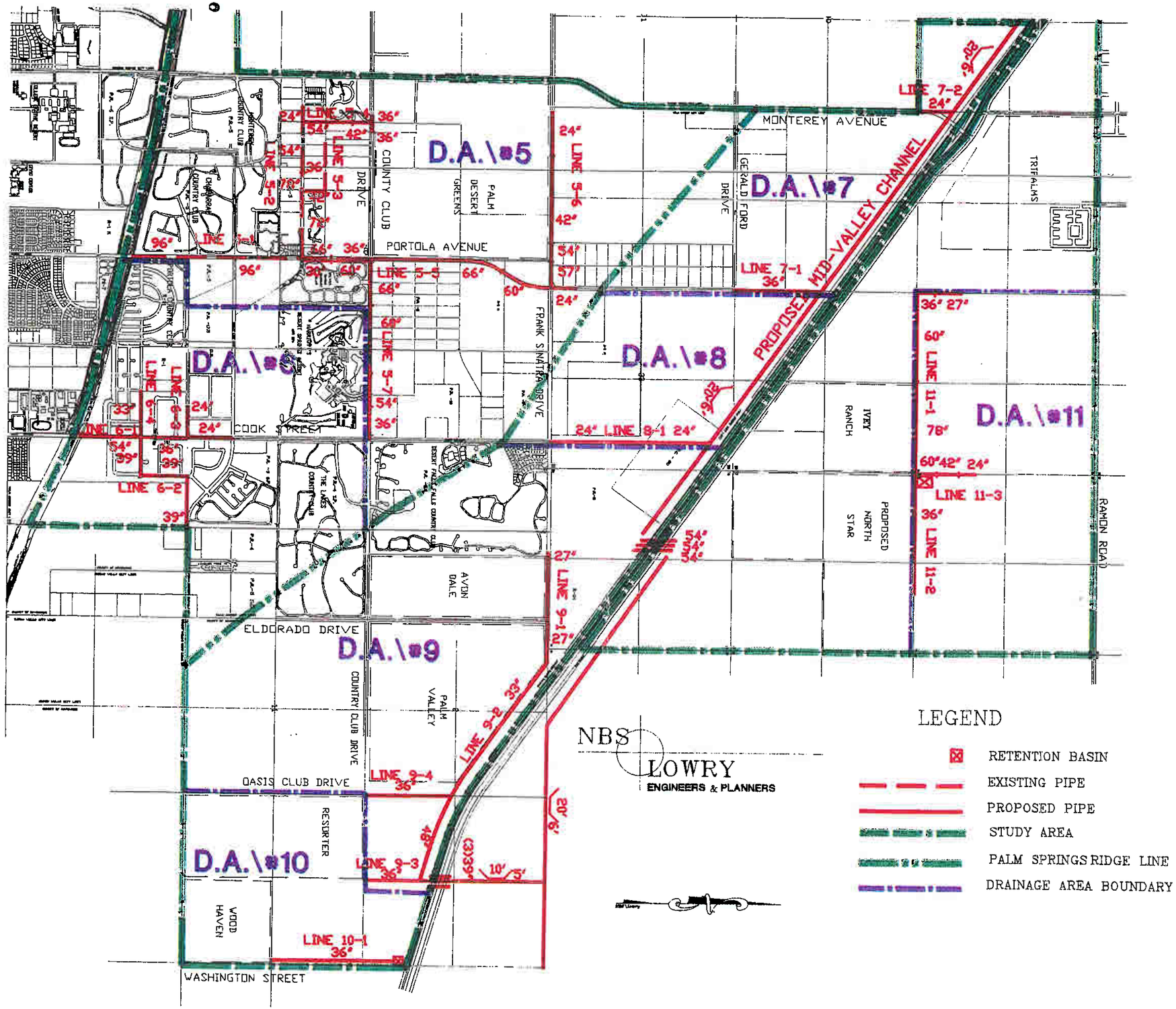
  The main portion of this system runs in Portola Avenue from Frank Sinatra Drive to the Whitewater Channel. Line 5-1, which runs in Portola Avenue from the Whitewater Channel to Country Club Drive, is an existing facility. This facility is responsible for collecting flows at Portola Avenue conveyed by Country Club Drive and Portola Avenue north of Country Club Drive. This facility also picks up flows from Hovley Lane West. This tributary consists of proposed Line 5-4 which drains the southwest corner of Section 5 from Country Club Drive, then runs south along the boundary of the Sagewood Development to Hovley Lane. Line 5-2 picks up runoff from Line 5-4 and conveys it eastward, again picking up runoff from Line 5-3, until it connects to Line 5-1 in Portola Avenue. The facilities previously mentioned are either existing or designed for construction as of this report.

  An extension north in Portola Avenue is proposed from Country Club Drive to just beyond Frank Sinatra Drive (Line 5-5). Line 5-6 picks up flows from section 32 and conveys them along Frank Sinatra Drive to Line 5-5. Another proposed tributary on Line 5-5 is Line 5-7 which collects runoff from Section 4 and conveys the flow westward along Country Club Drive to Line 5-5.

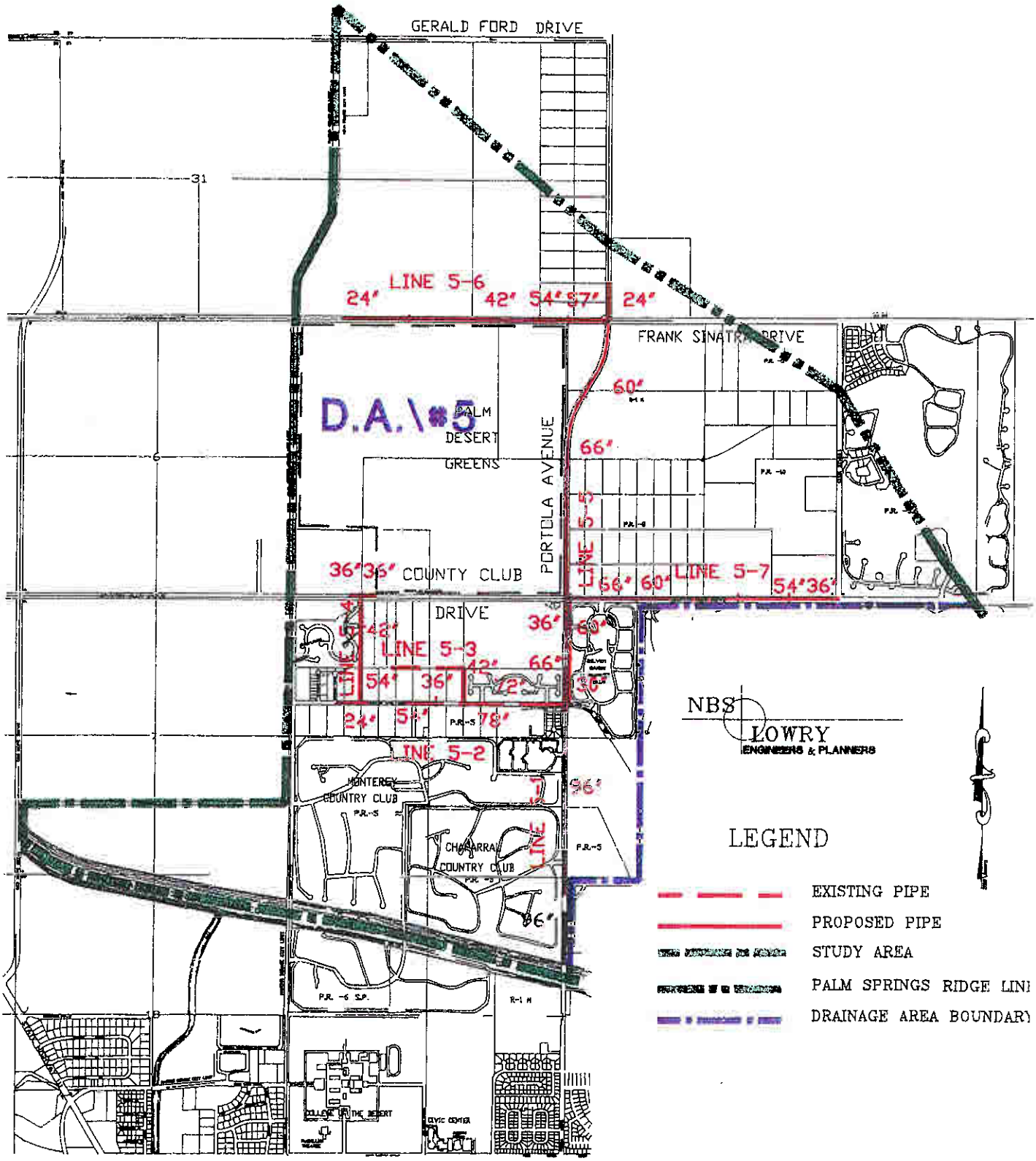
- Drainage Area #6 (See Exhibit 3.6)

  Drainage Area #6 is bounded on the north by Country Club Drive, on the west by Drainage Area #5's eastern boundary, on the east by the Palm Springs Ridge Line and the City limit, and on the south by the Whitewater Channel.

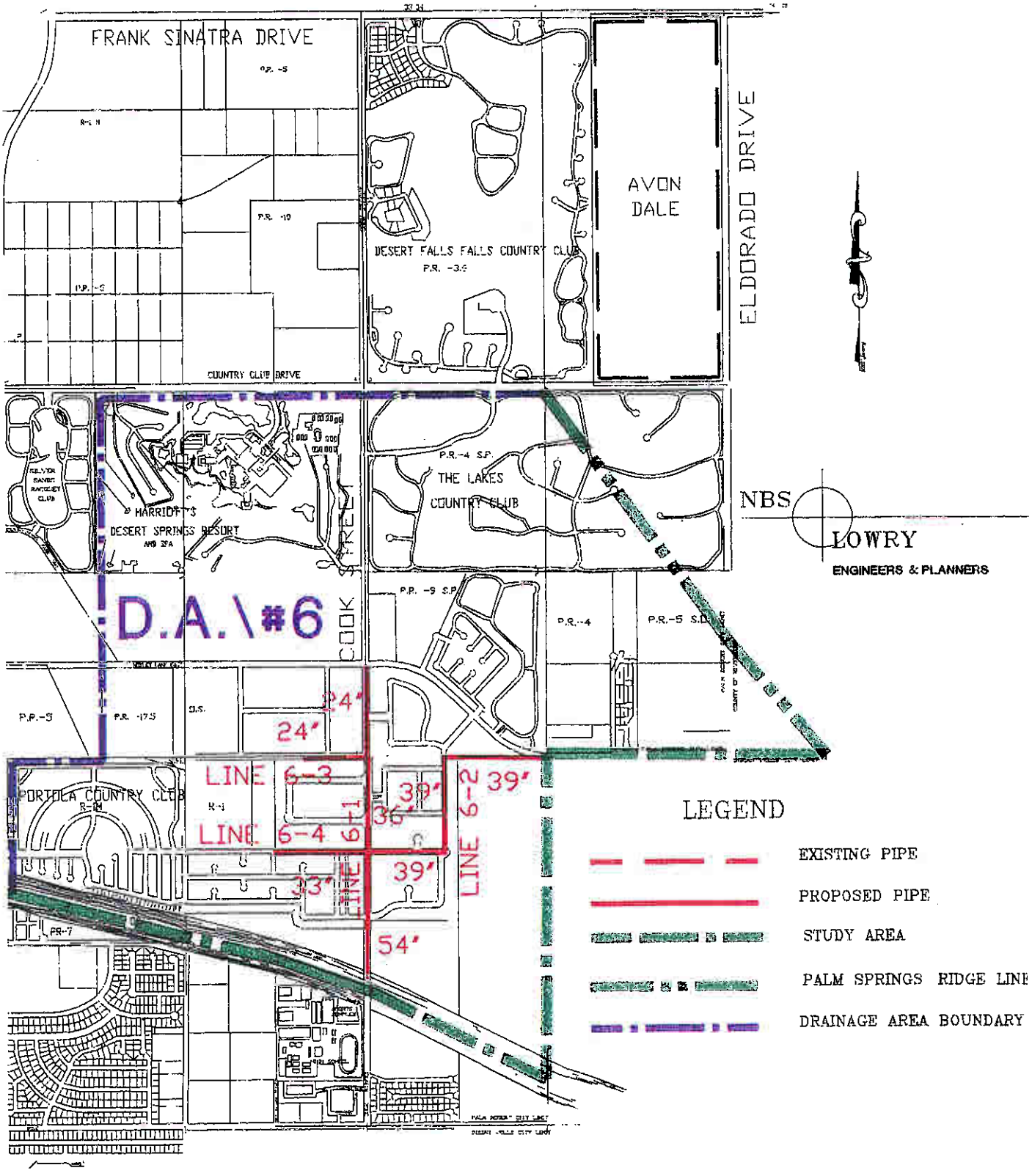
  Line 6-1 runs in Cook Street from Hovley Lane East to the Whitewater Channel. This proposed line primarily serves the industrial areas along Cook Street, picking up runoff from Line 6-3 which runs westerly on 42nd Avenue. Line 6-1 also has tributaries both east and west on Merle Drive. Line 6-4 extends west on Merle Drive, picking up flow from the industrial area; and Line 6-2 conveys flows east of Cook Street to the City limits, down to Merle Drive west and connects to Line 6-1.



MASTER PLAN FACILITIES
EXHIBIT 3



MASTER PLAN FACILITIES
EXHIBIT 3.5



MASTER PLAN FACILITIES
EXHIBIT 3.6

ZONE 3

Zone 3 is bounded on the north by Interstate 10, on the south by the Palm Springs Ridge Line, on the west by Monterey Avenue, and on the east by Washington Street (see Exhibit 3).

- Drainage Area #7 (See Exhibit 3.7)

  This area is bounded on the north by I-10 and on the south by the Palm Springs Ridge Line. The western boundary follows the Palm Desert Adopted Sphere boundary north from the Palm Springs Ridge Line to I-10. The eastern boundary of this area follows Portola Avenue north from the Palm Springs Ridge Line to I-10.

  In this Drainage Area only accumulated street flows can be conveyed into the proposed Mid-Valley Channel. Line 7-1 conveys street flows north along the future continuation of Portola Avenue . Line 7-2 picks up street flows at Monterey Avenue and Dinah Shore Drive and conveys them to the proposed Mid-Valley Channel.

- Drainage Area #8 (See Exhibit 3.8)

  Drainage Area #8 is bounded on the north by I-10, the south by the Palm Springs Ridge Line, the west by Portola Avenue, and on the east by Cook Street. Only one facility is proposed for this area, Line 8-1. Line 8-1 conveys street flows within this area north in Cook Street to the proposed Mid-Valley Channel.

- Drainage Area #9 (See Exhibit 3.9)

  Drainage Area #9 is bounded on the north by I-10 and on the south by the Palm Springs Ridge Line. The western boundary is Cook Street and the eastern boundary of this area runs north along the eastern boundary of Section 11 to Country Club Drive, then heads east to the mid-section line of Section 1, and then heads north to I-10.

  Within this area, approximately 1/2 mile east of Cook Street, the Mid-Valley Channel will head north under I-10, three proposed 54" RCP culverts will convey the flow under I-10.

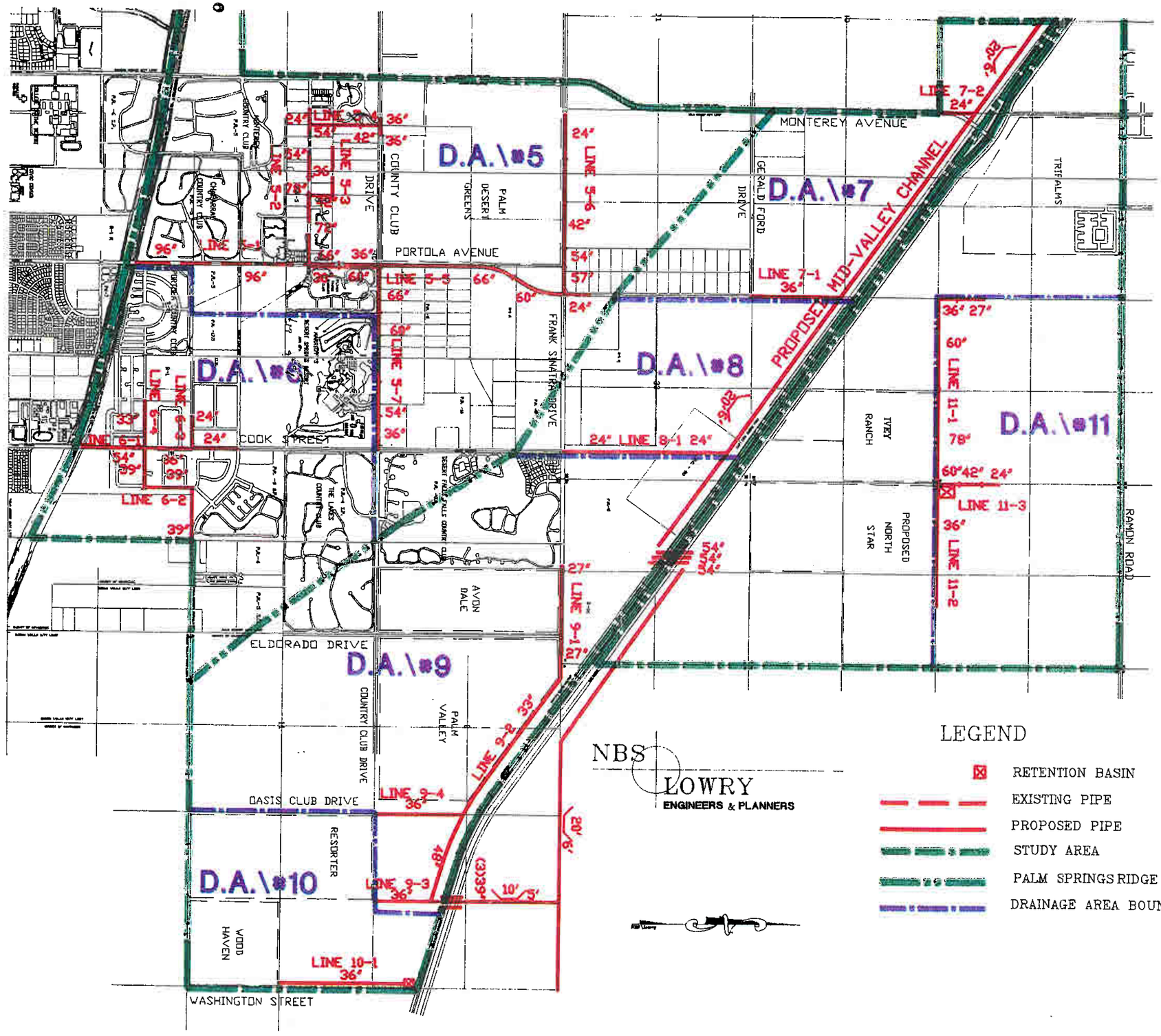
  Line 9-1 conveys street flows east along Frank Sinatra Drive where it connects with Line 9-2, then heads southeast along the northern limit of Palm Valley Country Club paralleling I-10 until approximately 1/2 mile west of Washington Street. At that point, Line 9-2 connects with Line 9-3. Line 9-3 drains the low point on Country Club Drive approximately 1/2 mile west of Washington Street.

After the confluence of Line 9-2 and Line 9-3, the system is jacked under I-10 with 3-39" RCP's into a channel that will run north to the proposed Mid-Valley Channel.

- Drainage Area #10 (See Exhibit 3.9)

Drainage Area #10 is bounded on the west by the eastern boundary of Drainage Area #9, on the north by I-10, on the east by Washington Street, and on the south by the south section line of Section 12.

Line 10-1 conveys runoff north along Washington Street in the City of Palm Desert. Street flows in this area are collected on Washington Street and conveyed to a retention basin along I-10.



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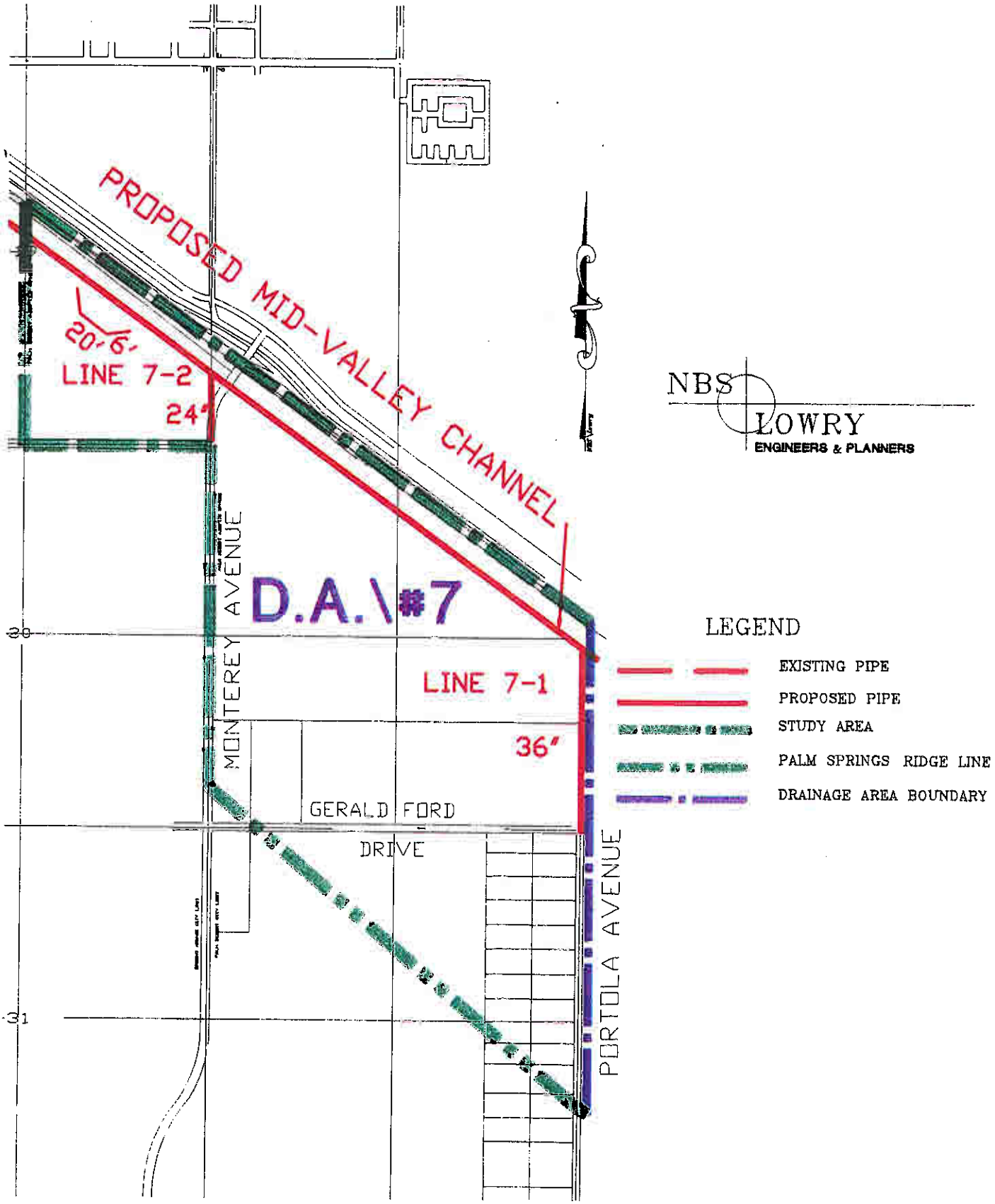
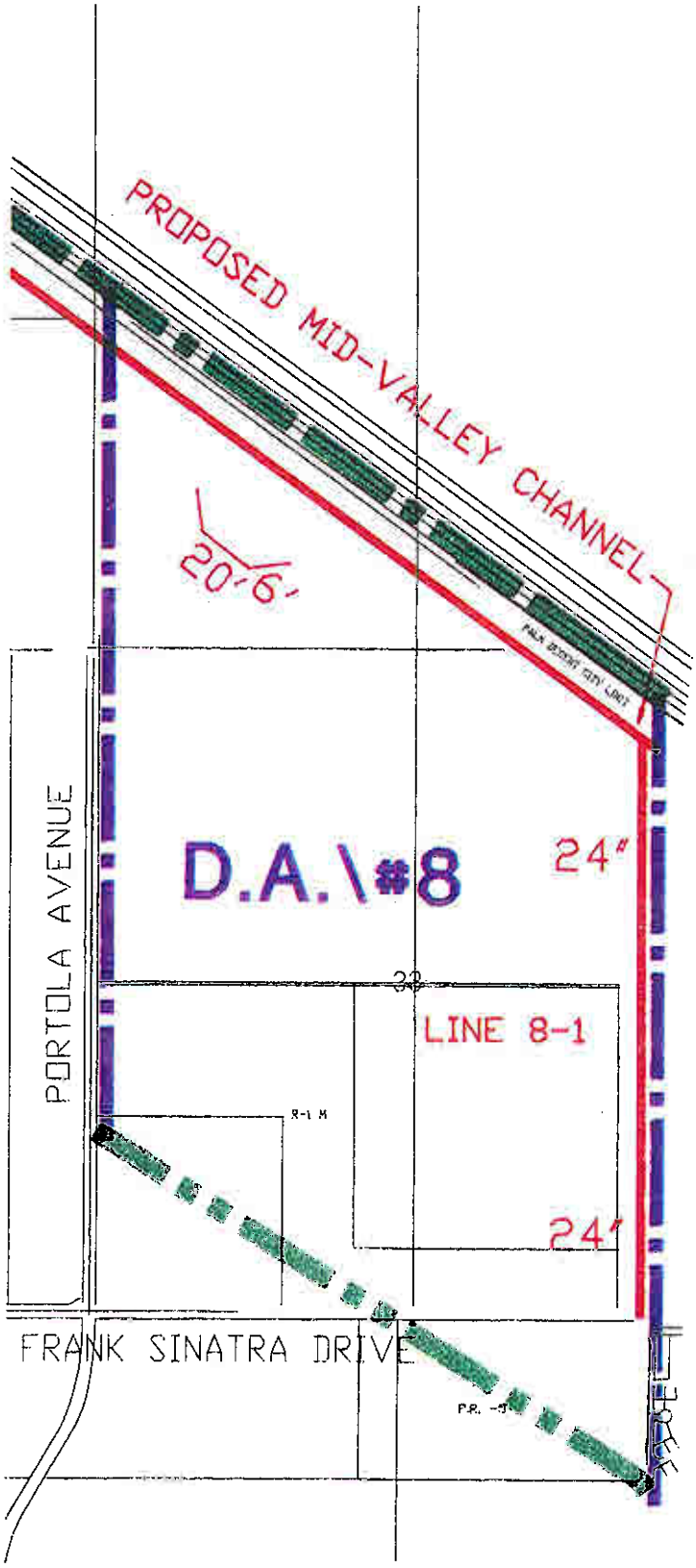
LEGEND

- RETENTION BASIN
- EXISTING PIPE
- PROPOSED PIPE
- STUDY AREA
- PALM SPRINGS RIDGE LINE
- DRAINAGE AREA BOUNDARY

MASTER PLAN FACILITIES
EXHIBIT 3



MASTER PLAN FACILITIES
EXHIBIT 3.7



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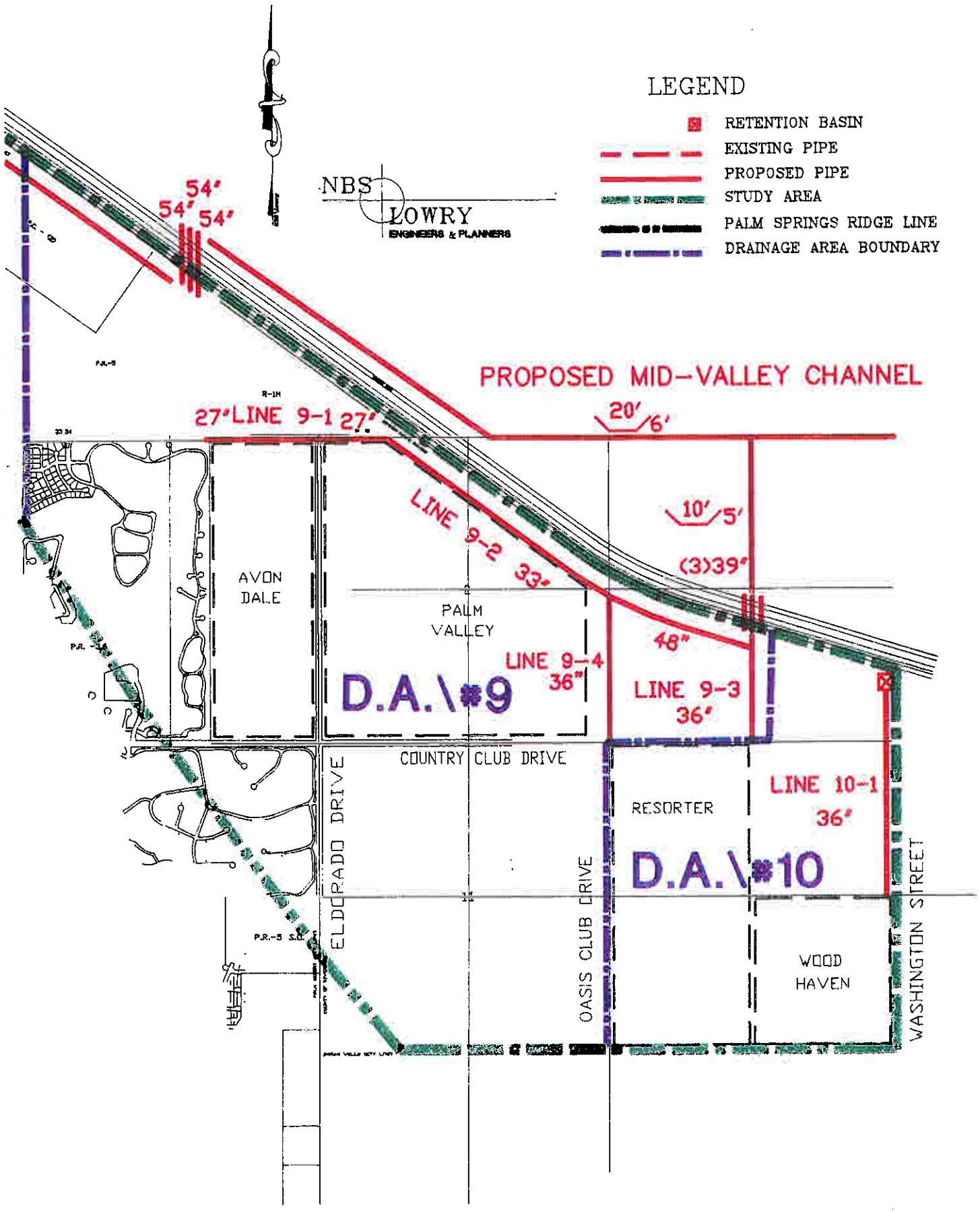
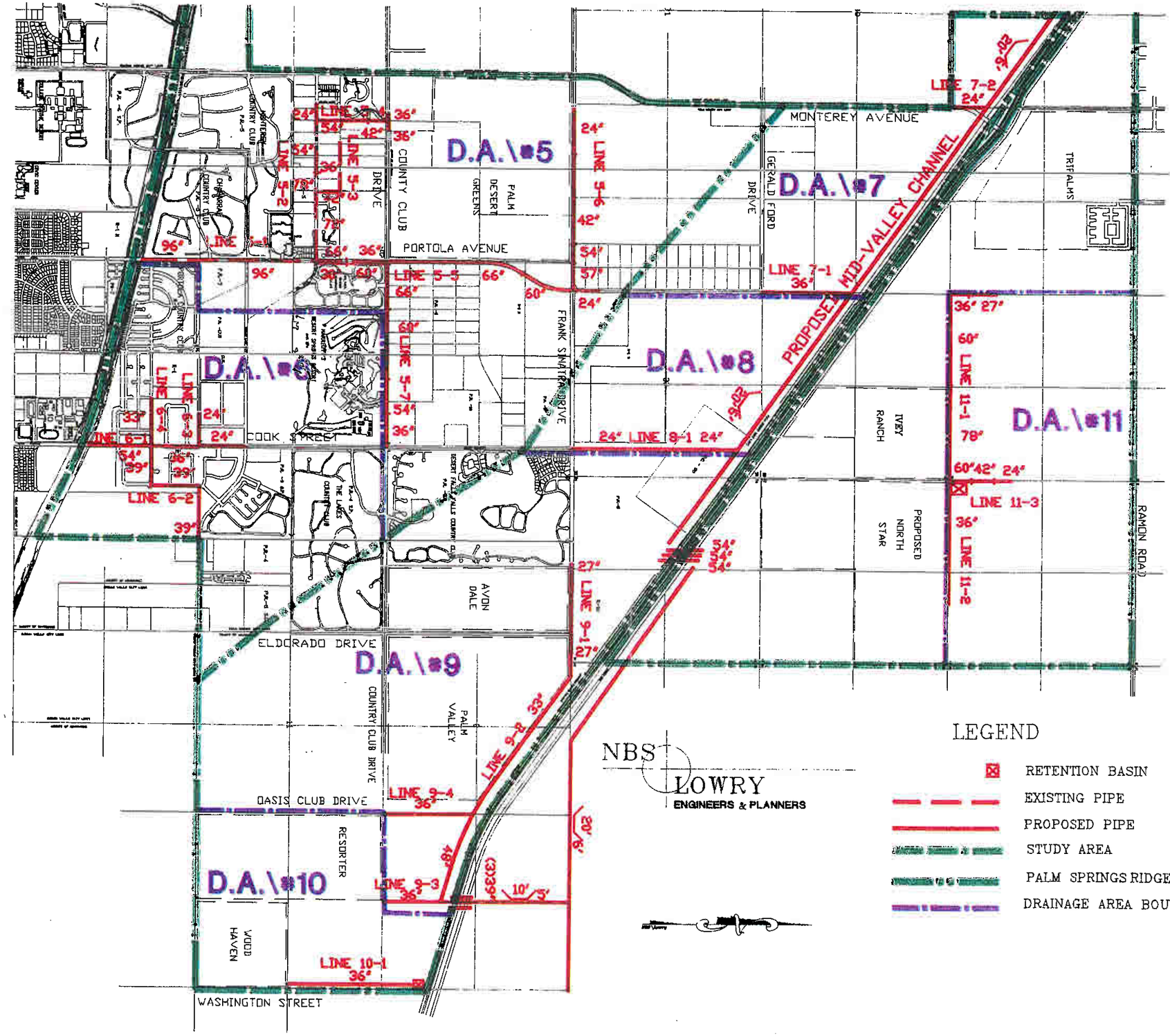
LEGEND

- EXISTING PIPE
- PROPOSED PIPE
- STUDY AREA
- PALM SPRINGS RIDGE LINE
- DRAINAGE AREA BOUNDARY

MASTER PLAN FACILITIES
EXHIBIT 3.8



MASTER PLAN FACILITIES
EXHIBIT 3.9



MASTER PLAN FACILITIES
EXHIBIT 3

ZONE 4 (Reference Only)

Zone 4 is bounded on the south and west by Interstate 10, on the north by Ramon Road, and on the east by eastern section lines of sections 22, 27, and 34 (see Exhibit 3). In this zone, north of I-10, only one drainage area was designed for pipe flows. Given the knowledge of the drainage within the existing and proposed developments, no other facilities were designed. The Federal Emergency Management Agency has determined that Zone 4 is located in a Flood Zone and is given an AO designation. The depth of flooding in this zone range from two feet at Interstate 10 to four feet at the mouth of Thousand Palms Canyon with flow velocities ranging from six feet per second to nine feet per second.

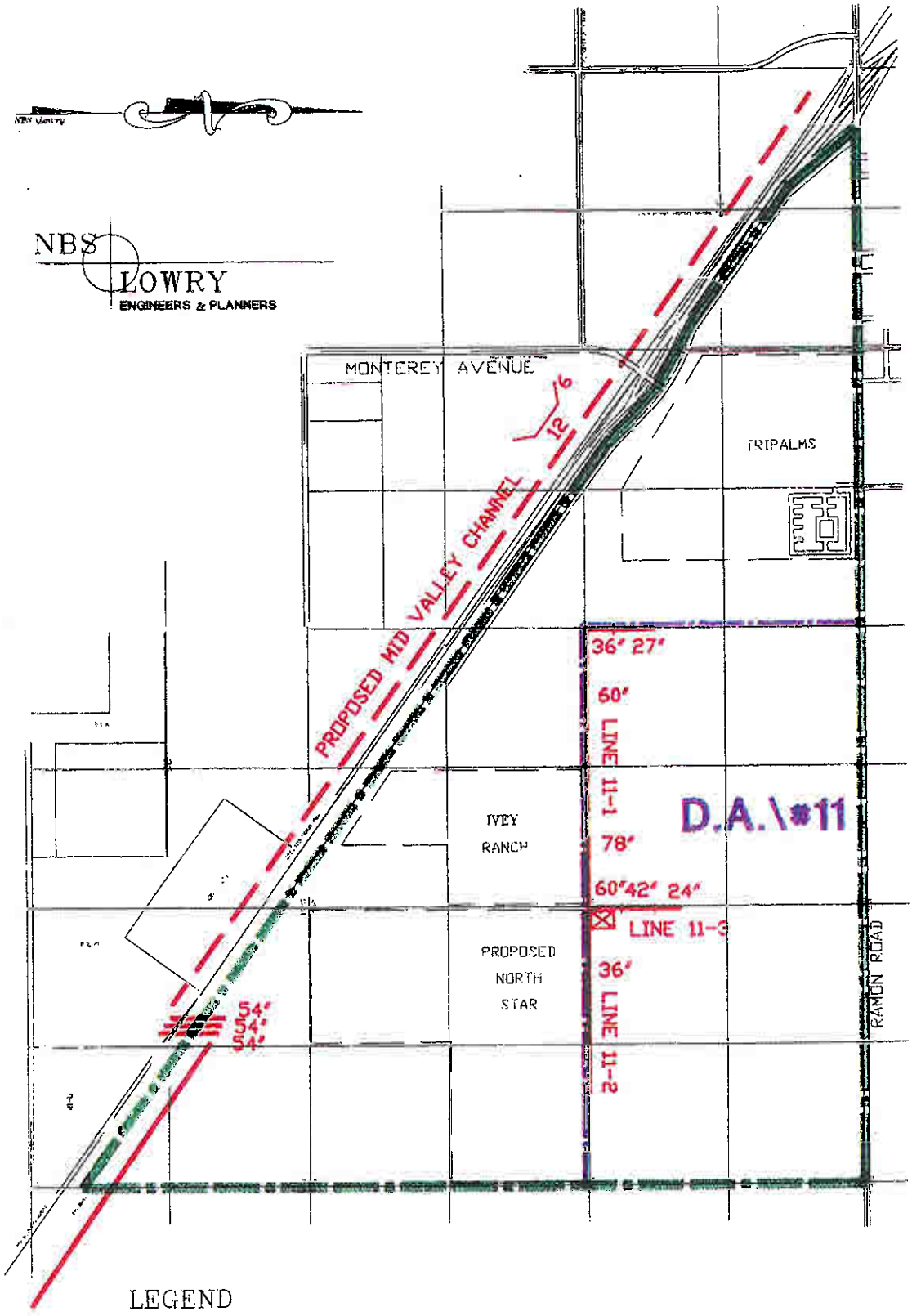
- Drainage Area #11 (See Exhibit 3.11)

  Drainage Area #11 is bounded on the north by Ramon Road, on the west by the Tri-Palms Development, on the south by the Ivey Ranch Development, and on the east by the east section line of Section 22.

  Line 11-1 conveys flows along the southern boundary of Section 21 eastward to a retention basin. Line 11-2 conveys flows westward along the southern boundary of Section 22 to the same basin. Line 11-3 runs south along the intersection of these two sections to the retention basin.

  The retention basin in Drainage Area #11 has been calculated to hold 116.62 acre-feet of flow. To achieve this volume of retention, a suggested 20-acre site with a depth of 6 feet would be sufficient.

  Options for development of this site range from a park to a golf course fairway or a golf course lake. These are just a few possibilities for the provision of an aesthetically pleasing retention basin.



MASTER PLAN FACILITIES
EXHIBIT 3.11

SYSTEM ALTERNATIVES

This proposed Master Drainage Plan was developed using reinforced concrete pipe (RCP) to convey flows throughout the City. Although these facilities are adequate to convey runoff, other alternative conveyances were studied.

Cast in place concrete pipe (CIPP) is an alternative to RCP. This alternative was not introduced into this study because of factors deterrent to its use. Trench wall stability is a major deterrent to using CIPP in the region. Due to the nature of soils in Palm Desert, this system does not seem feasible for keeping drainage facility costs at a minimum.

Cast in place concrete pipe is installed more efficiently if trench wall stability is maintained, no ground water is encountered, and if the soils are not expansive in nature. If these conditions can be met in specific areas, CIPP should be investigated as an alternative.

Another alternative conveyance of runoff for use which was studied is corrugated steel pipe - concrete lined (HCCL). This system was not expanded into the design criteria due to the fact that the design life of RCP is longer than that of HCCL. With this in mind and comparing material costs (both conveyances are relatively equal), HCCL was not incorporated into this proposed system.

There are other alternatives to this proposed drainage plan. Open concrete lined channels could replace some in-ground facilities. Although open channels are cheaper to install, the issues of maintenance, right-of-way acquisition, safety and aesthetics must be considered.

Although there are alternatives to the system designed in this report, the system of RCP is recommended as the best alternative for the conveyance of runoff in Palm Desert.

A detailed cost analysis for the recommended drainage alternative, consisting of RCP, is provided in the following table.

PALM DESERT MASTER DRAINAGE PLAN
DETAILED COST ANALYSIS

DRAINAGE AREA #1A

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
1A-1	243	48 IN	400	$ 192	$ 76,800
	65	36 IN	700	144	100,800
1A-2	55	30 IN	1100	120	132,000
1A-3	70	36 IN	2800	144	403,200
1A-4	103	36 IN	1020	144	146,880
1A-5	85	36 IN	275	144	39,600
1A-6	175	48 IN	940	192	180,480
Outlet Structures		6 EA		30,000	180,000

****

TOTAL COST DRAINAGE AREA #1A $1,259,760

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DRAINAGE AREA #1B

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
1B-1	864	(2)10x4 RCB	1375	$ 500	$ 687,500
	799	10x4 RCB	402	500	201,000
	60	36 IN	635	144	91,440
	53	30 IN	108	120	12,960
	35	24 IN	138	96	13,248
Outlet Structures		1 EA		30,000	30,000

****

TOTAL COST DRAINAGE AREA #1B $1,036,148

****

DRAINAGE AREA #1C

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
1C-1	17	30 IN	200	$ 120	$ 24,000
1C-2	108	48 IN	308	192	59,136
	65	36 IN	230	144	33,120
Outlet Structures		2 EA		30,000	60,000

****

TOTAL COST DRAINAGE AREA #1C $176,256

****

DRAINAGE AREA #1

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
1-4	23	24 IN	1800	$ 96	$ 172,800
	50	27 IN	600	108	64,800
	81	30 IN	250	120	30,000
1-9	679	90 IN	4510	360	1,623,600
1-10	60	36 IN	1340	144	192,960
1-11	281	36 IN	660	144	95,040
1-12	145	36 IN	700	144	100,800

****

TOTAL COST DRAINAGE AREA #1 $2,280,000

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DRAINAGE AREA #2

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
2-1	62	30 IN	910	$ 120	$109,200
2-6	123	39 IN	510	156	79,560
	103	33 IN	340	132	44,880
	85	30 IN	315	120	37,800
	68	27 IN	350	108	37,800

****

TOTAL COST DRAINAGE AREA #2 $309,240

****

DRAINAGE AREA #3

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
3-1	421	60 IN	850	$ 240	$ 204,000
	350	54 IN	1650	216	356,400
	102	36 IN	3000	144	432,000
	51	30 IN	500	120	60,000
3-2A	102	36 IN	600	144	86,400
	18	24 IN	500	96	48,000
3-2	183	48 IN	1075	192	206,400
	96	36 IN	275	144	39,600
	59	24 IN	565	96	54,240
3-3	40	24 IN	1175	96	112,800
3-4	126	36 IN	600	144	86,400
	16	24 IN	250	96	24,000
Outlet Structures		1 EA		50,000	50,000

****

TOTAL COST DRAINAGE AREA #3 $1,760,240

****

DRAINAGE AREA #4

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
4-1	222	42 IN	1750	$ 168	$ 294,000
	50	24 IN	1000	96	96,000
4-2	741	90 IN	1320	384	506,880
4-3	946	90 IN	1120	384	430,080
Outlet Structures		1 EA		50,000	50,000

****

TOTAL COST DRAINAGE AREA #4 $1,555,280

****

DRAINAGE AREA #5

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
5-1	368	60 IN	900	$ 240	$ 216,000
	58	30 IN	1000	120	120,000
5-4	160	42 IN	2000	$ 168	$ 336,000
	70	36 IN	400	144	57,600
5-5	395	66 IN	2250	264	594,000
	374	60 IN	2850	240	684,000
	65	24 IN	550	96	52,800
5-6	255	57 IN	670	228	152,760
	241	54 IN	1200	216	259,200
	105	42 IN	750	168	126,000
	21	24 IN	1710	96	164,160
5-7	322	66 IN	650	264	174,600
	288	60 IN	2150	240	516,000
	185	54 IN	1150	216	248,400
	74	36 IN	1350	144	194,400

****

TOTAL COST DRAINAGE AREA #5 $3,892,920

****

DRAINAGE AREA #6

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
6-1 a	443	54 IN	1950	$ 216	$ 421,200
b	79	36 IN	1350	144	194,400
c	30	24 IN	1200	96	115,200
6-2	196	39 IN	4050	156	631,800
6-3	25	24 IN	850	96	81,600
6-4	79	33 IN	1350	132	178,200
Outlet Structures		1 EA		50,000	50,000

****

TOTAL COST DRAINAGE AREA #6 $1,672,400

****

DRAINAGE AREA #7

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
7-1	193	36 IN	2400	$ 144	$ 345,600
7-2	23	24 IN	950	96	91,200
Outlet Structures		2 EA		30,000	60,000

****

TOTAL COST DRAINAGE AREA #7 $496,800

****

DRAINAGE AREA #8

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
8-1	17	24 IN	4200	$ 96	$403,200
Outlet Structures		1 EA		30,000	30,000

****

TOTAL COST DRAINAGE AREA #8 $433,200

****

DRAINAGE AREA #9

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
9-1	22	27 IN	3100	$ 108	$ 334,800
9-2	42	33 IN	7000	132	924,000
9-3	61	36 IN	1600	144	230,400

****

TOTAL COST DRAINAGE AREA #9 $1,489,200

****

DRAINAGE AREA #10

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
10-1	61	36 IN	3450	$ 144	$496,800
Retention Basin		1 EA		300,000	300,000

****

TOTAL COST DRAINAGE AREA #10 $796,800

****

DRAINAGE AREA #11 *

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
11-1	337	78 IN	2400	$ 312	$ 748,800
	226	60 IN	2850	240	684,000
	88	36 IN	1300	144	187,200
	17	27 IN	1900	108	205,200
11-2	134	36 IN	3800	144	547,200
11-3	269	60 IN	800	240	192,000
	127	42 IN	1250	168	210,000
	24	24 IN	800	96	76,800
Retention Basin		1 EA		300,000	300,000

****

TOTAL COST DRAINAGE AREA #11 $3,151,200

****

MID-VALLEY CHANNEL *

Line #	Flow (CFS)	Diameter	Length (Feet)	Cost/Foot ($)	Cost ($)
MID-1	621	20x6x1.5 CH	22000	$ 350	$ 7,700,000
MID-2	621	(3)54 IN	600	1,080	1,944,000
MID-3	653	20x6x1.5 CH	11200	350	3,920,000
MID-4	107	(3)39 IN	500	780	1,170,000
MID-5	112	10x5x1.5 CH	3100	300	930,000
MID-6	762	20x6x1.5 CH	2600	350	910,000

****

TOTAL COST FOR MID-VALLEY CHANNEL $16,574,000

****

TOTAL FACILITY COST	$17,158,244
MASTER PLAN	131,500
ENGINEERING 15%	2,573,737
RIGHT-OF-WAY 5%	857,912
UTILITY RELOCATION 5%	857,912
CONTINGENCIES 10%	1,715,824
	$23,295,129*

TOTAL ASSESSABLE ACRES = 4890
DRAINAGE FEE PER ACRE FOR TOTAL UNDEVELOPED AREA $4,764**

*DRAINAGE AREA # 11 AND MID-VALLEY CHANNEL NOT INCLUDED IN TOTAL FACILITIES COST

**BASED ON COACHELLA VALLEY WATER DISTRICT UNIT PRICES
1992 DOLLARS - ENR 20 CITIES INDEX FOR JANUARY 1, 1992; 4,885.03

RECOMMENDED PRIORITY LIST

PRIORITY		DESCRIPTION
1	Deficiency: Exhibit 2.1	The inability of the Fred Waring storm drain to convey runoff generated along Highway 74 north of Grapevine Street to Fred Waring Drive.
	Recommendation:	Install Lines 1 through 1 12 to convey the runoff flowing down Monterey Avenue to the Whitewater Channel, thus bypassing the Fred Waring Drive storm drain.
2	Deficiency: Exhibit 2.3	Lack of storm drain facilities to divert runoff generated in Drainage Area #3 and #4 from passing into Indian Wells.
	Recommendation:	Install Line 3-1,Line 4-1, line 4-2, and Line 4-3 to convey this runoff to the Whitewater Channel.
3	Deficiency: Exhibit 2.1	Lack of sufficient drainage facilities between El Paseo and Highway 111 from Lupine Lane to San Luis Rey Avenue.
	Recommendation:	Install a series of pipes and catch basins to collect and convey runoff north to the existing Line 1-4 located in the north frontage road of Highway 111.
4	Deficiency: Exhibit 2.1A	Lack of storm drain interceptors on Highway 74 to divert flows to the Palm Valley Channel, south of El Paseo in Drainage Area #1A.
	Recommendation:	Install four interceptor systems located along Highway 74 south of El Paseo, Lines 1A-3 through 1A-6.
5	Deficiency: Exhibit 3.6	Cook Street's inability to convey runoff generated in Drainage Area # 6 to the Whitewater Channel.
	Recommendation:	Install Line 6-1 through 6-4 within this area will sufficiently convey runoff to the Whitewater Channel.
6	Deficiency: Exhibit 2.3	Lack of drainage facilities in Deep Canyon Road north of Fred Waring Drive.
	Recommendation:	Install Line 3-4 to convey runoff generated within the interior streets west Deep Canyon Road to the Whitewater Channel.

7	Deficiency: Exhibit 3.5	Lack of drainage facilities on Country Club Drive just east of Monterey Avenue.
	Recommendation:	Complete the remainder of the proposed drainage facility from Hovley Lane West to Country Club Drive (Line 5-4)
8	Deficiency: Exhibit 3	A major channel to convey runoff generated in Zone 3.
	Recommendation:	Incorporate the construction of the proposed Mid-Valley Channel with the implementation of the Master Drainage Plan.
9	Deficiency: Exhibit 2.1	Lack of draiange facilities on Monterey Avenue from Homestead Road to the Whitewater Channel.
	Recommendation:	Wide range of solutions including detention basin and alternate storm drains that require discussion with adjacent land owners and CVWD. An annual review of this deficiency will be conducted to evaluate and compare alternative solutions.

DRAINAGE FEES

An essential requirement for the implementation of the Master Drainage Plan is a mechanism to provide project funding. Once a Master Plan has been adopted, positive steps must be taken to provide adequate monies to construct the proposed facilities.

It is evident that no single method of funding will provide an adequate source of money for the implementation of this Master Plan. Therefore, it is recommended that the City consider a combination of funding methods to insure that adequate funds are made available for the construction of the previously described facilities.The following discussion outlines a number of possible financing methods.

PRESENT PRACTICES

- General Fund

  One source of funds that is legally available for the construction of Master Plan facilities is the City's General Fund. Considered as a limited source of revenue, the use of these funds for the construction of drainage facilities would be a low priority when compared to the tremendous demand for funding of necessary services.

- Drainage Fees

  Under the provisions of the government code of the State of California, a local government or regulatory agency may adopt a program for the collection of drainage fees. The Subdivision Map Act enables the City to enact the drainage fee program after certain prerequisites have been satisfied. The requirements for the drainage fee program include:

  1. Adoption of a Master Drainage Plan for each local drainage area.

  2. Certification of the Master Drainage Plan by the legislative body of the County and/or Special District having a Countywide and/or Districtwide drainage plan.

  3. Adoption of a fee structure based on the cost of the required facilities for each drainage area and equitably proportioned to all affected properties.

  4. Establishment of local drainage facilities funds.

Following the adoption of the appropriate ordinances, drainage fees can be collected from developers as a condition of approval of final subdivision maps. Funds are then deposited in the appropriate "Local Drainage Facilities Funds". As funds accumulate, they may be expended for engineering, administrative and construction costs of the drainage facilities to be constructed within a particular drainage area.

- Federal/State Assistance Programs

  There are a number of Federal and State programs which provide financial assistance to local governments for the development of needed facilities. The City currently receives an allotment of funds under the Housing and Community Development Act of 1974. These HCDA monies could be potentially utilized to construct certain portions of the proposed drainage system. However, because of the limited funding available and the demand for other community facilities, it probably cannot be considered a primary source of funding. Many of the other Federal programs are geared to assist communities with lower per capita incomes or where the nature of the community is less urbanized.

- Assessment Districts

  Assessment district proceedings offer a variety of methods of financing storm drain systems under the Acts of 1911, 1913, 1915, or other assessment proceedings. Assessment district financing could be used for funding in local drainage areas, particularly those which are now substantially developed.

However, the establishment of an assessment district requires that the property owners within the area recognize the problem and agree to the assessment approach for facility financing.

Assessment districts, like most other methods of municipal financing, have been affected by the passage of Proposition 13. Certain cases now being considered by the courts may affect the viability of assessment proceedings for the funding of future municipal improvements.

- Mello-Roos Community Facilities Act

The Mello-Roos Community Facilities Act of 1982 provides an alternative method of financing certain public capital facilities. A community facilities district formed under a Mello-Roos is established for the purpose of carrying specific activities of a public project.

A "Community Facilities District" is defined as the district of land in which public facilities and authorized services are to be provided, and in which special taxes and charges may be levied pursuant to the Mello-Roos Community Facilities Act to pay for those facilities and services.

- Redevelopment Agency

In theory, the Redevelopment District's tax is frozen to all taxing agencies within the boundaries of the District. As assessed valuation increases due to redevelopment, the increased taxes that result are funneled to the Redevelopment Agency for their use. These tax increment funds can be used by the Redevelopment Agency for eligible projects.

In present practice however, most taxing agencies will not agree to receiving only the frozen tax base amount. Instead "pass thru" agreements are entered into by the Redevelopment Agency in order to get the Redevelopment District formed. These pass through agreements entitle the existing taxing agencies to their fair share of the tax increment funds. This pass through of funds to existing taxing agencies dilutes the amount of the tax increment funds available to the Redevelopment District.

At present, two Redevelopment Project Areas exist within the City, with a third expected to be approved by mid-1991 and a fourth Redevelopment Project Area in the feasibility stage.

Redevelopment Project Area No.1 parallels State Highway 111 from the eastern City boundary to State Highway 74, then the area spreads out until it reaches the western City boundary.

Redevelopment Areas No. 2, No. 3, and proposed No. 4, encompass approximately 90% of the City's land between I-10 and the Whitewater Channel.

RECOMMENDED FEE STRUCTURE

In the case of the City of Palm Desert, a drainage fee program could be utilized to establish a cost per gross acre of undeveloped land to be assessed as the land develops. Based on a total undeveloped acreage of 4,890 acres and a total Master Plan cost of $23,295,129 , the applicable acreage fee has been divided among two drainage basins. The first drainage basin is comprised of Zones 1 & 2 and drains directly to the Whitewater Channel. A drainage fee of $4,000 per acre is recommended Zone 1 and $1,500 per acre is recommended for Zone 2.

The second drainage basin is comprised of Zones 3 & 4 and drains directly to the proposed Mid-Valley Channel. Zone 4 is for reference only and, therefore, no construction costs have been allocated at this time. Based on the cost of proposed drainage facilities, a drainage fee per acre of $1,000 is recommended for Zone 3. These costs are based on the ENR 20 cities index for January 1, 1992.

APPENDIX A

INCREMENTAL RUNOFF ANALYSIS
AND
RETENTION BASIN SIZES

INCREMENTAL RUNOFF ANALYSIS AND RETENTION BASIN SIZES

The following tables represent the incremental runoff analysis demonstrating on-site retention for 10-, 25-, 50-, and 100-year storms for 5-acre, single-family residential development and 0.25-acre commercial development. The storage volume required for each storm return period is noted in Table 1.

Within a 5-acre residential development approximately 23 lots of 8,000 square feet can be constructed. This figure is derived by allowing 15% of the total area to be used for roads and open space. Table 2 represents the storage basin sizes for each return period. From this table it is summarized that 1 lot per 5-acre development can accommodate the storage volume required. The storage volume provided in the table represents a standard 80' x 100' lot with a 15' wide maintenance road around the basin. The length and width of the basins remain the same with only the depth changing accordingly.

Appendix B graphically represents the storage volume required in cubic feet per acre, for both residential and commercial developments.

Appendix C represents runoff generated for residential development of 5 acres. Developed runoff and undeveloped runoff are shown graphically with the use of a bar chart.

TABLE-1

INCREMENTAL RUNOFF ANALYSIS
VOLUME REQUIREMENT

Storm Event Return Period (Years)	Undev. Flow (CFS)	Dev. Flow (CFS)	Time of Concen. (Min.)	Storage Required (Cu. Ft.)	Storage Required (CF/Acre)
	Residential Development * 5-Acre Drainage Areas				
10	5.23	9.92	11.52	3243	649
25	6.79	12.32	11.52	3823	765
50	8.38	14.72	11.52	4383	877
100	9.82	16.85	11.52	4860	972
	Commercial Development * 1/4 Acre Drainage Areas				
10	0.41	0.92	5.00	153	612
25	0.53	1.12	5.00	177	708
50	0.64	1.32	5.00	204	816
100	0.75	1.51	5.00	228	912

TABLE-2

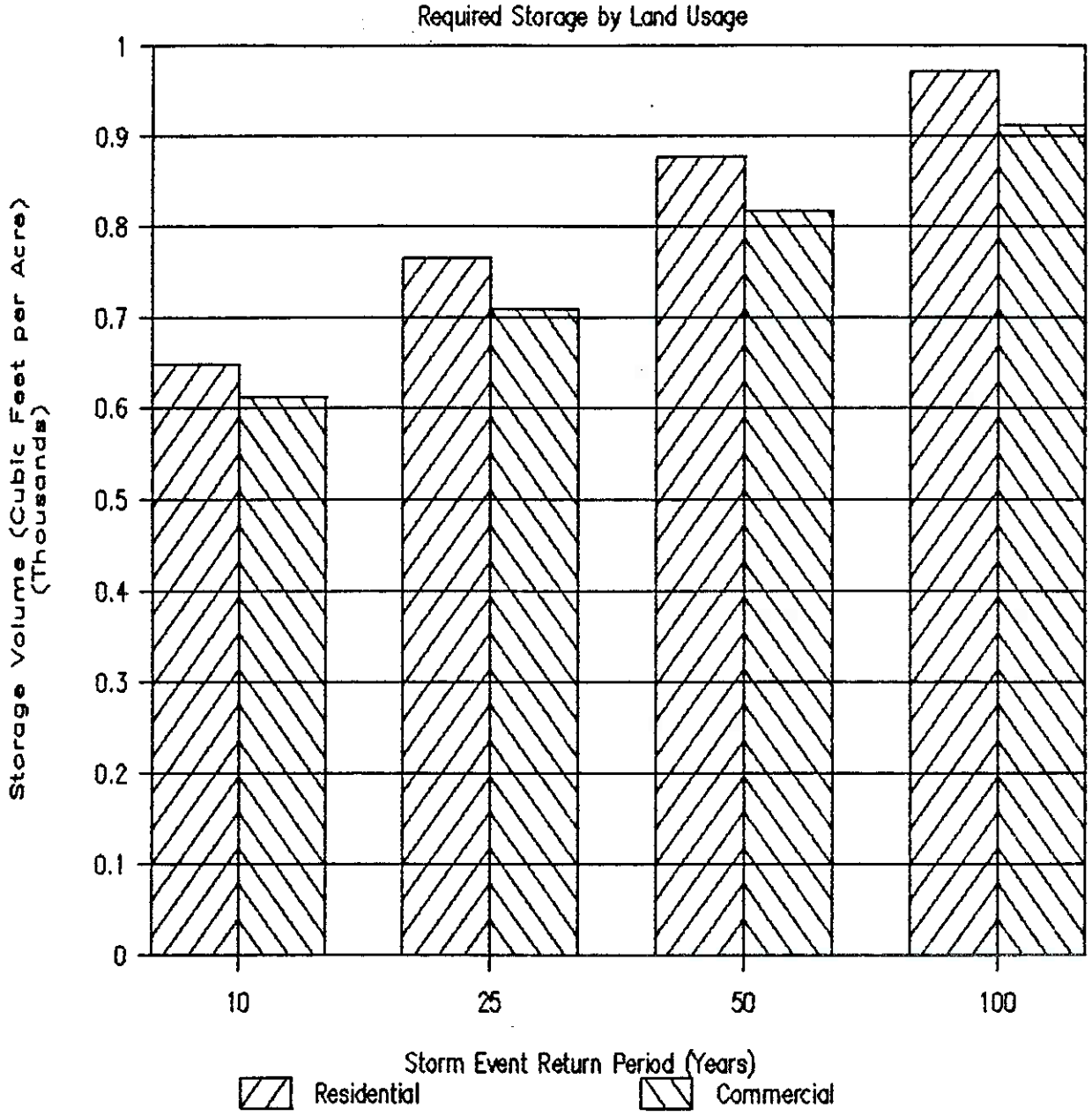
INCREMENTAL RUNOFF ANALYSIS
RETENTION BASIN SIZES

Storm Event (Years)	Storage Volume Required (CFS)	Storage Volume Provided (CFS)
	Residential Development * 5-Acre Development	
10	3243	3500
25	3823	4375
50	4383	5250
100	4860	7000
	Commercial Development * 1/4 Acre Development	
10	153	187.5
25	177	199.5
50	204	225.0
100	228	262.5

APPENDIX B

CITY OF PALM DESERT
REQUIRED STORAGE BY LAND USAGE

City of Palm Desert

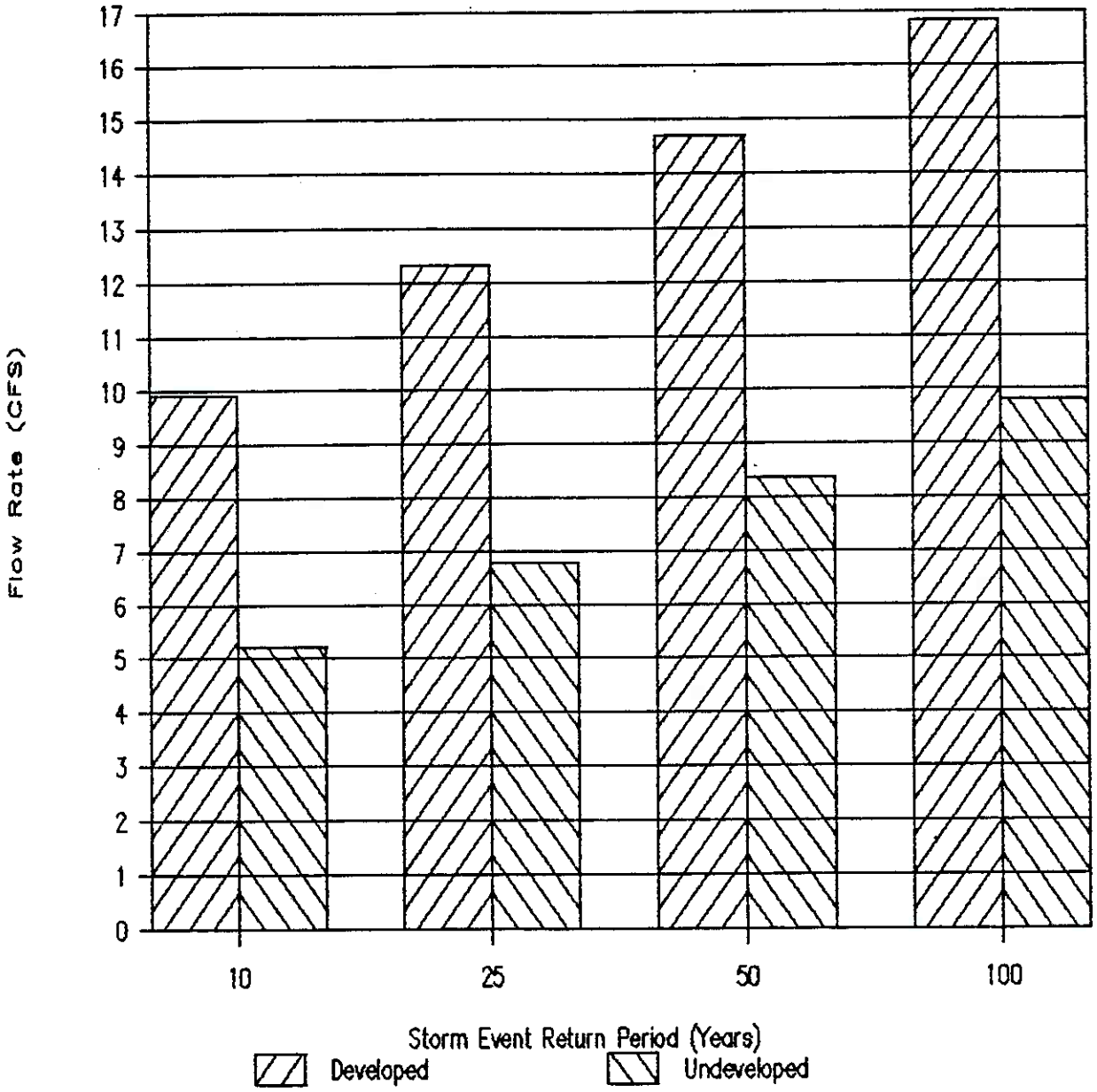


APPENDIX C

CITY OF PALM DESERT
INCREMENTAL RUNOFF ANALYSIS - RESIDENTIAL

City of Palm Desert

Incremental Runoff Analysis–Residential



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        RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                    (RCFC&WCD)  1978 HYDROLOGY MANUAL
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                          Especially prepared for:

                        NBS/LOWERY ENGINEERS & PLANNERS

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**********DESCRIPTION OF RESULTS*****************************************
* PALM DESERT  INCREMENTAL RUNOFF ANALYSIS                                 *
* 10 YEAR EVENT UNDEVELOPED VS. DEVELOPED(COMMERCIAL)                      *
* 10/10/90                                                                 *
********************************************************************************

--------------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =  .9898
  SLOPE OF INTENSITY DURATION CURVE =  .5799

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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                    Advanced Engineering Software [AES]
                              SERIAL No. I00971
                    VER. 3.3C     RELEASE DATE: 2/20/86

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**********************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
----------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
======================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   150.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     97.00
  ELEVATION DIFFERENCE =      3.00
```

```
  10.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.578
 SOIL CLASSIFICATION IS "B"
 UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6400
 SUBAREA RUNOFF(CFS) =        .41
 TOTAL AREA(ACRES) =        .25   TOTAL RUNOFF(CFS) =        .41

****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   150.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     97.00
 ELEVATION DIFFERENCE =      3.00
 TC =  .303*[(  150.00**3)/(     3.00)]**.2 =    4.918
 COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
  10.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.182
 SOIL CLASSIFICATION IS "B"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8820
 SUBAREA RUNOFF(CFS) =        .92
 TOTAL AREA(ACRES) =        .25   TOTAL RUNOFF(CFS) =        .92
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
(RCFC&WCD) 1978 HYDROLOGY MANUAL

Especially prepared for:

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**********DESCRIPTION OF RESULTS**********
* PALM DESERT INCREMENTAL RUNOFF ANALYSIS *
* 25 YEAR EVENT UNDEVELOPED VS. DEVELOPED (COMMERCIAL) *
* 10/10/90 *

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

USER SPECIFIED STORM EVENT(YEAR) = 25.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 18.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = .95
10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) = 2.770
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = .980
100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) = 4.520
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.600
SLOPE OF 10-YEAR INTENSITY-DURATION CURVE = .5799047
SLOPE OF 100-YEAR INTENSITY-DURATION CURVE = .5796024
COMPUTED RAINFALL INTENSITY DATA:
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.2027
SLOPE OF INTENSITY DURATION CURVE = .5799

RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

Advanced Engineering Software [AES]
SERIAL No. I00971
VER. 3.3C RELEASE DATE: 2/20/86

****
FLOW PROCESS FROM NODE 90.00 TO NODE 85.00 IS CODE = 2

>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

ASSUMED INITIAL SUBAREA UNIFORM
DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
INITIAL SUBAREA FLOW-LENGTH = 150.00
UPSTREAM ELEVATION = 100.00
DOWNSTREAM ELEVATION = 97.00
ELEVATION DIFFERENCE = 3.00

```
  25.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.133
 SOIL CLASSIFICATION IS "B"
 UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6745
 SUBAREA RUNOFF(CFS) =       .53
 TOTAL AREA(ACRES) =       .25   TOTAL RUNOFF(CFS) =       .53

****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   150.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     97.00
 ELEVATION DIFFERENCE =      3.00
 TC =  .303*[(  150.00**3)/(     3.00)]**.2 =    4.918
 COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
  25.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.081
 SOIL CLASSIFICATION IS "B"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8846
 SUBAREA RUNOFF(CFS) =      1.12
 TOTAL AREA(ACRES) =       .25   TOTAL RUNOFF(CFS) =      1.12
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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        RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                  (RCFC&WCD)  1978 HYDROLOGY MANUAL
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**********DESCRIPTION OF RESULTS*****************************************
* PALM DESERT INCREMENTAL RONOFF ANALYSIS                                 *
* 50 YEAR EVENT UNDEVELOPED VS. DEVELOPED(COMMERCIAL)                     *
* 10/10/90                                                                *
***************************************************************************

--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   50.00   1-HOUR INTENSITY(INCH/HOUR) = 1.4134
  SLOPE OF INTENSITY DURATION CURVE =  .5798

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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**************************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
          ASSUMED INITIAL SUBAREA UNIFORM
          DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   150.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     97.00
  ELEVATION DIFFERENCE =      3.00
```

```
  50.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.681
SOIL CLASSIFICATION IS "B"
UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .7006
SUBAREA RUNOFF(CFS) =       .64
TOTAL AREA(ACRES) =       .25   TOTAL RUNOFF(CFS) =       .64

****************************************************************************
FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
INITIAL SUBAREA FLOW-LENGTH =   150.00
UPSTREAM ELEVATION =    100.00
DOWNSTREAM ELEVATION =     97.00
ELEVATION DIFFERENCE =      3.00
TC =  .303*[(  150.00**3)/(     3.00)]**.2 =    4.918
COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
  50.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.969
SOIL CLASSIFICATION IS "B"
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8866
SUBAREA RUNOFF(CFS) =      1.32
TOTAL AREA(ACRES) =       .25   TOTAL RUNOFF(CFS) =      1.32
============================================================================
END OF RATIONAL METHOD ANALYSIS
```

```
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
       RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                   (RCFC&WCD)  1978 HYDROLOGY MANUAL
============================================================================

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**********DESCRIPTION OF RESULTS*********************************************
* PALM DESERT INCREMENTAL RUNOFF ANALYSIS                                   *
* 100 YEAR EVENT UNDEVELOPED VS. DEVELOPED (COMMERCIAL)                     *
* 10/10/90                                                                  *
*****************************************************************************

----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) = 1.6000
  SLOPE OF INTENSITY DURATION CURVE =  .5796

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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****************************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   150.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     97.00
  ELEVATION DIFFERENCE =      3.00
```

```
 100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.166
SOIL CLASSIFICATION IS "B"
UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .7192
SUBAREA RUNOFF(CFS) =       .75
TOTAL AREA(ACRES) =       .25   TOTAL RUNOFF(CFS) =       .75

****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   150.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     97.00
 ELEVATION DIFFERENCE =      3.00
 TC =  .303*[(  150.00**3)/(     3.00)]**.2 =    4.918
 COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
 100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.755
 SOIL CLASSIFICATION IS "B"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8879
 SUBAREA RUNOFF(CFS) =      1.50
 TOTAL AREA(ACRES) =       .25   TOTAL RUNOFF(CFS) =      1.50
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
    RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
  RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
              (RCFC&WCD)  1978 HYDROLOGY MANUAL
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**********DESCRIPTION OF RESULTS*****************************************
* PALM DESERT INCREMENTAL RUNOFF ANALYSIS                                 *
* 10 YEAR EVENT UNDEVLOPED VS. DEVELOPED(1/4 ACRE SINGLE FAMILY)          *
* 10/10/90                                                                *
*************************************************************************

--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =  .9898
  SLOPE OF INTENSITY DURATION CURVE =  .5799

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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**************************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   660.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     86.80
  ELEVATION DIFFERENCE =     13.20
```

```
  10.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.829
 SOIL CLASSIFICATION IS "B"
 UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .5722
 SUBAREA RUNOFF(CFS) =      5.23
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =      5.23

****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS SINGLE FAMILY (1/4 ACRE)
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   660.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     86.80
 ELEVATION DIFFERENCE =     13.20
 TC =  .393*[(  660.00**3)/(    13.20)]**.2 =   11.523
  10.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.577
 SOIL CLASSIFICATION IS "B"
 SINGLE-FAMILY(1/4 ACRE LOT) RUNOFF COEFFICIENT = .7699
 SUBAREA RUNOFF(CFS) =      9.92
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =      9.92
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
      RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
    RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                (RCFC&WCD)  1978 HYDROLOGY MANUAL
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**********DESCRIPTION OF RESULTS*****************************************
* PALM DESERT INCREMENTAL RUNOFF ANALYSIS                                 *
* 25 YEAR EVENT UNDEVELOPED VS. DEVELOPED(1\4 ACRE SINGLE FAMILY)         *
* 10/10/90                                                                *
***************************************************************************

--------------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   25.00   1-HOUR INTENSITY(INCH/HOUR) = 1.2027
  SLOPE OF INTENSITY DURATION CURVE =  .5799

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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**********************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
----------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
======================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   660.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     86.80
  ELEVATION DIFFERENCE =     13.20
```

```
  25.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.222
 SOIL CLASSIFICATION IS "B"
 UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6116
 SUBAREA RUNOFF(CFS) =      6.79
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =      6.79


****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS SINGLE FAMILY (1/4 ACRE)
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   660.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     86.80
 ELEVATION DIFFERENCE =     13.20
 TC =  .393*[(  660.00**3)/(    13.20)]**.2 =   11.523
  25.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.131
 SOIL CLASSIFICATION IS "B"
 SINGLE-FAMILY(1/4 ACRE LOT) RUNOFF COEFFICIENT = .7872
 SUBAREA RUNOFF(CFS) =     12.32
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =     12.32
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
        RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                    (RCFC&WCD)  1978 HYDROLOGY MANUAL
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**********DESCRIPTION OF RESULTS*****************************************
* PALM DESERT INCREMENTAL RUNOFF ANALYSIS                                 *
* 50 YEAR EVENT UNDEVELOPED VS. DEVELOPED(1\4 ACRE SINGLE FAMILY)         *
* 10/10/90                                                                *
*************************************************************************

--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   50.00   1-HOUR INTENSITY(INCH/HOUR) = 1.4134
  SLOPE OF INTENSITY DURATION CURVE =  .5798

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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**************************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   660.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     86.80
  ELEVATION DIFFERENCE =     13.20
```

```
  50.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.611
 SOIL CLASSIFICATION IS "B"
 UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6423
 SUBAREA RUNOFF(CFS) =      8.38
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =      8.38

****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS SINGLE FAMILY (1/4 ACRE)
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   660.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     86.80
 ELEVATION DIFFERENCE =     13.20
 TC =  .393*[(  660.00**3)/(    13.20)]**.2 =   11.523
  50.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.679
 SOIL CLASSIFICATION IS "B"
 SINGLE-FAMILY(1/4 ACRE LOT) RUNOFF COEFFICIENT = .8003
 SUBAREA RUNOFF(CFS) =     14.72
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =     14.72
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
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**********DESCRIPTION OF RESULTS*******************************************
* PALM DESERT INCREMENTAL RUNOFF ANALYSIS                                 *
* 100 YEAR EVENT UNDEVELOPED VS. DEVELOPED(1\4 ACRE SINGLE FAMILY         *
*                                                                         *
***************************************************************************

---------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
---------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.770
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =   .980
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  4.520
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.600
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =   .5799047
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =   .5796024
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) = 1.6000
  SLOPE OF INTENSITY DURATION CURVE =  .5796

  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED

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***************************************************************************
  FLOW PROCESS FROM NODE    90.00 TO NODE    85.00 IS CODE =   2
---------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
===========================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =   660.00
  UPSTREAM ELEVATION =    100.00
  DOWNSTREAM ELEVATION =     86.80
  ELEVATION DIFFERENCE =     13.20
```

```
 SOIL CLASSIFICATION IS "B"
 UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6644
 SUBAREA RUNOFF(CFS) =      9.82
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =      9.82

****************************************************************************
 FLOW PROCESS FROM NODE    80.00 TO NODE    75.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS SINGLE FAMILY (1/4 ACRE)
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =   660.00
 UPSTREAM ELEVATION =    100.00
 DOWNSTREAM ELEVATION =     86.80
 ELEVATION DIFFERENCE =     13.20
 TC =  .393*[(  660.00**3)/(    13.20)]**.2 =   11.523
  100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.163
 SOIL CLASSIFICATION IS "B"
 SINGLE-FAMILY(1/4 ACRE LOT) RUNOFF COEFFICIENT = .8095
 SUBAREA RUNOFF(CFS) =     16.85
 TOTAL AREA(ACRES) =      5.00   TOTAL RUNOFF(CFS) =     16.85
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

REFERENCES

GLOSSARY OF TERMS

CFS	Cubic Feet Per Second
Drainage Area	The area that contributes storm flows to a specific concentration point, or storm drain system
Hydrology	A multi-disciplinary subject dealing with the occurrence, circulation, and distribution of the waters of the Earth.
Peak Discharge	The highest rate of storm runoff expressed in cubic feet per second.
RCP	Reinforced Concrete Pipe
Sub Area	A smaller tributary area located within a drainage area.
25 & 100 year storm	An annual maximum event whose peak discharge is equaled or exceeded once, on the average, every 25 or 100 years, respectively.
Standard Project Flood	The discharge that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographical region involved.