STORM DRAINAGE JUNE 1964 SPARKS

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SPARKS NEVADA

A REPORT ON

STORM DRAINAGE

JUNE - 1964

KENNEDY ENGINEERS

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City of SPARKS NEVADA

PUBLIC WORKS
DEPARTMENT
CITY HALL
222 12TH STREET
SPARKS, NEVADA

September 30, 1964

Mr. Joe Latimore,
City Manager
City of Reno
P. O. Box 1900
Reno, Nevada

Dear Joe:

Enclosed please find a copy of Sparks Storm Drainage Report prepared by Kennedy Engineers.

A copy of this report was given to Public Works Director Holcomb last week.

We invite your comments on the report.

Very truly yours,

Cal. Dodson

Calvin J. Dodson,
Public Works Director

CJD:bw
encl.

cc: City Manager
R. Churn
File

KENNEDY ENGINEERS

SPARKS, NEVADA

A REPORT ON STORM DRAINAGE WITH STORM DRAINAGE MASTER PLAN AND FLOOD PLAIN DEFINITION

Chester S. Christensen Mayor

City Council

Arthur S. Pryor
Alan W. Rock, Sr.
Henry C. Swart
Dr. Albert J. DeMers
William A. Galt

City Officials

David B. Henry	City Manager
Calvin J. Dodson	Director of Public Works
James R. Brooke	City Attorney
Claude Cauble	City Clerk

June 1964

Prepared by

KENNEDY ENGINEERS - SAN FRANCISCO

KENNEDY ENGINEERS

604 Mission Street • San Francisco 5, California • Telephone: DOuglas 2-6065

29 June 1964

City Council
City of Sparks
Sparks, Nevada

Gentlemen:

We submit herewith our Report on Storm Drainage for the City of Sparks as authorized by the Sparks City Council in July 1963.

This report is presented as a Master Plan for Storm Drainage within the City of Sparks designated Planning Area. The Storm Drainage Master Plan incorporates existing storm drains and certain irrigation drains together with a basic plan for drainage of the undeveloped portions of the designated Sparks Planning Area. Rainfall and runoff criteria have been developed in conjunction with this report to be used as a guide for the design of storm drainage facilities.

The recommended design flood plain of the Truckee River has been defined and the problems of development within the flood plain are outlined. Problems relating to the control of storm waters which originate outside the City Planning Area have been outlined.

It is hoped that this report, together with supporting data furnished the Director of Public Works, will serve as a comprehensive guide for storm drainage planning with the basic purpose of ensuring efficient storm drainage which can be constructed on an incremental basis at minimum cost through sound and timely planning.

Very truly yours,

KENNEDY ENGINEERS

Richard R. Kennedy

Richard R. Kennedy

RRK:fb

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I. INTRODUCTION

Preparation of the Storm Drainage Master Plan for the City of Sparks has involved field investigations and surveys, compilation of available data, evaluation of existing storm drainage and irrigation systems, and the development of schematic design and flow criteria for future extensions of the City storm drainage system.

Considerable assistance of the Public Works Department staff has been utilized in all phases of this study.

This study has been closely coordinated with a concurrent study of area-wide irrigation and drainage problems being performed by Mr. Walter Reid, P.E.

The following scope of work approved by the Director of Public Works has been utilized as a basic study outline:

1. Preliminary Office Work

   Update City base map
   Compilation and plotting topographic data
   Plotting of existing drainage facilities
   Compilation and evaluation of all available hydrologic data

2. Field Investigations

   Field confirmation of existing drainage facilities
   Evaluation of irrigation systems
   Check of additional February 1963 high water data
   Measurement of rainfall and runoff from a typical urban area

3. Data Reduction and Studies

   Evaluation of existing storm drainage facilities
   Preparation of drainage maps
   Definition of hydraulic and hydrologic criteria
   Outline of storm drainage master plan
   Definition of Truckee River flood plain

4. Report Preparation and Submittal

   Progress review with Director of Public Works
   Preliminary presentation of findings to City Council
   Final report preparation and submittal

Supporting data and detailed criteria for design of storm drainage facilities are being submitted to the Director of Public Works under separate cover.

II. STORM DRAINAGE PLANNING

Storm drainage problems and storm drainage planning for the City of Sparks at the present time relate closely to the effects of growth and development.

Until recently, existing storm drainage facilities have generally met the practical requirements of providing drainage with minimal inconvenience or damage. Present and proposed highway construction has complicated the already complex drainage problems of the area.

Recent storm drainage problems experienced during the year 1963 emphasized the need for planning storm drainage facilities which are integrated with existing facilities and which allow sufficient capacity for future planned development within the designated City Planning Area. Such a plan must also incorporate the existing storm drainage system by making maximum use of available existing conduit capacities and should correct any deficiencies apparent in the existing storm drainage system.

The designated City of Sparks Planning Area is shown on Plate 1. This Planning Area includes the present incorporated area of the City of Sparks; the remainder of the North Truckee Meadows, extending from the Reno-Sparks boundary line on the west and from the Truckee River on the south to the foothill line on the north and east. A portion of the Sparks Planning Area which extends into Spanish Springs is also shown.

Planning areas and the major tributary drainage areas are shown on Plate 1. These areas are tabulated as follows:

Planning Areas:

City of Sparks, 1964	3.6 sq mi
North Truckee Meadows	14.8 sq mi
Spanish Springs	4.5 sq mi
Total	22.9 sq mi

Tributary Drainage Areas:

City of Reno (portion)	6.9 sq mi
Spanish Springs	75.9 sq mi
Sun Valley	10.6 sq mi
Virginia Foothills	7.9 sq mi
Total Area Tributary to Planning Area	101.3 sq mi
Planning Area	22.9 sq mi
Total Tributary Area	124.2 sq mi

The previously described Sparks Planning Area is located in a semi-arid climatic zone which lies between an area of relatively high precipitation over the Sierra Nevada to the west and the arid desert plateau of the Great Basin to the east. The Planning Area is affected by Pacific storms which typically originate in the Gulf of Alaska and swing south, picking up large quantities of moisture over the humid Pacific before turning inland. These storms often penetrate to the Great Basin, but not before being greatly reduced in intensity by the "orographic squeeze" of the Sierra Nevada Range. This phenomenon is reflected in the comparison of mean annual precipitation records from various meteorological recording stations running from west to east from the Pacific Coast. The marked effect of the Sierra Nevada in producing its "orographic squeeze" is demonstrated by the steepness of this precipitation profile between the recording stations at Blue Canyon (60.37 inches); Truckee (31.14 inches); Reno Airport (7.15 inches); and Lahontan Dam (4.12 inches).

Storm drainage problems within the present corporate boundaries of the City of Sparks are not critical at the present time in terms of actual experienced primary damage. The principal storm drainage need at this time is that of planning for adequate drainage in future areas of development. Both existing and future development must be protected from the effects of increases in runoff which will originate outside areas of present development. Conflict between existing irrigation ditches and storm drains will continue to be a problem as urban areas develop, although the parallel reduction of land being irrigated should permit either consolidation or elimination of irrigation lines. Flooding resulting from runoff from tributary areas outside the Planning Area will become increasingly more critical as agricultural lands formerly available for detention and spreading of storm water are developed. As development extends easterly and southerly, developmental pressure will encourage encroachment of the Truckee River flood plain with resultant potential damage to property and the creation of serious public works maintenance problems for the City.

In recognition of some of the above problems and because of specific drainage problems experienced during 1963 in the Meadowvale Subdivision of the City of Sparks, the Federal Housing Authority has requested that the City adopt a Master Plan for Storm Drainage and require adherence by all future development to this Master Plan. A letter from the Federal Housing Authority dated 16 July 1963 is included in the Appendix.

The primary objective of the Federal Housing Authority in recommending adoption and adherence to a storm drainage master plan is in the interest of protecting the value of developed property. There are additional benefits to the City which will also result from adherence to a storm drainage master plan and which should be considered. These include the following:

1. A storm drainage master plan will encourage orderly and integrated development and will assist the developer with planning.

2. Enforcement of development in accordance with a storm drainage master plan results in more equitable financing of storm drainage improvements by those most directly benefitting.

3. Master plan development of storm drainage will result in maximum benefit at minimum cost by eliminating paralleling facilities or duplication of construction at a later date. Correction of deficiencies at a later date is far more costly than initial construction, particularly where inadequate rights-of-way are reserved.

4. Consolidation of irrigation ditches and storm drains will permit more efficient location of storm drains and will tend to reduce the present high ground water table.

5. Adoption of a storm drainage master plan will simplify coordination of City drainage needs with those of the State Highway and County Road Departments and other affected agencies.

It is with the above problems and objectives in mind that the City of Sparks Storm Drainage Master Plan has been developed.

III. CRITERIA

Rainfall and runoff criteria as developed are based on analyses of available records in and adjacent to the study area. Additional data have been recorded based on field observations.

Rainfall

Rainfall criteria are based on U.S. Weather Bureau records of rainfall observed at the Reno Airport since 1942 and at the Reno Post Office between 1906 and 1942. Intensity-duration-frequency curves are plotted based on these data. An evaluation of these intensity-duration-frequency curves indicates that, for rainfall duration less than two hours, intensity is based almost completely on Summer storms. Observations of the typical Summer storm patterns over the Truckee Meadows basin summarized in reports by U.S. Weather Bureau meteorologists and as observed indicate that the typical movement of thundershowers in this area is for thundershowers to drift slowly north or northwesterly. The most severe thunderstorm activity in the basin occurs typically along the eastern slope of the Sierra Nevada Range and is associated with heavy cumulus buildup over the mountains in the afternoon and early evening. Thundershowers typically are more scattered, less severe and less inclined to become static in movement in the vicinity of the Sparks Planning Area than in the westerly portion of the basin.

Because of the above factors, thundershower activity in the vicinity of the City of Sparks has not generally been as severe a problem in the Sparks Planning Area as Reno Post Office and Reno Airport precipitation records would indicate. The limited area of precipitation, the short duration, the northerly velocity and the freedom of movement of thundershowers combine to minimize the problem of Summer storm runoff over the Sparks Planning Area.

For this reason, rainfall intensity-duration-frequency curves developed for the City of Sparks Planning Area have been modified to minimize the effect of Summer storms. These intensity-duration-frequency curves are shown on Plate A-1.

Because of the wide variation in the precipitation pattern across the Truckee Meadows basin, there is a need for additional precipitation gaging stations which would provide data which could then be correlated with the longer period of record data recorded at the Reno rain gaging stations. The variation in the precipitation patterns over the basin can be explained when it is considered that the area is located in the lee of the Sierra Nevada Range relative to major storm patterns moving inland from the Pacific Coast. Mean annual precipitation varies from in excess of 60-inches over the Sierra crest to 7.15-inches at Reno in a distance of less than 60 miles. Comparison of coincident rainfall periods of Reno Post Office and Reno Airport from 1939 through 1942 indicates a consistently lower rainfall intensity observed at Reno Airport, 2.3 miles east of Reno Post Office. Maximum yearly 24 hour rainfall over this period as measured at Reno Airport is 82 percent of measurement taken at Reno Post Office.

Runoff

There is no program for flow measurement of any tributary to the Sparks Planning Area except flow in the Truckee River which is gaged by the U.S. Geological Survey. Recently, the U.S. Geological Survey initiated a program of stream measurement for some of the smaller watersheds along the westerly slope of the Truckee Meadows basin. The limited information available from this source has been considered and has been utilized as a basis of correlation to assist in establishing runoff criteria within the Sparks Planning Area. These data have been supplemented with measurement of flow in the Sun Valley Drain and the North Truckee Drain during the February 1963 storm. Additional development of data on runoff from local drainage areas within representative sections of the City was planned for the current rainfall season. Flow measuring and recording equipment was installed in the existing storm drainage system under this master plan study and additional totalizing rain gages were placed in the local drainage area. Information gathered from this local measuring program to date is of insufficient duration to use in establishing storm drainage criteria. It is hoped that this program will be continued and possibly expanded to provide accurate data which can be used to refine criteria now developed.

Master Plan Criteria

The Storm Drainage Master Plan is based on providing satisfactory drainage under a condition of full development of the Sparks Planning Areas as shown on Plate 3. Planning area density and nature of development have been assumed to be equivalent to that of presently developed portions of the City. Runoff coefficients have also been based on existing development within the City.

Level of Protection Criteria

It is common practice in the design of planning of storm drains to establish design standards for storm drainage capacity in terms of "level of protection". "Level of protection" defines conditions for storm drainage design in terms of the probability of recurrence of the design condition or design storm. Probability of recurrence of the design storm is expressed as a period, measured in years, during which a given condition is statistically expected not to be exceeded.

Criteria relating to the various levels of protection as used herein to determine master plan storm drainage capacity requirements are as follows:

1.	Local Drainage	5 year
2.	Major Tributaries to the City of Sparks Planning Area (Sun Valley Drain, Spanish Springs Drain, Virginia Foothills Drainage)	50 year

3. Total local inflow combined with Spanish Springs Drainage in North Truckee Drain — 25 year

See Appendix for detailed discussion of master plan flow determination and methods of calculation.

It should be pointed out that, in spite of possible legal responsibilities, it is not practical or feasible to construct drainage facilities which will handle the greatest rainstorm that may occur. For this reason, good judgment and good engineering practice dictates that drainage facilities be provided for reasonable levels of protection considering the possible inconvenience and damage that might result from a storm above the protection level. This has become even more important where flood plains are being developed for uses which would permit occasional flooding.

IV. EXISTING STORM DRAINAGE SYSTEM

The existing storm drainage system consists of approximately 21.4 miles of pipe, 568 catch basins, 275 manholes, and an unestimated footage of ditch. An additional 9.5 miles of irrigation pipelines and ditches are utilized partially for City storm drainage. Pipe in place is predominantly concrete. Some corrugated metal pipe is also in service.

The condition of the existing storm drainage system is generally good based on recent inspection by the Department of Public Works. The recent initiation of a routine cleaning and maintenance operation has significantly improved the carrying capacity of the system.

The existing system has been evaluated hydraulically, and compared with capacity requirements based on derived flow requirements using the master plan criteria applied to the existing system.

It was determined that 15.2 miles of existing storm drains were of adequate capacity to meet present requirements. (Existing capacity is equal to 90 percent or more of required capacity based on Master Plan criteria, existing conditions.)

It was determined that 1.6 miles of existing storm drains have capacity in excess of present requirements which can be utilized to meet hydraulic requirements for additional flow under Master Plan conditions. (Existing capacity exceeds 110 percent of required capacity based on Master Plan criteria, existing conditions.)

It was determined that 4.6 miles of existing storm drains were inadequate to provide a recommended level of protection. (Existing capacity is less than 90 percent of required capacity based on Master Plan criteria, existing conditions.)

With the exception of the Meadowvale Subdivision mentioned previously, which has experienced limited flood problems, the existing storm drainage system has generally met the test of performance. Damage and inconvenience, as measured on an average annual basis, have been within reasonable limits. The performance of the existing storm drainage system has been assisted significantly by the fact that the present development area of the City of Sparks slopes adequately and uniformly to the southeast. As a result, there is little tendency for surface waters to pond or to accumulate in damaging quantity. Deficiencies in conduit size, particularly in older sections of the City are offset by the fact that surface flow moves uniformly and without undue concentration and is relieved after flowing a relatively short distance by discharging onto agricultural land. After the residential and industrial development of this agricultural land, drainage problems will result unless adequate provisions are made.

One serious storm drainage system deficiency which creates not a drainage problem but a sanitary sewerage problem is found in those areas where storm drainage enters the sanitary sewer system. Approximately 90 acres of land within the existing development area, as shown on Plate 2, are drained to the sanitary system. This combination of storm sewerage and sanitary sewerage should be eliminated.

One of the major problems with the existing storm drainage system results from problems relating to existing irrigation systems, most of which were constructed prior to urban development. In many areas of the City, storm drainage is discharged to existing irrigation ditches both as a result of interception of surface flow and as a result of direct connection to City storm drains. There exists a conflict in function between these irrigation ditches and urban storm drains which results from the fact that the basic purposes of the two systems are not similar. Irrigation systems in the Sparks Planning Area, as shown on Plate 4, divert water from the Truckee River, convey this water away from the River, and finally collect irrigation return tailwater and return it to the River. The purpose of a storm drainage system is to convey drainage to the River, or major drainageway, as directly as possible. Irrigation supply lines are typically constructed at a minimum grade in order to preserve available fall and permit irrigation of a maximum area of land.

The North Truckee Ditch, which is shown on Plate 4, currently irrigates an area of approximately 2300 acres. The North Truckee Ditch runs in a northeasterly direction through the center of the City and intercepts drainage from 840 acres of urban land. There are several major problems which result from operation of the North Truckee Ditch, all of which support serious consideration for abandonment of this ditch:

1. Alignment of the ditch in a direction away from the River imposes an inefficient drainage pattern for all drainage intercepted by the North Truckee Ditch, resulting in some drainage being conveyed in excess of five miles farther than necessary before being ultimately discharged to the River.

2. The North Truckee Ditch, when running at, or in excess of established water rights or irrigation need, has insufficient capacity to carry additional storm drainage.

3. The City, because storm drainage is being discharged to the North Truckee Ditch, has assumed responsibility for ditch cleaning and maintenance in urban areas without obtaining commensurate benefit.

4. Transfer of water rights to the Orr Ditch would minimize maintenance and operation costs for the ditch companies.

5. The North Truckee Ditch contributes to high ground water problems over a large area of the City, adding to the problem of underground utilities construction and sanitary sewer infiltration.

6. The open ditch sections of the North Truckee Ditch are a safety hazard, particularly in residential areas.

7. The transfer of irrigation flow from the North Truckee Ditch would permit the full utilization of conduit capacity for storm drainage in that portion north of Oddie Boulevard and would permit its incorporation into the Master Plan.

Flood Problem Areas

Principal problem areas subject to recurrent flooding in the existing storm drainage system are limited, and it is significant that each of these problem areas is related to drainage originating outside the City. There is no indication of any serious, frequently recurrent drainage problem in the existing system which is primarily a result of local drainage. The winter storm flooding in the Meadowvale Subdivision area was the result of the combination of local drainage and Sun Valley runoff, a condition which was further complicated by the fact that the People's Drain Ditch was running full and had no receiving capacity for flow in addition to that being contributed by areas to the west. The Summer storm flooding in this area resulted from intense local rainfall, which was unable to adequately drain because of irrigation flow in the People's Drain Ditch, an irrigation ditch draining from the west as shown on Plate 4. Since this flooding, a 24-inch diameter collector drain has been constructed which will relieve this problem area.

The area north of the railroad and west of Sullivan Lane which is immediately adjacent to the Silverada Subdivision in Reno is considered a potential problem area at the present time. Existing storm drains through this area are inadequate to convey runoff which is tributary from a large rapidly developing area of northeast Reno. Serious damage to the City of Sparks in 1963 was averted because of an inadvertant restriction to flow at the City Limit line which caused severe flooding in an undeveloped portion of the Silverada Subdivision which provided sufficient storage with which to reduce peak flows through Sparks.

Drainage from Spanish Springs has caused no problems up to the present only because existing development does not extend into the affected area at the present time.

V. DESCRIPTION OF MASTER PLAN

The Storm Drainage Master Plan provides maximum utilization of existing storm drains and provides for the conversion of certain irrigation lines to storm drainage use in addition to establishing the basic drainage pattern for extended development into presently undeveloped portions of the City Planning Area.

Basic Storm Drainage Plan

The Storm Drainage Master Plan presented on Plate 3 utilizes the North Truckee Drain as improved as the principal drain for all of the Planning Area north of Highway 40. The North Truckee Drain, which has been recently improved and realigned, is located primarily along the same alignment as the arterial roadway proposed for this area. The North Truckee Drain will intercept the major storm drains extending to the east from the area of present development as well as the drainage from the Virginia Foothills, Spanish Springs, and Sun Valley.

The major lateral drains tributary to the North Truckee Drain, as shown, are proposed as:

1. McCarran Drain which will extend easterly along the proposed alignment of McCarran Boulevard;
2. Greenbrae Drain which will be the extension of the North Truckee Ditch converted fully to storm drainage use;
3. Prater Way Drain which will extend easterly along Prater Way;
4. "B" Street Drain which combines with highway drainage to the east of the area of present development.

The Sparks Industrial Area, located between Highway 40 and the Truckee River, is drained directly to the Truckee River in that portion of the area west of Stanford Way. That portion of the Sparks Industrial Area which is located east of Stanford Way will be drained by the Kleppe Way Industrial Drain to a point of confluence with the North Truckee Drain just south of Highway 40.

Highway 40 drainage as well as the proposed Freeway, Interstate Route 80 drainage, is routed more or less independently to a point of confluence with the North Truckee Drain.

Northeast Reno Drainage

The Sparks Storm Drainage Master Plan is based on the assumption of conformance by the City of Reno to the provisions of their adopted Storm Drainage Master Plan. The City of Reno Storm Drainage Master Plan provides for the interception of all surface

drainage at the common Reno-Sparks city boundary and for conveyance of this flow south to the Truckee River. The City Attorney for the City of Sparks advises that "the City of Reno has no right to use the City of Sparks as a means to convey its surplus drainage waters to the final outlet".

There is no provision in this Master Plan for conveyance of any storm drainage which may originate within that portion of the Reno Watershed which is also tributary to the City of Sparks. An alternative for conveying northeast Reno storm waters through the City of Sparks in a joint storm drain has been investigated and is determined to be not feasible based on benefit to either the City of Sparks or the City of Reno.

Sun Valley Detention Reservoir

The desirability and feasibility of controlling flooding which occurs in the Sparks Planning Area as a result of uncontrolled storm water from Sun Valley has been investigated. It has been determined that a flood detention reservoir located approximately as shown on Plate 3 is both desirable and feasible for reducing flood damage and in reducing the cost of drainage conduit required to ultimately convey Sun Valley Drainage to the Truckee River. This storm water must be conveyed nearly six miles to its point of discharge to the Truckee River, thus affecting the capacity requirement of storm drains for this considerable distance. A reservoir detention capacity of approximately 200 acre-feet would be adequate to limit maximum discharge to approximately 20 cfs and would result in significantly reduced conduit capacity requirement downstream.

Irrigation Ditch Elimination Program

One important phase of this Master Plan is the consideration of elimination of some ditch systems in order to improve storm drainage and to reduce problems associated with irrigation ditches traversing urban areas. The benefits of such a program would be to: improve storm drain alignment, decrease ground water problems, increase existing storm drain capacity, reduce safety hazard, and significantly improve the efficiency of irrigation operations.

Problems in phasing out irrigation ditch systems, as agricultural areas are otherwise developed, lie with requirements for providing substitute interim irrigation ditches or pipelines, removal of existing City storm drainage from affected irrigation lines, and transfer of ditch water rights. In some instances, interim irrigation ditches or pipelines can be incorporated into the storm drainage system at a later date, if carefully located. There are several examples of this within the existing storm drainage system.

The major item in the program to minimize irrigation conflicts is the proposed elimination of the North Truckee Ditch as an active irrigation ditch. It has been determined from a review of the ditch

systems and location of lands currently under irrigation and representing active water rights that it is feasible to eliminate irrigation diversion to the North Truckee Ditch within two years. Construction of a connecting irrigation line from Orr Ditch to the areas presently being irrigated by the North Truckee Ditch would be required and represents the basic cost to the City of this program.

Feasibility of the proposed elimination of irrigation flow in the North Truckee Ditch is based on the findings of a concurrent study by Mr. Walter G. Reid of irrigation and drainage problems of the agricultural areas within the Sparks Planning Area.

Because of the possibility of eliminating a costly drainage structure under the proposed Freeway, abandonment of the lower portion of the North Truckee Ditch should be considered as an alternative drainage plan. This drainage plan would be contingent upon the possible application of funds saved by elimination of the Freeway crossing structure to the construction of a drain serving the same tributary area, plus some Freeway drainage which would be routed south to the River rather than to the North Truckee Ditch. This alternative drainage plan would require transfer of North Truckee Ditch water rights to the Orr Ditch and construction of an irrigation line from the Orr Ditch prior to commencement of Freeway construction.

Additional consolidation or elimination of irrigation ditches in the Industrial Area west of Stanford Way appears feasible and is essential to provide for orderly development of this area. The Sessions, Stevens, and Glendale Ditches, the Mary Wahl Drain, and miscellaneous tailwater drains all traverse this area. Essentially all of the Sessions Ditch irrigation area is planned for imminent industrial development as is a portion of the Stevens Ditch irrigation area. It is believed that completion of sanitary sewer facilities now under construction will accelerate industrial development in the Glendale Ditch irrigation area.

Present irrigation systems and irrigation service areas and a summary of water rights and acreage related to the various irrigation systems located within the Sparks Planning Area as prepared by Walter G. Reid are shown on Plate 4.

Truckee River Flood Plain

The definition of area subject to periodic flooding by the Truckee River and consideration of restrictions on development within this flood plain area is an important element of the Storm Drainage Master Plan. The Truckee River flood plain area is shown on Plate 5. This flood plain is based on routing December 1955 flood flow through the existing channel as improved by the Corps of Engineers in 1960. One interesting factor observed is the effect of the railroad berm in reducing the flood plain level in the North Truckee Meadows, north of the railroad.

Damage resulting from flooding of the Truckee River in the Sparks Planning Area is presently limited to agricultural land inundation inasmuch as the present area of development lies well above the flood plain. Primary damage is in the Kleppe Way area where farms and farm homes have been flooded. The Sparks-Vista Airport is subject to flooding which in the past has required removal of aircraft.

The greatest potential for minimizing of flood damage from the Truckee River is available through planning and adequate control of development in that portion of the Sparks Planning Area which lies within the flood plain. Development within this area must be controlled to the extent necessary to encourage land uses which can withstand flooding with a minimum exposure to damage. Much of this land is well suited for recreational development or industrial uses which through careful design could avoid significant flood damage other than interruption of use and inconvenience. Much of the flood plain is relatively shallow and could be developed by nominal filling to an elevation above the flood plain. Control of street and utility construction must be exercised in order to minimize City maintenance costs. Control of development within the flood plain zone can best be accomplished through enactment of a flood plain development ordinance well in advance of the time it may be needed. This is the most economical flood control measure available at this time.

There has also been considerable discussion regarding further physical flood control measures on the Truckee River because of increasing interest in development of this rather large area which will soon have the added asset of sewerage facilities.

Without the benefit of the extensive study and investigation which would be required to compare alternative programs for flood protection of this area, it is difficult to suggest what the most feasible solution might be. The basic alternatives for flood control in the Truckee Meadows area may be expected to consist of one or a combination of the following measures:

1. Deepening and enlargement of the Truckee River and its lower tributaries to improve hydraulic conditions at the controlling point of flood plain discharge.

2. Construction of a system of flood plain containment levees on the Truckee River and lower tributaries.

3. Construction of additional local basin flood detention structures such as the Steamboat Creek Detention Reservoir.

4. Construction of supplemental channels and levees for tributaries including local storm water pumping facilities which would be required for drainage of all land behind levees.

5. Filling of flood plain areas.

Considering the apparent costs of further channel improvement in the Vista area which would be required in conjunction with any further deepening or enlargement of the Truckee River channel, it would appear more feasible to construct a system of levees designed to partially contain and reduce the Truckee Meadows flood plain. This Levee system would permit the reclamation of the remaining area for urban development. Pumping and local storage of local storm drainage in these areas protected by levees would be required.

Feasibility of this program would be based on the increased valuation of land reclaimed for urban development.

VI. SUMMARY OF FINDINGS

1. The existing storm drainage system, with the exception of those areas where storm drainage is discharged to the sanitary sewer system and those areas subject to flooding from uncontrolled drainage originating outside the Sparks Planning Area, is generally adequate for existing requirements.

2. The interrelation of existing storm drains and irrigation ditch systems reduces the effectiveness of the storm drainage system.

3. It is feasible to convert many of the major existing irrigation pipelines and ditches which traverse the City to exclusive use as storm drains, utilizing excess irrigation capacity for providing storm drainage capacity for future areas of development within the City Planning Area.

4. It is feasible to eliminate irrigation flow in the North Truckee Ditch by transferring water rights to the Orr Ditch together with construction of an irrigation pipeline from the Orr Ditch to the North Truckee Ditch irrigation service area, based on the findings of Mr. Walter G. Reid, P.E.

5. Construction of an enlarged People's Drain along the alignment indicated with sufficient capacity for the needs of both the cities of Reno and Sparks is not economically feasible based on a comparison with alternative solutions considered.

6. Construction of a storm water detention reservoir to control Sun Valley drainage is desirable and appears to be feasible.

7. Approximately 90 acres of developed land is drained to the sanitary sewer system. The presence of storm water requires added sewer and sewage treatment capacity and represents an uneconomical use of sanitary sewerage facilities.

8. There exists at the present time a serious need for an ordinance governing development within the established flood plain of the Truckee River. The immediacy of this need results from current sanitary sewer construction in a portion of this area, which will improve the potential for industrial development of this area.

9. There is a serious need for additional rainfall and runoff data which are specifically applicable to the Sparks Planning Area.

Additional hydrologic data will minimize assumptions of design criteria and will permit more exact design of storm drainage facilities.

VII. RECOMMENDATIONS

1. It is recommended that the Storm Drainage Master Plan and design criteria as presented herein be adopted as the governing basis for all storm drainage construction within the City of Sparks Planning Area.

2. It is recommended that the construction program required to discontinue irrigation use of the North Truckee Ditch be implemented and that the City assist in the transfer of ditch water rights from the North Truckee Ditch to the Orr Ditch.

3. It is recommended that the City schedule a program to extend the existing storm drain system as required to effect complete separation of storm waters from the sanitary sewer system.

4. It is recommended that the Sparks City Council adopt a resolution requesting U.S. Department of Agriculture, Soil Conservation Service assistance in planning and constructing a flood detention reservoir to provide control of Sun Valley drainage, with the City of Sparks named as the sponsoring agency.

5. It is recommended that the Sparks City Council establish a policy with regard to the problem of continued discharge of storm drainage from the City of Reno into waterways tributary to the City of Sparks. Recommendations by the City Attorney should be considered together with the findings relating to feasibility of a joint storm drainage facility.

6. It is recommended that the Sparks City Council adopt an ordinance controlling development within known flood plain areas based on the flood plain developed herein.

7. It is recommended that the Sparks City Council review and consider necessary revisions to the existing subdivision ordinance requiring adherence to the Storm Drainage Master Plan, preventing encroachment on Storm Drainage Master Plan rights-of-way, and establishing a basis for the financing of offsite storm drainage improvements.

8. It is recommended that a request be submitted to the State Department of Highways asking for reassignment of funds saved by the proposed elimination of the North Truckee Ditch crossing of the proposed freeway. Reassignment of these funds, if applied to the construction of the People's Drain extension south to the Truckee River, would benefit both the City of Sparks and the highway construction program.

9. Construction of the 15th Street storm drainage interceptor is recommended as funds become available. This interceptor is required to relieve inadequate storm drainage capacity in the downtown commercial area of the City.

10. It is recommended that the program for measurement of rainfall and storm runoff at representative locations in the Sparks Planning Area be continued. Establishment of a recording rain gage in the Sparks Planning Area on a cooperative basis with the U.S. Weather Bureau should be requested. It is recommended that a request for inclusion of Spanish Springs and Sun Valley Drains with the U.S. Geological Survey Small Watershed Stream Gaging Program be made.

VIII. COST ESTIMATE SUMMARY

1. Immediate Construction Program

(a) People's Drain Extension South

Construction Cost	$29,900	
Contingency	4,500	
Total	$34,400	
Design, Legal, Construction Supervision, and Incidental Costs	10,000	
Rights-of-way	15,600	
Total Project Cost		$60,000
Recommended Budget		$65,000 *

(b) Orr Ditch Diversion Pipeline

Construction Cost	$60,000	
Contingency	9,000	
Total	$69,000	
Design, Legal, Construction Supervision, and Incidental Costs	15,000	
Rights-of-way	5,000	
Total Project Cost		$89,000
Recommended Budget		$95,000 *

* Exclusive of costs of negotiations for land and water rights transfer and abandonment of unused ditches.

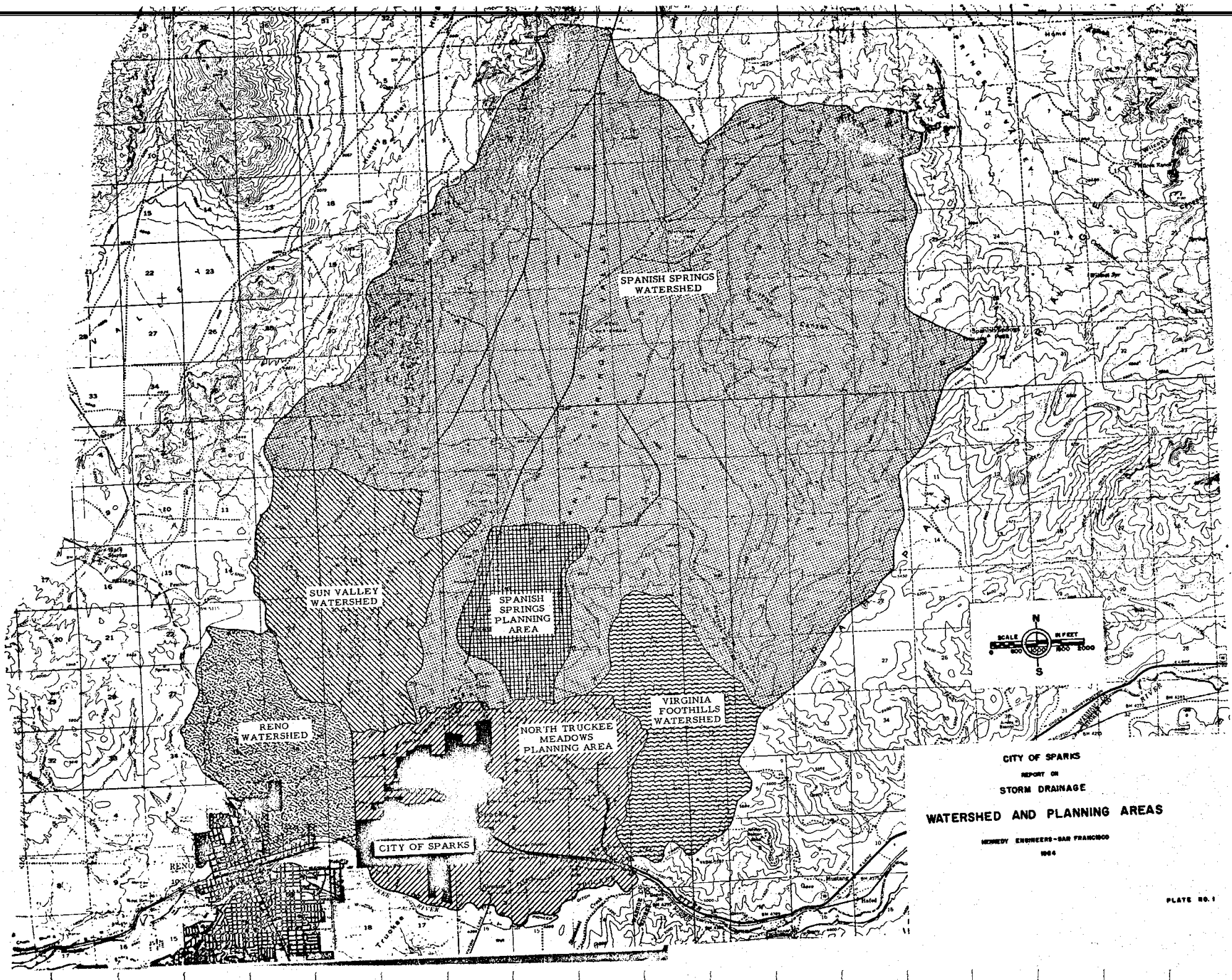
VIII. COST ESTIMATE SUMMARY - Cont'd.

(c) North Truckee Ditch Crossing at Freeway (Savings)

Construction Cost	$ 35,000	
Contingency	3,500	
Total	$ 38,500	
Design, Legal and Administrative	(no savings)	
Construction Supervision	3,500	
Total Project Cost		$ 42,000
Less Suggested Benefit to Highway Project (10%)		4,000
Net Funds Available (Suggested)		$ 38,000
Funds Available (Budget)		$ 35,000

People's Drain Extension South	$ 65,000	
Orr Ditch Diversion Pipeline	95,000	
Total	$160,000	
Highway Construction Saving Funds Available (Budget)	- 35,000	
Total Recommended Project Budget		$125,000 *

* Exclusive of costs of negotiations for land and water rights transfer and abandonment of unused ditches.


SPANISH SPRINGS WATERSHED
SUN VALLEY WATERSHED
SPANISH SPRINGS PLANNING AREA
VIRGINIA FOOTHILLS WATERSHED
RENO WATERSHED
NORTH TRUCKEE MEADOWS PLANNING AREA
CITY OF SPARKS
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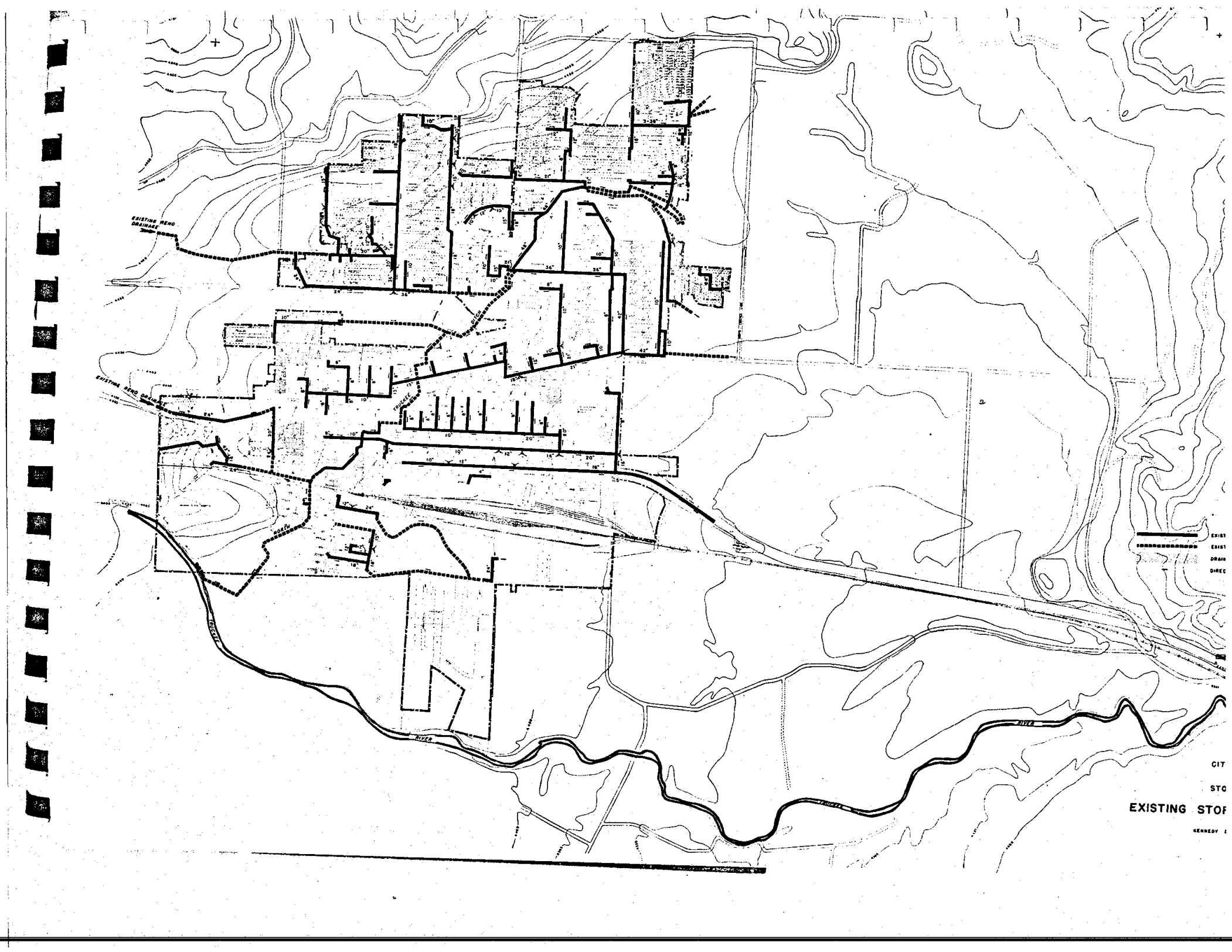
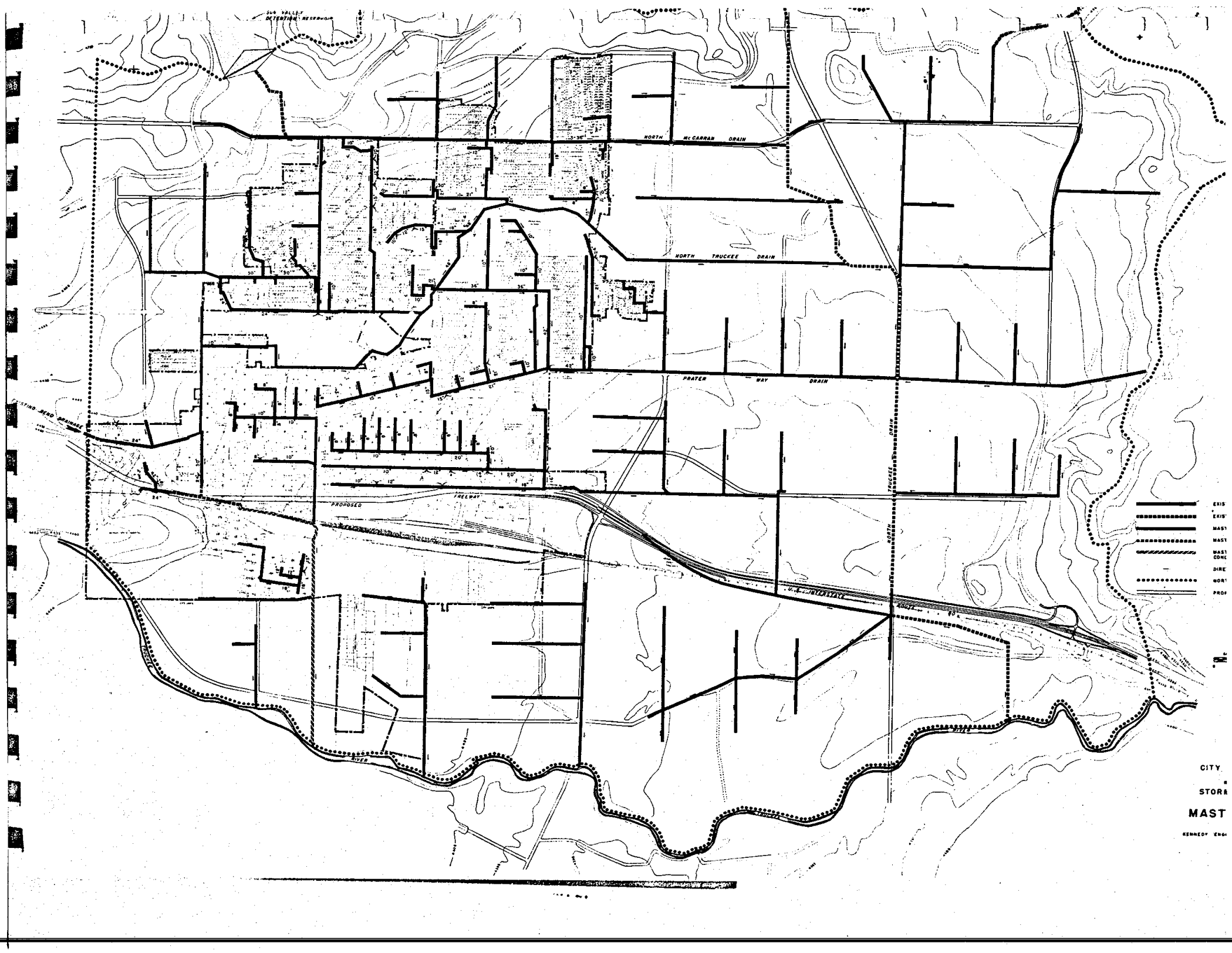
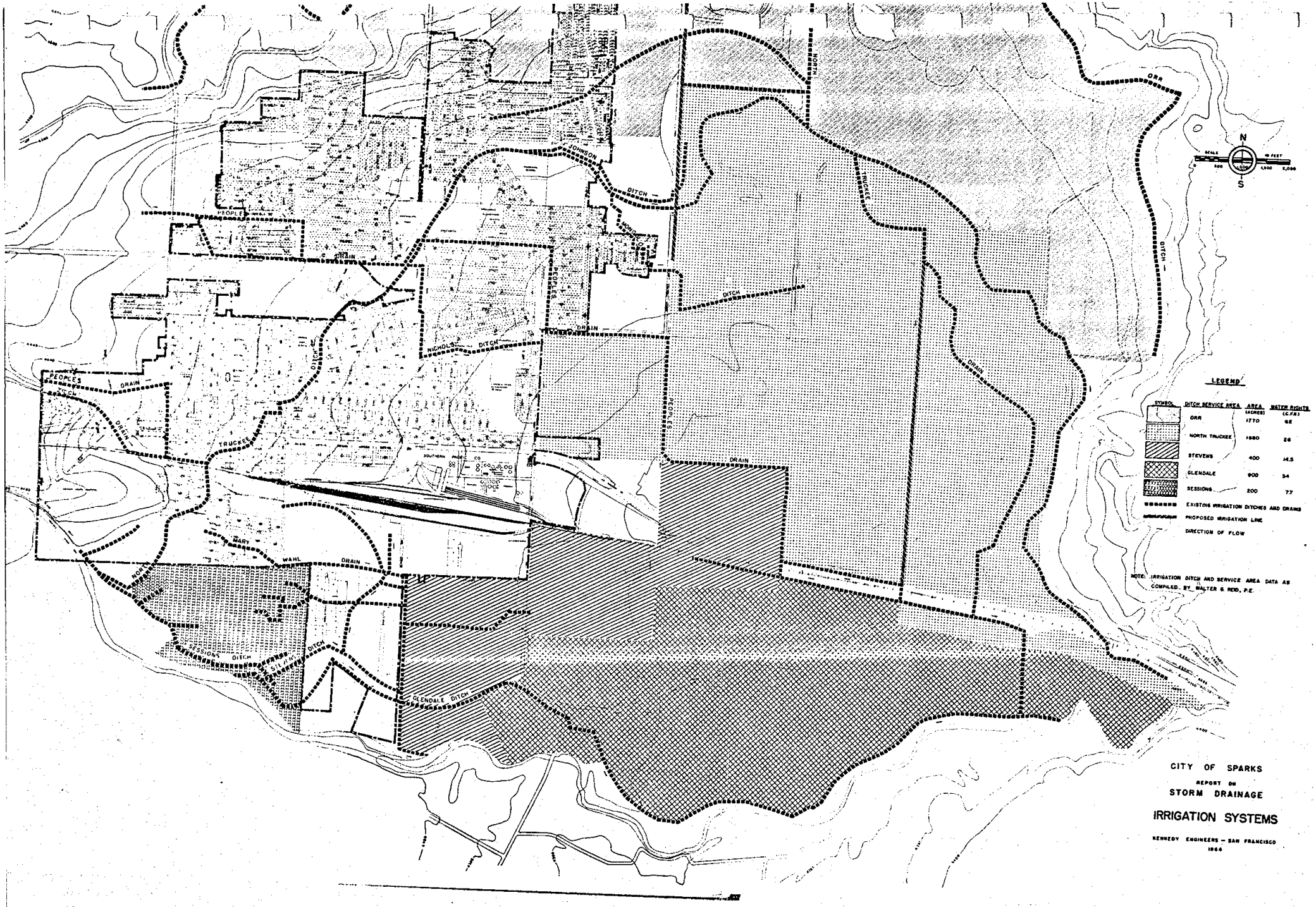
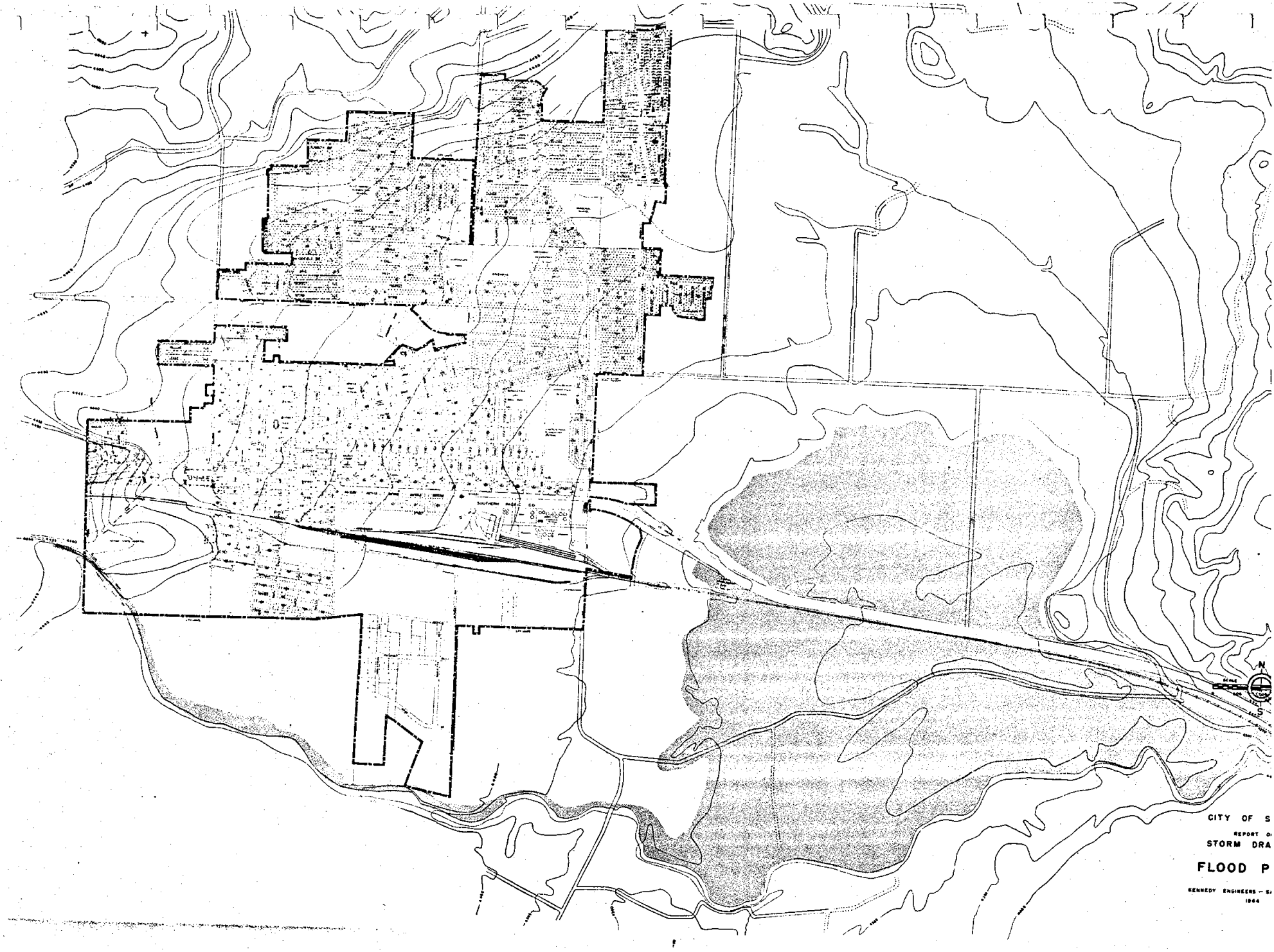
SCALE IN FEET
0 800 1600 2400
CITY OF SPARKS
REPORT ON
STORM DRAINAGE
WATERSHED AND PLANNING AREAS
KENNEDY ENGINEERS - SAN FRANCISCO
1964
PLATE NO. 1


EXISTING STORM DRAINAGE
TRUCKEE
RIVER
CIT
STO
EXISTING STOR
KENNEDY


NORTH McCARRAN DRAIN
NORTH TRUCKEE DRAIN
PRATER WAY DRAIN
PROPOSED FREEWAY
RIVER


ORR
NORTH TRUCKEE
DITCH
JOHNSON
DITCH
PEOPLES
DRAIN
NICHOLS
DITCH
PEOPLES
DRAIN
TRUCKEE
DRAIN
PEOPLES
DRAIN
DITCH
DRAIN
SOUTHERN PACIFIC CO.
MARY
WAHL
DRAIN
NORTH
TRUCKEE
DRAIN
SESSIONS DITCH
GLENDALE
DITCH
GLENDALE DITCH
N
S
SCALE
IN FEET
0
500
1000
1500
2,000
LEGEND
SYMBOL
DITCH SERVICE AREA
AREA (ACRES)
WATER RIGHTS (C.F.S.)
ORR
1770
62
NORTH TRUCKEE
1680
26
STEVENS
400
14.5
GLENDALE
900
34
SESSIONS
200
77
EXISTING IRRIGATION DITCHES AND DRAINS
PROPOSED IRRIGATION LINE
DIRECTION OF FLOW
NOTE: IRRIGATION DITCH AND SERVICE AREA DATA AS COMPILED BY WALTER G. REID, P.E.
CITY OF SPARKS
REPORT ON
STORM DRAINAGE
IRRIGATION SYSTEMS
KENNEDY ENGINEERS – SAN FRANCISCO
1964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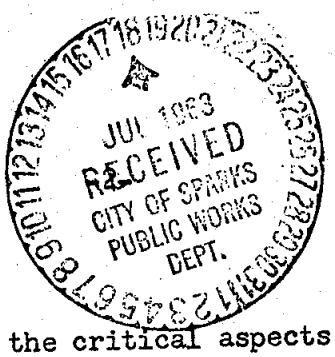
1964

APPENDIX

Mr. Calvin J. Dodson



July 16, 1963

In recognition of the critical aspects of the foregoing items, it is recommended that the following objectives and requirements be requested to properly protect the interests of the FHA in this area.

It is, therefore, requested that the Cities of Reno, Sparks and Washoe County furnish FHA with information indicating the status of your respective master storm drainage plans. The information will need to include the anticipated timing of the installation of the permanent facilities. FHA also wishes to be apprised as to the anticipated time that the emergency and temporary facilities are to be installed so that proper precautions can be taken in new proposed areas of development.

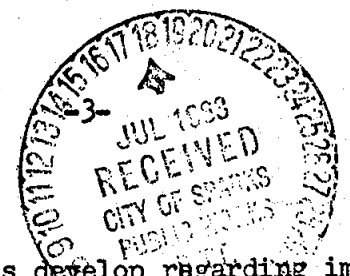
In the development of all future subdivisions in the Reno, Sparks and Washoe County areas, we shall be requiring the developers to obtain certification from the respective local authorities indicating that their proposed improvement plan and details have been reviewed and are in compliance with the requirements of the master storm drainage plans for the locality. Also, when installed in accordance with the approved plans and details, FHA can be assured of having positive and adequate storm drainage facilities that will not cause inundation of adjoining land and subdivisions nor will it cause a back up and flooding of the adjoining tracts. Also, we will require that all drainage channels extending from a subdivision to a natural water course be located in recorded easements, and accepted for maintenance by the local authorities.

Due to the seriousness of the ground water problem in many of the areas, special consideration will need to be given in developing the master storm drainage plans to also adequately control this problem. It is generally economically more feasible to control this problem at the time of installation of major storm drainage facilities than to approach it as a separate item.

Serious consideration should be given by the local authorities to the establishment of an overall flood control district to coordinate and determine future requirements. This would also provide review by one office, eliminating many problems that would occur from overlapping systems.

FHA is vitally interested in the foregoing problems and will be maintaining a contact with the local authorities to keep abreast of the progress that is being made in the implementation and establishment of permanent master plans and development of adequate and permanent facilities which will assure a positive storm drainage outlet for all new developments in the area.

Mr. Calvin J. Dodson -3- July 16, 1963



Should any problems develop regarding implementation of the proposed program, FHA would be pleased to call on their technicians to assist local authorities in attempting to work out a mutually acceptable solution to our problems.

Sincerely yours,

James E. Baker
Director

A-II LEGAL COMMENTS FROM SPARKS CITY ATTORNEY

The following comments relating to various legal aspects of City of Sparks storm drainage problems were received from Mr. James R. Brooke, City Attorney for the City of Sparks in response to questions submitted:

In answer to the many questions contained in your letter of 20 April 1964, please let me first quote from McQuillin, Municipal Corporations, Section 37.254.

An action of tort at common law will not lie against a city or town for diverting the surface water from its streets in order to keep them safe, and causing it to flow upon adjoining premises, even when the surface water is drained into a culvert or watercourse. The remedy is under the statute.

In the absence of negligence in the performance of the work a municipal corporation is not liable for damage to private property resulting from improvements, as the construction of a street or the change of grade thereof, so as to cause surface water to accumulate on the property. Likewise, in the absence of negligence, a municipality is not liable for injuries arising from the incidental interruption or change in the flow of surface water occasioned thereby. But municipal liability exists for injuries occasioned by turning the waters of a creek into a channel, which proved inadequate to hold the water which escaped and flooded plaintiff's land.

The municipality may protect its streets from water that accumulates thereon, and to that end may construct drains, gutters, culverts and conduits, and may discharge the water into natural drains, but it has no right to discharge the water thus accumulated in a body upon adjacent lands. That is, where surface water is collected by the municipality from the highway and discharged upon private property in substantially larger quantities and in a substantially different manner than it would flow naturally, the owner of such land is entitled to damages therefor. So a municipality is liable for collection of water in holes in a street which, owing to the porous condition of the soil flows in and under an abutting lot, causing the soil to slip and destroy a building. To state the rule differently, if the municipality collects surface water and precipitates it in a body onto private property, where it was not accustomed to flow, liability exists. And in such case it is not important that some of the water so collected consists of spring water or drainage, or sewerage water. If surface water flows after the grading of a street as it flowed before, of course, there is no municipal liability. A municipality has no right by artificial drains to divert surface water from the course it would otherwise take, and cast it in a body large enough to do substantial injury on private land, where, but for such artificial drain, it would not go.

A municipality is not liable for damages caused merely by reason of failure to so grade a public street as to prevent surface water from flowing upon the lots of the adjoining proprietors. But municipal liability exists for filling up or damming back, or otherwise diverting, a stream of running water, so that it overflows its banks and flows upon the land of another.

A municipality which so constructs its streets and the gutters thereof as to divert into certain of these gutters the surface water of a large area, yet fails to provide sufficient means for the escape of the water thus collected on these gutters during ordinary rains, is liable for the damages done to adjoining lands by the consequent overflow thereon of the surface water so collected. But since such cause of overflow can be readily remedied by the construction of suitable underground drains, or the enlargement of these gutters, the wrong will be treated as temporary in character, and consequently, in an action for the damages thus occasioned by overflows, only the damages actually sustained at the date of the institution of the suit can be recovered.

A municipality is only liable for the want of ordinary care in providing and maintaining sufficient curbing, guttering, and sidewalks, but, if by reason of the want of such ordinary care and prudence, the curbing and guttering become defective and out of repair, and this defective condition becomes an active agent commingled with the Act of God in producing damage to property, municipal liability exists. But while a city has no right to improve its streets in such a negligent manner as to cause injury to an abutting owner by throwing an unnecessary burden upon him or causing injury which he might have protected himself against if he had reasonable warning, it is unquestionably the right of the city to make its streets passable, and in doing so to provide for the passage of surface water in drains or culverts through or under them, and if the method adopted is reasonably suitable for the purpose, the abutting property owner cannot complain that he has been relieved of a burden of drainage to which his land was already subjected, even though the improvement of the street operates to some extent to his detriment.

Specific reference should be made directly to this section of McQuillin so that supporting legal authority, contained in footnotes, can be obtained.

Several of the questions contained in your letter are answered in this rather comprehensive section. Several of your questions are so comprehensive that they defy answer in something less than a tretise.

With specific reference to question No. 3, concerning the legal implications and responsibilities of construction and maintenance of a major drainage way through Sparks with primary benefit to the City of Reno and with secondary benefit to the City of Sparks, please be advised that the City of Reno has no right to use the City of Sparks as a means to convey its surplus drainage waters to the final outlet. This is a matter which is subject to negotiation between the cities of Reno and Sparks

and a matter which perhaps can be solved by agreement at a later date. At this particular time, however, there is no law which allows the City of Reno, or any other city for that matter, to traverse the City of Sparks with a major drainage way to carry off Reno's drainage waters.

Your question 4-b is impossible for me to answer at this time without knowing whether the city has any agreement with any of the ditch companies and if not, we should know what the custom has been in the past because this custom may dictate what our responsibilities are going to be in the future.

With respect to questions 4-c and 4-d, the answer is similar in each case. The city has a right to enforce operation of irrigation ditches to within the limitations of water rights actually held if the operation outside of those limitations is damaging to the city or its inhabitants in any way or if it can be looked upon as a nuisance or health or safety problem.

If the ditch itself is inactive or if the waters can be transferred to an alternate location without any expense to the ditch company or to the owners of the water rights, it is my opinion that the city can force abandonment of the ditch and transfer of the water to an alternate location.

A-III HYDROLOGY

Rainfall Intensity-Duration-Frequency Curves are developed using the Gumbel method for determining probability and U.S. Weather Bureau Records of Rainfall dating from 1906 at Reno Post Office and Reno Airport. Adjustment is made for reduced intensity of short duration Summer storms in the Sparks Planning Area based on observations of local conditions. Rainfall Intensity-Duration-Frequency Curves are shown on Plate A-1.

Determination of Master Plan flow capacity requirements are based on a combined utilization of the Rational Formula and the Muskingum Channel flow routing method as applied by Linsley.

The Rational Formula ($Q = CiA$) is applied for determination of local inflow using the following criteria:

Q = quantity of flow in cubic feet per second
C = Runoff coefficient
i = Rainfall intensity
A = Tributary Area in acres

Runoff coefficients, based on an evaluation of existing development are:

0.90 - paved area
0.80 - commercial area
0.40 - roof area
0.25 - bare ground
0.15 - turf or native

Based on conditions observed in present residential areas, a composite runoff factor of 0.43 for the master planning area for residential zoning is used.

A runoff coefficient of 0.35 is used for industrial zoning and flood plain areas.

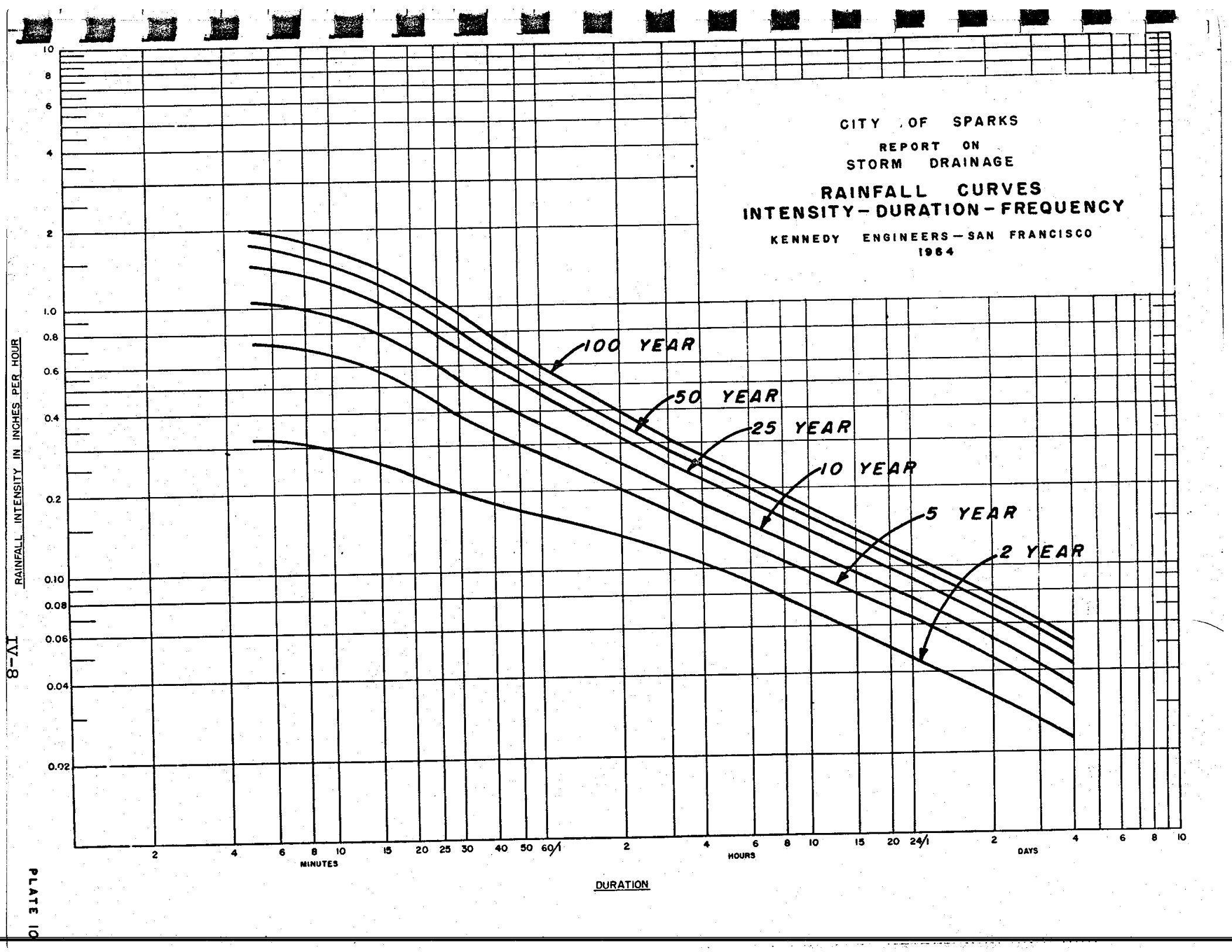
Channel flow routing utilizes the Muskingum flow routing method with the formula:

$$O_2 = CoI_2 + C_1 I_1 + C_2 O_1 \quad \text{(Outflow = Inflow - Storage)}$$

Unit hydrographs are developed for local inflow areas as well as the Sun Valley and Spanish Springs Drains and the major drains from the Virginia Foothills. Unit hydrographs for estimated 50-year level of protection are developed for Sun Valley and Spanish Springs Drains utilizing high water elevations observed in February 1963. Hydrograph shape is based on correlation with records of measured flow on other small streams in the Truckee Meadows watershed.

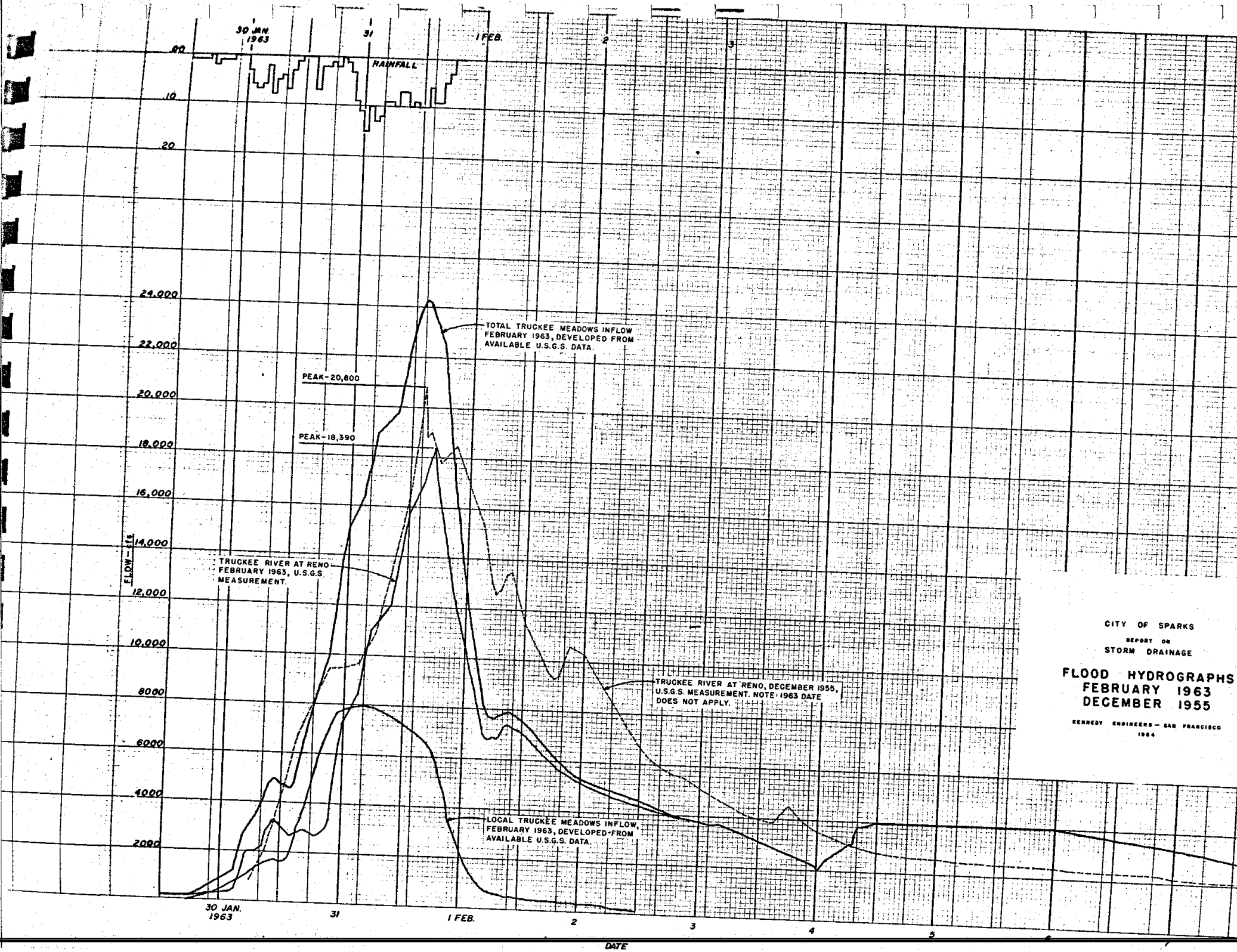
For the purpose of major channel routing, a flow based on 25-year level of protection for local inflow is combined with 50-year level of protection for main stem flow and routed through channel storage as described. Flow routing calculations are included in supporting data submitted under separate cover.

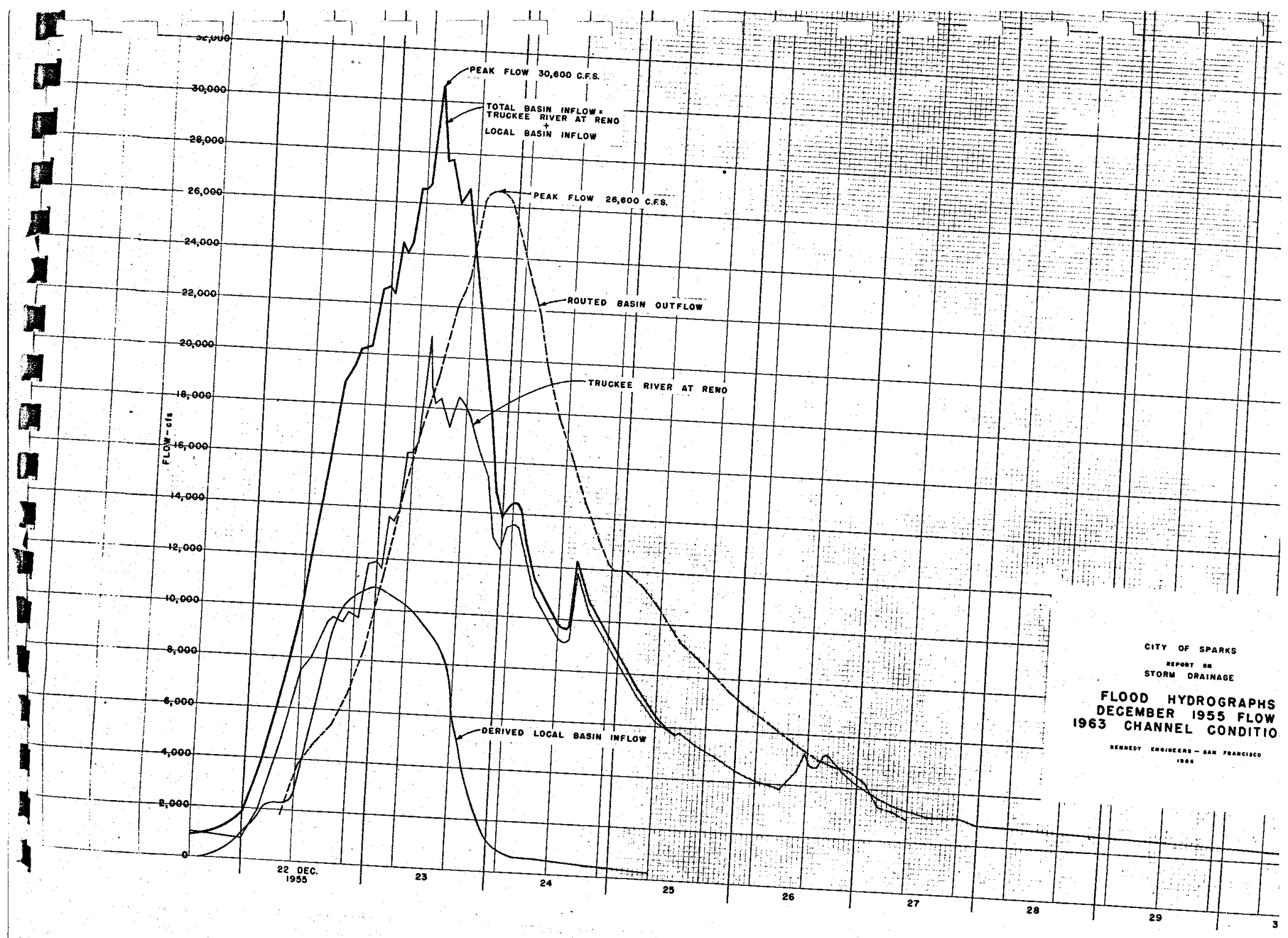
To verify local runoff criteria, rainfall gages were located at various points in the Sparks Planning Area and a flow meter was installed to measure runoff from a typical residential area. The area selected for the study is bounded by Pyramid Way, "M" Street, 4th Street, and "G" Street. The flow meter was installed in the 10-inch diameter storm drain in 4th Street near "G" Street. Because of limited precipitation as rainfall during the 1963-64 season, insufficient data were obtained to influence design criteria. Continued monitoring of storm water flow at this point is recommended. Modifications to selected storm drain design criteria resulting from the continuation of this program, if significant, can be readily applied.


CITY OF SPARKS
REPORT ON
STORM DRAINAGE
RAINFALL CURVES
INTENSITY - DURATION - FREQUENCY
KENNEDY ENGINEERS - SAN FRANCISCO
1964
100 YEAR
50 YEAR
25 YEAR
10 YEAR
5 YEAR
2 YEAR
RAINFALL INTENSITY IN INCHES PER HOUR
10
8
6
4
2
1.0
0.8
0.6
0.4
0.2
0.10
0.08
0.06
0.04
0.02
2 4 6 8 10 15 20 25 30 40 50 60/1
MINUTES
2 4 6 8 10 15 20 24/1
HOURS
2 4 6 8 10
DAYS
DURATION

IV-8

PLATE 10


30 JAN. 1963
31
1 FEB.
2
3
RAINFALL
00
10
20
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8000
6000
4000
2000
FLOW - CFS
TOTAL TRUCKEE MEADOWS INFLOW FEBRUARY 1963, DEVELOPED FROM AVAILABLE U.S.G.S. DATA.
PEAK-20,800
PEAK-18,390
TRUCKEE RIVER AT RENO FEBRUARY 1963, U.S.G.S MEASUREMENT.
TRUCKEE RIVER AT RENO, DECEMBER 1955, U.S.G.S. MEASUREMENT. NOTE: 1963 DATE DOES NOT APPLY.
LOCAL TRUCKEE MEADOWS INFLOW, FEBRUARY 1963, DEVELOPED FROM AVAILABLE U.S.G.S. DATA.
30 JAN. 1963
31
1 FEB.
2
3
4
5
DATE
CITY OF SPARKS
REPORT ON
STORM DRAINAGE
FLOOD HYDROGRAPHS
FEBRUARY 1963
DECEMBER 1955
KENNEDY ENGINEERS - SAN FRANCISCO
1964



CITY OF SPARKS

REPORT ON

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FLOOD HYDROGRAPHS DECEMBER 1955 FLOW 1963 CHANNEL CONDITIO

KENNEDY ENGINEERS – SAN FRANCISCO

1964

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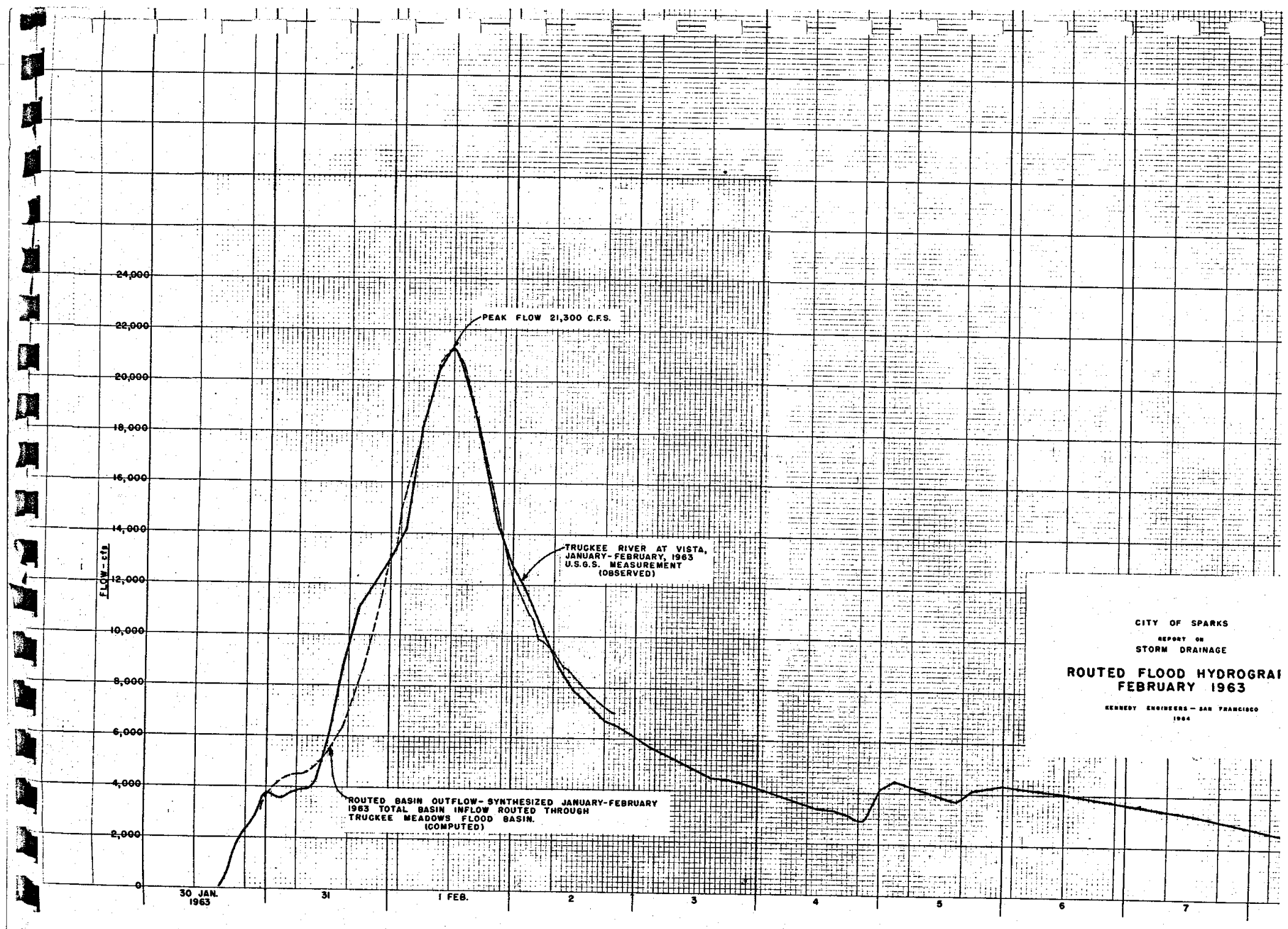
PEAK FLOW 21,300 C.F.S.
TRUCKEE RIVER AT VISTA, JANUARY-FEBRUARY, 1963 U.S.G.S. MEASUREMENT (OBSERVED)
ROUTED BASIN OUTFLOW- SYNTHESIZED JANUARY-FEBRUARY 1963 TOTAL BASIN INFLOW ROUTED THROUGH TRUCKEE MEADOWS FLOOD BASIN. (COMPUTED)
FLOW - cfs
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
30 JAN. 1963
31
1 FEB.
2
3
4
5
6
7
CITY OF SPARKS
REPORT ON
STORM DRAINAGE
ROUTED FLOOD HYDROGRAI
FEBRUARY 1963
KENNEDY ENGINEERS — SAN FRANCISCO
1964