Del Webb's
Sun City West—Expansion Area

DEVELOPMENT MASTER PLAN

JANUARY 1992

Appendix
Volume 1 of 2

RECEIVED
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DEPARTMENT OF PLANNING & DEVELOPMENT
BY
mp 92-1

Prepared By
STANLEY CONSULTANTS, INC.

MARICOPA COUNTY DEPARTMENT OF PLANNING AND DEVELOPMENT

301 W. Jefferson Phoenix, Arizona 85003

January 31, 1992

TO: Distribution Noted Below

FROM: Jill Herberg-Kusy, Principal Planner
Planning Division

SUBJ: Maricopa County Development Master Plan MP 92-1
Expansion of Sun City West

Enclosed are the following materials relating to the above subject:

Narrative Report Case Map Land Use Plan Map

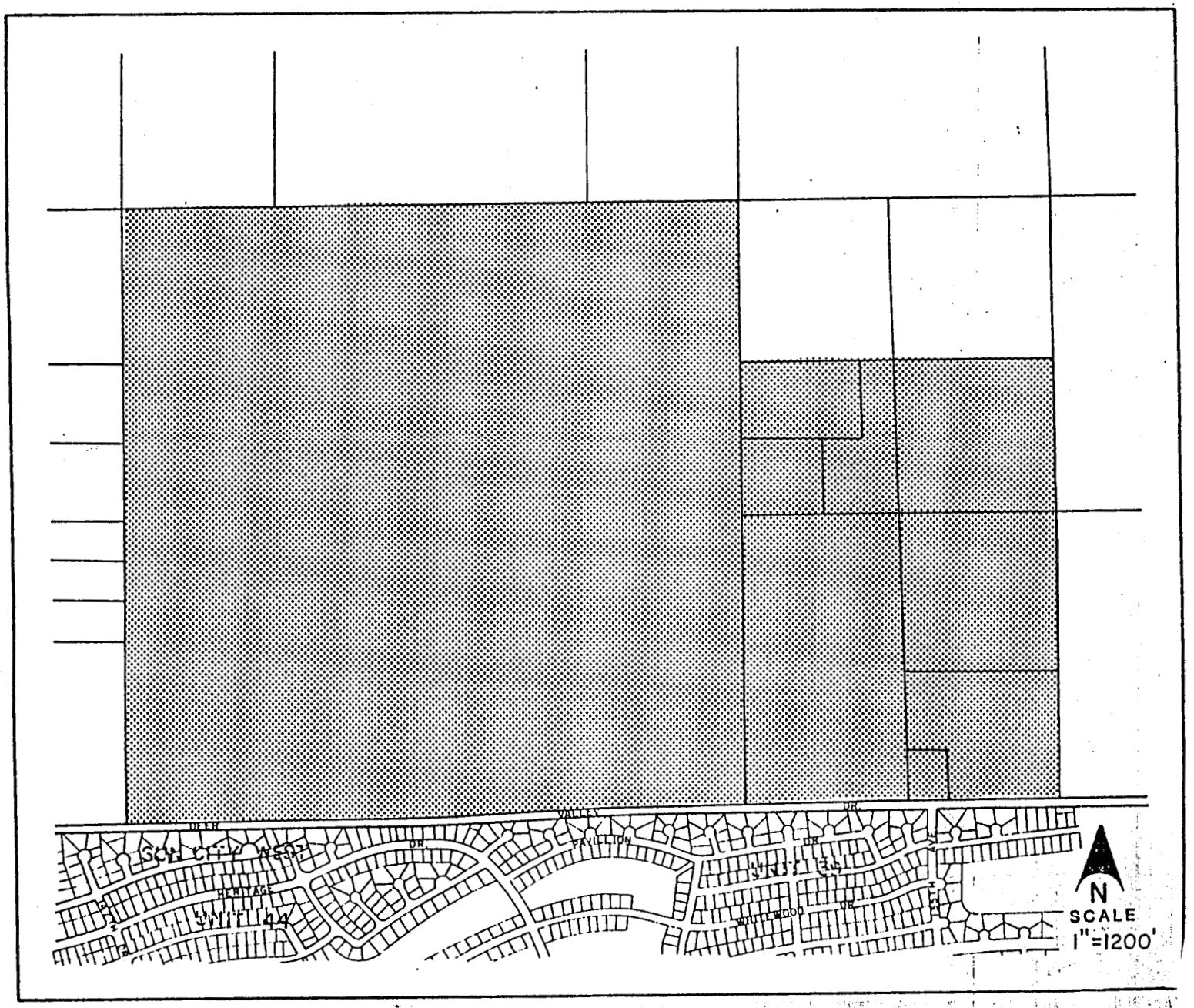
A meeting will be held before the Technical Advisory Committee on **TUESDAY, FEBRUARY 18, 1992, AT 10:30 A.M.** in the Department of Planning and Development Conference Room, Third Floor, of the NEW County Administration Building, 301 West Jefferson, Phoenix.

You or your authorized representative are requested to be present, and you should be prepared to submit written comments and recommendations at this meeting. If unable to attend, written recommendations should be submitted to our Department prior to the date of the meeting.

DW/jbw
Enclosures

DISTRIBUTION:

Gerry Toscano, County Dept. of Transportation
Greg Holverson, County Dept. of Transportation
Bob Brittain, Zoning Division
Ed Raleigh, Flood Control District
Debra Stark, Current Planning
John Lee, Rural Metro Corporation
Planning Dept, City of Peoria
Sun City Utilities Company
Urban Freeways, AZDOT
Jo Crumbaker, Air Pollution/Health Dept.
Bill McManus/Ryley Carlock & Applewhite
Aquifer Protection, AZ Dept. of Enviro. Quality
Carolyn Bray, Phoenix Metro Investors
Leo Zabella, Building Safety
Don Conroy, County Health Dept.
Sun City West PORA
Shereen Lerner, Ph.D., SHPO
Major Al Weiss, Sheriff's Office
AT&SF
Citizens Utility Company
Nicki Hansen, State Land Dept.
Arizona Corporation Commission
Dept. of Water Resources
James Wirth, Capital Resources
Parks and Recreation



REQUEST FOR MASTER PLAN AMENDMENT

A REQUEST FOR AN AMENDMENT TO SUN CITY WEST DEVELOPMENT MASTER PLAN (880 ACRES)

SEE EXHIBIT "A"

MARICOPA COUNTY DEPARTMENT OF PLANNING AND DEVELOPMENT, PHOENIX, ARIZONA

DRAFTED	DATE	CHECK	REVISIONS					FINAL CHECK
AM	1/29/92							

1/4 SEC - SEC	TWNSHP	RANGE	Z-MAP	APPLICANT
PT 15,16	4N	1W	C-61	

FINAL ACTION	DATE	EFFECTIVE

CASE NO. MP92-1

APPENDIX 1

1. Legal Description and Title Information
2. Adjacent Property Owners
3. Development Suitability Report - January, 1992
4. Guide to the Recreation Centers of Sun City West, Inc.
5. Traffic Impact Study - January, 1992
6. Archaeology Survey Report - February, 1991
7. Environmental Property Evaluation - February, 1991
8. Preliminary Geotechnical & Geological Review - January, 1991
9. Master Drainage Study - January, 1992
10. Hydrogeological Review - April, 1991

Del Webb Corporation

LEGAL DEPARTMENT

STATEMENT OF OWNERSHIP

Current legal title to the property described in the Development Master Plan for the Sun City West Expansion Area and planned to be developed as the Sun City West Expansion Area is vested in First American Title Insurance Company, a California corporation, as Trustee, under Trust No. 3987 wherein Del Webb Home Construction, Inc., is the sole beneficiary. Name and address of trust beneficiary is as follows:

Del Webb Home Construction, Inc.,
an Arizona corporation
2231 E. Camelback Rd, #400
Phoenix, Arizona 85016

2231 E. CAMELBACK ROAD P.O. BOX 29040 PHOENIX, ARIZONA 85038 (602) 468-6800 FAX (602) 468-6797

Leonard F. Gostinski, P.E., R.L.S.
President

ASSOCIATES:
Bradford C. Gordon .....R.L.S.
Richard J. Hayes .....R.L.S.

WILEY & ASSOCIATES, INC.
SURVEYORS · ENGINEERS

Jan. 29, 1992 WA4219-J

MASTER PLAN BOUNDARY DESCRIPTION

That portion of Sections 15 and 16 and the North 55 feet of Section 21 and the North 55 feet of the West half of Section 22, Township 4 North, Range 1 West, G&SRB&M, Maricopa County, Arizona, more particularly described as follows:

Beginning at the Southwest corner of said Section 16; thence N-0°17'40"-E a distance of 2646.29 feet to the West 1/4 corner of said Section 16; thence N-0°17'23"E along the West line of said Section 16 a distance of 2442,45 feet to a point on the South line of Tract No. 43C as shown on a survey recorded in Book 63 of Maps, Page 31, Maricopa County Recorder; thence N-74°38'49"-E a distance of 746.89 feet to a point on the North line of said Section 16; thence S-89°30'23"-E a distance of 1908.29 feet to the North 1/4 corner of said Section 16; thence S-89°29'55"-E a distance of 2627.81 feet to the Northeast corner of said Section 16; thence S-0°31'14"-W along the East line of said Section 16 a distance of 1320.88 feet to the Southwest corner of the North half of the Northwest Quarter of said Section 15; Thence S-89°09'29"-E along the South line of said North half of the Northwest Quarter of Section 15 a distance of 2633.36 feet to the Southeast corner of said North half of the Northwest Quarter of Section 15; thence S-0°28'12"-W along the North-South mid-section line of said Section 15 a distance of 3957.93 feet to the South 1/4 corner of said Section 15; thence N-89°18'27"-W a distance of 2637.35 feet to the Southeast corner of said Section 16; thence N-89°34'41"-W a distance of 2640.39 feet to the South 1/4 corner of said Section 16; thence N-89°34'48"-W a distance of 2593.31 feet to the point of beginning.

TOGETHER WITH: Beginning at the Northwest corner of said Section 21; thence S-89°34'48"-E a distance of 2593.31 feet to the North 1/4 corner of said Section 21; thence S-89°34'41"-E a distance of 2640.39 feet to the Northwest corner of said Section 22; thence S-89°18'27"-E a distance of 2637.35 feet to the North 1/4 corner of said Section 22; thence South a distance of 55.00 feet; thence West parallel to and 55.00 feet South of the North line of Sections 22 and 21 to a point which is 55.00 feet South of the Northwest corner of said Section 21; thence North a distance of 55.00 feet to the point of beginning.

Containing 884.7 Acres.

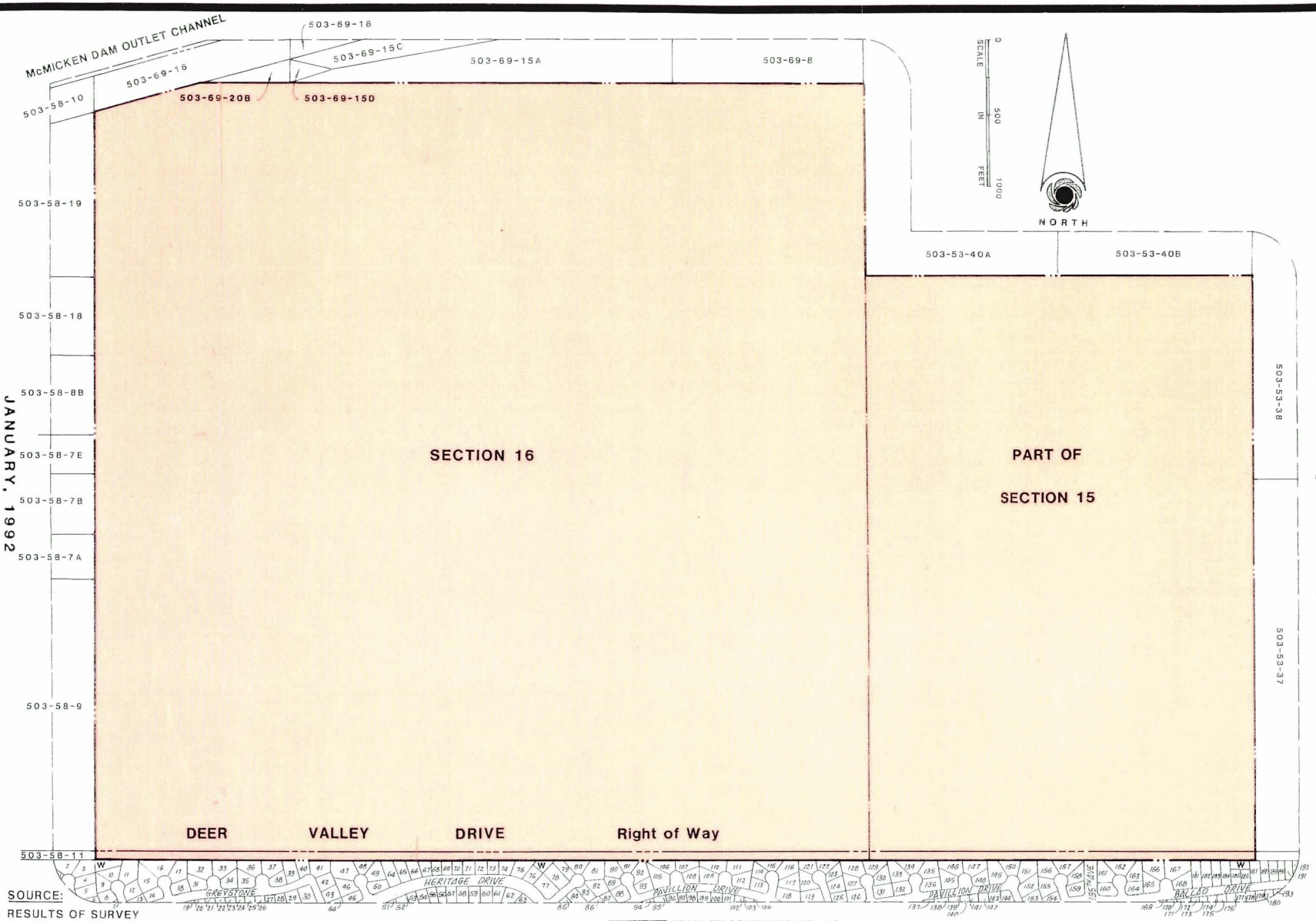
REGISTERED LAND SURVEYOR
CERTIFICATE NO. 19614
BRADFORD C. GORDON
Signed 1-29-92
ARIZONA, U.S.A.

3200 N. Hayden Rd., Suite 130 • Scottsdale, Arizona 85251 • (602) 947-7507 • FAX: 947-2503

PROPERTY BOUNDARY

(WITH ADJACENT PARCELS WITHIN 300 FEET)

Del Webb's Sun City West - Expansion Area



JANUARY, 1992

SOURCE:
RESULTS OF SURVEY
WILEY & ASSOCIATES, INC.
SURVEYORS & ENGINEERS

STANLEY CONSULTANTS, INC.

FIGURE 15

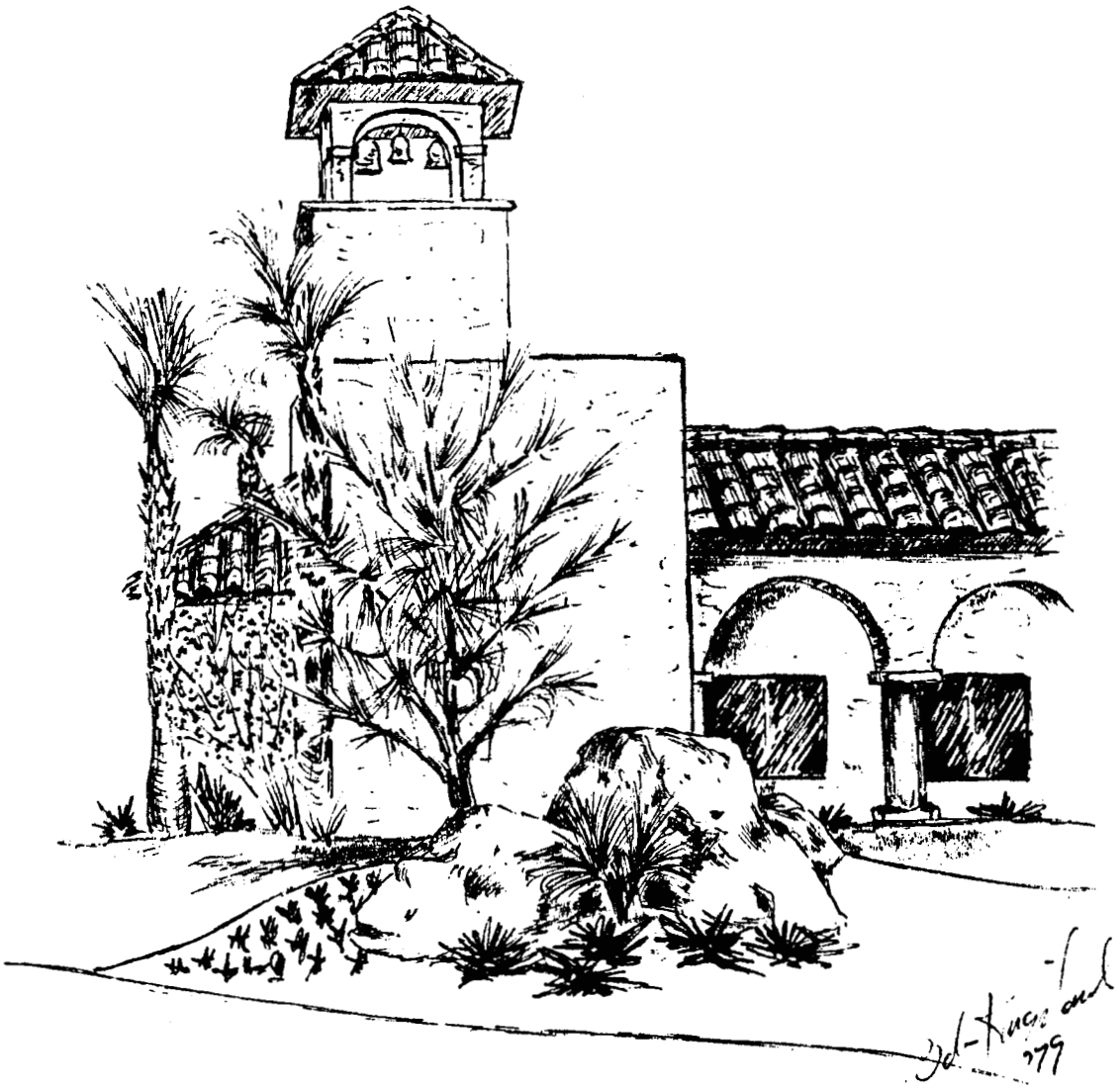
PROPERTY OWNERS

MAP REF	UNIT	LOT	PARCEL #	NAME
151	W39	123	232-19-123	YOUNG, M.
156	W39	129	232-19-129	CHALMERS, B.
157	W39	130	232-19-130	GINTER, J.
161	W20A	2	232-11-405	RENO, J.
162	W20A	3	232-11-406	JOHNSON, A.
163	W20A	4	232-11-407	DALE, O.
166	W20A	7	232-11-410	MAHONEY, J.
167	W20A	8	232-11-411	PARADISE, J.
181	W20A	10	232-11-413	POOLEY, L.
182	W20A	11	232-11-414	HECK, J.
183	W20A	12	232-11-415	THIER, H.
184	W20A	13	232-11-416	RUDD, E.
W	W20A	TR C	232-11-641	1ST AM. (WEBB)
187	W20A	16	232-11-419	BAUERNFEIND, B.

PARCEL #	NAME
503-53-037	TRNSAM TITLE TRUSTEE
503-53-038	TRNSAM TITLE TRUSTEE
503-53-40A	A. A. HORWITCH FDN
503-53-40B	KASPER, GEORGE
503-58-07A	MISSOURI & 19TH AV INVST
503-58-07B	MISSOURI & 19TH AV INVST
503-58-07E	FITZPATRICK, MICHAEL
503-58-08B	STUCKEY, JAY
503-58-009	LENOCKER & KEEN TR.
503-58-010	MCFCD
503-58-018	RANCHO CAMINO INVST
503-58-019	RANCHO CAMINO INVST
503-69-008	COLLINS, BRENT
503-69-15A	ARMSTRONG, RONI
503-69-15C	MINNESOTA TITLE TR.
503-58-15D	SALT RIVR AGRI/PWR DIST
503-69-016	MCFCD
503-69-018	MCFCD
503-69-20B	CURRY, C W

PROPERTY OWNERS

MAP REF	UNIT	LOT	PARCEL #	NAME
W	W44	TR D	232-20-349	1ST AM. (WEBB)
11	W44	253	232-20-258	HARDWICK, J.
16	W44	258	232-20-263	WONG, H.
17	W44	259	232-20-264	SPRINGER, R.
32	W44	262	232-20-267	MITCHELL R.
33	W44	263	232-20-268	BERULDSEN, J.
36	W44	266	232-20-271	HASSAN, R.
37	W44	267	232-20-272	WORKMAN, D.
39	W44	269	232-20-274	BOYD, L.
40	W44	270	232-20-275	SLAWSON, D.
41	W44	271	232-20-276	ZIMMERMANN, F.
47	W44	277	232-20-282	ANGOTTI, T.
48	W44	278	232-20-283	STEVENS, B.
49	W44	279	232-20-284	GUTWENIGER, E.
64	W44	281	232-20-286	JENNINGS, I.
65	W44	282	232-20-287	FLEENOR, R.
66	W44	283	232-20-288	BARNES, C.
67	W44	284	232-20-289	SCHMIDT, M.
68	W44	285	232-20-290	
69	W44	286	232-20-291	SMITH, W.
70	W44	287	232-20-292	THORN, D.
71	W44	288	232-20-293	GENDRON, E.
72	W44	289	232-20-294	TRAINER, J.
73	W44	290	232-20-295	DE BLASI, D.
74	W44	291	232-20-296	STRANTZ, C.
75	W44	292	232-20-297	KOZAK, H.
W	W44	TR E	232-20-350	1ST AM. (WEBB)
79	W39	67	232-19-067	KEITEL, D.
80	W39	68	232-19-068	LINDSAY, J.
81	W39	69	232-19-069	PRATT, W.
90	W39	80	232-19-080	DERR, I.
91	W39	81	232-19-081	MORROW, J.
92	W39	82	232-19-082	ALLEVA, A.
106	W39	85	232-19-085	BICE, W.
107	W39	86	232-19-086	HALL, M.
110	W39	89	232-19-089	KARPIEL, G.
111	W39	90	232-19-090	KUFAHL, E.
114	W39	93	232-19-093	ZIZZO, N.
115	W39	94	232-19-094	CAIRD, J.
116	W39	95	232-19-095	WILSON, C.
121	W39	101	232-19-101	BURKE, W.
122	W39	102	232-19-102	NAMVAR, A.
128	W39	108	232-19-108	RIFF, S.
129	W39	109	232-19-109	HERSHORN, M.
133	W39	113	232-19-113	BUFFAM, L.
134	W39	114	232-19-114	LAUBLER, R.
135	W39	115	232-19-115	DINSMORE, R.
146	W39	118	232-19-118	JOHNSON, A.
147	W39	119	232-19-119	SUCHARA, J.
149	W39	121	232-19-121	MIXER, J.
150	W39	122	232-19-122	PEDERSEN, E.



Guide to the Recreation Centers of Sun City West, Inc.

Sun City West Association

CREED

We believe the affairs of the Association must be conducted with integrity, high ethical standards and a sense of community responsibility.

MISSION STATEMENT

The Recreation Centers of Sun City West, Inc. (the "Association") is a non-profit corporation formed as an Association of homeowners to enhance the members' lifestyle through the acquisition, construction, management, maintenance and care of Association property.

The Association's primary mission is to provide a wide variety of social and recreational progams that result in member enjoyment, personal growth and satisfaction. We coordinate, implement and aid recreational, social and cultural clubs chartered by the Association and promote cooperation in all matters of interest and benefit to our members.

We will establish and update policies that result in cost-effective maintenance of all facilities and regular replacement of obsolete or unusable equipment.

Serving the best interests of the greatest number of Association members while respecting the rights of the minority will be a paramount guiding principle.

THE GOVERNING BOARD

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September 1, 1991

Chapter One

Purpose, Organization, and Finance

Purpose

The Recreation Centers of Sun City West, Inc. (hereinafter referred to as the Recreation Centers) was formed as a non-profit corporation under Arizona state law to operate, maintain and preserve facilities which enhance the recreational, social and leisure interests of its members. These facilities include all activities and programs known as and operated within the R.H. Johnson Recreation Center, Beardsley Park Recreation Center, Fred P. Kuentz Recreation Center, Pebblebrook Golf Course, Stardust Golf Course, Grandview Golf Course, Echo Mesa Golf Course, and Trail Ridge Golf Course.

Basis for Establishment

The Recreation Centers was established on July 1, 1979. As recreational and/or social facilities in Sun City West were constructed by Del E. Webb Communities, Inc. (WEBB), they were turned over to the Recreation Centers for operation and maintenance. **All facilities presently in use have been legally deeded (free and clear) to the Recreation Centers.** The Articles of Incorporation and related Bylaws form the legal basis for the Recreation Centers, while a Master Agreement (consummated between WEBB and The Recreation Centers) establishes the management structure. The ultimate management design for the Recreation Centers is to achieve financial self-sufficiency, separate its relationship from WEBB and, thereafter, maintain total responsibility for the management, operation, maintenance, and improvement of its facilities and programs.

Description of the Recreation Centers

- Includes a theater, an agricultural project, a library, 5 golf courses, outdoor sports fields/courts, dancing facilities, swim pools, and lecture/conference facilities.
- Additionally, they include facilities and equipment to support such crafts as ceramics, sewing, woodworking, leathercraft, lapidary, photography, silversmithing, fine arts, and other similar activities.

The Recreation Centers coordinate, implement and aid the various recreational, cultural and social clubs/associations to become established as non-profit organizations in their own right. This sponsorship status is required to operate within the Recreation Centers parameters.

Management Structure

Governing Board

The Governing Board is an interim management board appointed by WEBB to conduct the affairs of the Recreation Centers. This body will function until developer buildout occurs, or the Recreation Centers membership votes to separate its alignment with WEBB (whichever occurs first). The Governing Board is comprised of five (5) appointed senior management officials of WEBB and the president of the Advisory Board plus three (3) additional Advisory Board members. As an adjunct to the Governing Board, an Executive Committee serves to act in behalf of the Governing Board between monthly meetings. The Executive Committee is comprised of three (3) Webb officials, and the president of the Advisory Board plus one (1) additional Advisory Board member.

Advisory Board

The Advisory Board is elected by the Recreation Centers membership to consult with the Governing Board and to act as a communications link with the membership. The Advisory Board is comprised of nine (9) elected residents of Sun City West who serve for staggered three (3) year terms. When developer buildout occurs, or when the Recreation Centers membership votes to separate its alignment with WEBB (whichever comes first), the Advisory Board ceases to function as an advisory body and becomes a management Board of Directors.

- The Advisory Board meets monthly in open session (except July and August). Meetings are held at 9:00 a.m. on the second Tuesday of each month in the RHJ Lecture Hall. While all Recreation Centers members are invited to attend the open session, attendees do not participate unless invited by the President (as stated in the Bylaws). Minutes of each meeting are published and maintained in the Library for public access.

- The Board sponsors "open forums" at 1:30 p.m. on the 3rd Tuesday in March and October for the membership. These meetings are designed specifically to allow the membership an opportunity to ask questions and receive clarification.

General Manager

This individual serves as the manager over the Recreation Centers' day-to-day operation. This individual provides a full scope of management authority by effecting/implementing policies and procedures of the Governing Board/Board of Directors (as applicable).

Membership Meetings

- Annual and/or special meetings of the membership may be called at the discretion of the Governing Board. Once called, 400 voting members of record are required to effect a quorum.
- The membership may call a special meeting when 5% of the total membership of record (as of the preceding July 1) files a request with the Governing Board stating justification/reasons for such a meeting. The Governing Board may approve or reject such a request, but will provide a written response in either situation. Unless otherwise stipulated in the Articles of Incorporation, its Bylaws, or by statute, Roberts Rules of Order will prevail.

Elections

Voting Eligibility

Each residential unit receives two (2) votes, regardless of number of occupants per unit. Apartment owners who have been extended membership privileges by the Recreation Centers are entitled to one (1) vote per apartment unit which is rented or leased in the owner's behalf (maximum number of votes per apartment owner is 100). Renters are not eligible to vote in Recreation Centers' business affairs, but are welcome to participate in meetings as interested parties. Eligibility is restricted to authorized membership categories who are paid-up members of the Recreation Centers.

Voting Procedures

As long as a quorum is achieved, members in good standing may vote on any and each matter brought up for vote. Unless specifically provided for in the Articles of Incorporation, its Bylaws, or by statute, a majority of votes cast shall be sufficient to effect a decision.

Election of Advisory Board

- The term of office shall be three (3) years. No member who has served a minimum of two (2) years may be re-elected or appointed to the Advisory Board unless the member has had a two (2) year absence from the Board.
- Three (3) members will be elected annually to form a total number of nine (9) Board members. Elections will be held on the first Tuesday of December. Candidate qualifications will be validated prior to the election by the Advisory Board.
- Election procedures will be established and carried out by an Elections Committee appointed by the Advisory Board.

Finance

Recreation Centers Membership Fee

Each member is obligated to pay an annual fee to the Recreation Centers to be used to support the operation and maintenance of the Recreation Centers Division (excludes Golf & Bowling Divisions). The amount of the fee is determined annually by the Governing Board/Board of Directors (as applicable) and is due in advance each year on or before the anniversary date of the membership.

Budget

The Recreation Centers fiscal year is July 1 through June 30. Each year, a detailed budget is prepared by management, reviewed and recommended for adoption by the Advisory Board's Audit and Finance Committee, reviewed and recommended for approval by the Advisory Board, and subsequently reviewed and approved by the Governing Board. It is released for resident review no later than June 1, prior to the start of the fiscal year. Any changes in fees are announced at this time.

Five Year Forecast

In conjunction with the annual budget, management also prepares a 5 year budget forecast. Essentially, this document projects potential changes in fees during the ensuing 5 year period and provides ample justification to support the projections. In this manner, management and Board members have sufficient time to gauge the impact of a fee increase, determine if off-setting actions can be initiated and, if unavoidable, allow ample time for residents to prepare for budgetary or program adjustments.

Special Assessments

A special assessment (applicable to one particular year only) may be levied for the purpose of defraying essential needs of Recreation Centers facilities or operation. Any special assessment requires the assent of a majority vote of the membership at a special meeting called for such purpose. Neither the Governing Board, nor the Advisory Board can unilaterally effect a special assessment—it can only be effected by majority assent of the voting membership.

Asset Replacement Fund

This fund is generated from a portion of each member's annual membership fee, with monies deposited into interest-bearing accounts for the express purpose of funding replacement of major equipment, or major repair needs. The Bylaws stipulate that this fund cannot be used until the management alignment with WEBB is terminated.

Golf Reserve Fund

Established in 1987, this fund is derived from supplemental fees assessed golfers for each round of golf played. Monies are deposited into interest bearing accounts for the express purpose of accumulating a fund to support the replacement and improvement of golf course facilities and maintenance equipment. This fund was created because the line item cost of golf maintenance equipment is exceptionally high; the number of replacement items could be exceptionally large; and subsequently, any required expenditures of this nature from the general fund might be disruptive to the Recreation Centers short and long-term financial condition. Like the Asset Replacement Fund, the Bylaws also stipulate that this Fund cannot be used until the management agreement with Webb is terminated.

Bowling Reserve Fund

Established in 1990, this fund is derived from supplemental fees assessed bowlers for each line bowled. Monies are deposited into interest-bearing accounts for the express purpose of generating monies to offset high cost of capital repairs and improvements. Unlike the Asset Replacement Fund and the Golf Reserve Fund, the Bowling Reserve Fund may be used during the period of developer (WEBB) control.

WEBB Subsidy

While the Recreations Centers is charged with the responsibility to pursue a break-even financial status during developer control, it is recognized that a deficit posture is likely during facility start-up years. For this reason, WEBB annually subsidizes the total net operational deficit of the Recreation Centers following validation by an independent audit firm.

References

Specific information relating to the establishment of the Recreation Centers, membership, voting, fee information, operating policies, management relationship with WEBB, etc. can be found in the following documents (all available at the Library):

- Articles of Incorporation, July 1, 1979.
- Articles of Amendment to the Articles of Incorporation, October 27, 1988.
- Amended and Restated Bylaws, December 27, 1988.
- First Amended and Restated Master Agreement, January 12, 1987.

Chapter Two

General Rules and Information

Eligibility and Priority For Use of Facilities

Residents of Sun City West with a current Recreation Centers membership are authorized full use of all facilities. Members have priority for the use of these facilities over guests and authorized visitors.

Recreation Centers Membership

As required by the Recreation Centers Articles of Incorporation, the Master Agreement, and the Facilities Agreement (consummated at homeowner closing), all Sun City West homeowners are required to be members of the Recreation Centers.

- Membership rates are recommended by the Advisory Board and approved by the Governing Board. Upon home purchase, the membership fee is included in closing costs; thereafter, cards must be renewed annually at the Recreation Centers' Administration Office (located in the RHJ Arts & Crafts Village/East Portal). Membership renewals are accommodated in person, by mail, or by SurePay.

- Each residence (regardless of number of homeowners) is entitled to two votes in official membership sessions. Renters may use Recreation Centers facilities by paying a small administrative fee; however, they do not acquire voting privileges.

- Membership cards are issued to titleholders of Sun City West properties as identified on the respective Facilities Agreement. Supplemental cards may be issued (at the regular membership rate) to non-title holders who maintain permanent residency as long as the non-title holder is 19 years or older, and is domiciled in the residence for a minimum of six months per calendar year. These supplemental cards extend full priviledges, use, and services of Recreation Centers facilities, but they do not extend Association voting rights. A certification of membership qualifications is required from the titleholder prior to issue of a supplemental card.

- While the Administration Office will mail renewal notices to members ahead of the due date, this mailing is purely a courtesy reminder and in no way relieves the member of the responsibility to renew their annual membership in a timely manner.

  1. Members are allowed a 30 day grace period beyond card expiration date to settle the renewal fee. After 30 days, a late notice will be issued and a late fee assessed.

  2. Members failing to respond to the 30 day letter will be issued 2nd and 3rd reminders (as necessary) at the 60 and 90 day points respectively. If no response is received following the 90 day letter, the Recreation Centers reserves the right to file a lien against the member's residence for the total amount due. The total amount may include whatever legal/collection agency fees which might accrue to the Recreation Centers.

- Refunds are only authorized in case of member death, the sale of a home, or the deletion of a member from a household. In the case of member death, death certificates are required to validate the pro rate date. In the case of death, refunds are not extended to the sole surviving titleholder since membership in the Association is a condition of home (property) sale. In the sale of a home, membership cards must be returned to the Recreation Centers Office to determine a pro rata refund date. In the deletion of a member, a letter of justification is required to determine the pro rata refund date.

- All facility users must present a current Recreation Centers Membership Card (or Guest Card if applicable) at each facility. Cards are not transferable and cannot be loaned.

Guests:

1. Membership cards provide for 24 "punch" numbers to be used each time a member sponsors a guest. One number will be punched for each facility used by a guest. When using the Membership Card guest proviso, the member must accompany the guest and ensure they are properly signed in.
2. If all 24 guest authorizations are used (from the Membership Card), or if a member simply wants his/her guest to use the facilities without having to accompany them, the member may purchase either a Weekly Guest Card or a "20 Punch" Guest Card. The Weekly Guest Card is for use by one guest (unlimited use of facilities, and restricted to a one week time frame). A "20 Punch" Guest Card is for use by one or more guests and is punched once for each guest (limit to 20 uses, and restricted to a 6 month time frame). Both cards may be purchased at the Administration Office. Note: When using either of these cards at the Recreation Centers' golfing facilities, the member must be present to validate sponsorship.
3. Guest conduct while using facilities remains the responsibility of the sponsoring member.

Dress Code

Proper dress is required in all facilities. While specific requirements are identified in Chapter 3, the following basic guidelines apply:

- Bathing suits are required in all aquatic facilities. Cut-offs, or other street clothes combinations are not acceptable.
- Upper body garments must be worn in all activities, except males using aquatic facilities.
- Appropriate athletic apparel is required in all athletic sport areas to include specific footwear and/or clothing.

Age Restrictions

- Children under 4 years of age are not allowed in the Swim Pool. Children 4-16 years may swim in the RHJ Pool between 10 a.m.-1:00 p.m. daily, but adult supervision must be provided for the duration of use. Children, regardless of age, are not permitted to swim in either the Beardsley Park Pool, or the Kuentz Center Pool.
- Children under 12 years of age may not bowl at R.H. Johnson Bowling Center, or play golf at Recreation Centers golf courses. In both activities, children 12-16 years must be accompanied by an adult.
- Children under 16 years of age may not use the Billiard Room Shuffleboard Courts, Therapy Pool/Spa, or Fitness Centers/Exercise Rooms.

No Smoking Policy

The No Smoking Policy adopted by the Recreation Centers fully complies with the related Maricopa County Ordinance. In designated club areas, the using organization may determine its own policy. Smoking is not allowed in all social halls, fitness centers, library, golf pro shops, rest rooms, or meeting room areas. In the Sports Pavilion, smoking is permitted only on the main concourse - it is not allowed in the bowling, shuffleboard, or pool/billiards areas. In all snack shops, a minimum of 60% of all seating is identified for non-smokers.

Publicity

- The monthly *Western Star* is a 4-6 page newsletter that is used to inform residents about specific events, or explain/clarify subjects which are either controversial, or complex. The *Western Star* is available for pick-up at the Recreation Centers Administration Office, and all monitored facilities on the 1st of each month.
- The Recreation Centers "Bulletin Boards" are located on the walls just outside the Administration Office, RHJ Sports Pavilion, Village Store, Beardsley Park Recreation Center, and the Kuentz Recreation Center. The boards are used to promote various special events and activities.
- Single-sheet "flyers" are periodically developed to promote special events/activities. They are generally provided to each major Recreation Centers facility and posted to the respective bulletin boards. Special Events and Club Activity Schedules are produced monthly in "flyer" format and are available at all *Western Star* locations, and are published in local newspapers.

Document Review

Key operational documents pertaining to the operation of the Recreation Centers are available for review in the Library. These documents include the Annual Budget, a summary review of monthly Financial Statements, Annual Audit Report, and Minutes of Advisory Board and Governing Board meetings. Membership data is restricted from public access because of the Privacy Act.

Chapter Three

Description of Facilities and General Rules for Use

General

The Recreation Centers base its member/guest program on the premise that participation is purely voluntary. Subsequently, since participation in virtually all recreation and craft activities involves the assumption of some personal or physical risk, program participation by a member or guest is perceived as tacit acknowledgement and acceptance of that risk.

Our primary goal is to consistently maintain Recreation Centers facilities in a first-rate, ready to use condition. However, periodic wear and tear, as well as seasonal/climatic factors, may temporarily render an area less than exemplary. If such a condition occurs, members are urged to contact the appropriate facility monitor for assistance. If a member accepts facility conditions, he/she does so with the understanding that the area is in a safe condition, and free of obstruction or hindrance.

Unless negligence on the part of the Recreation Centers or its chartered clubs is validated, the Recreation Centers is not liable for personal injury or inconvenience sustained during the routine use of its facilities and programs.

In assisting members and guests in the enjoyable pursuit of recreation and craft activities, reasonably comprehensive policies, operating instructions, rules, and signage have been developed to produce a safe and healthful membership program. Prior to participating in any activity, please take the time to become acquainted with facility layout and operating guidelines.

Golf Courses

Pebblebrook, Grandview and Trail Ridge courses are designated as regulation length courses, while Stardust and Echo Mesa are designated as executive-length courses. Pebblebrook, Grandview, Stardust, Echo Mesa and Trail Ridge Golf Courses are designated as Recreation Centers Golf Courses. Briarwood Golf Club is a private membership club available to residents, and Hillcrest Golf Course is a WEBB-owned and operated facility which is open to the public. Members may pay an annual prepaid greens fee (unlimited play at all Recreation Centers courses), or a daily greens fee (9 or 18 holes of golf at a specified Recreation Centers course).

- Proper golf apparel is required - upper body garments must be worn at all times.
- Children under 12 years are not allowed on the course, and children 12-16 years must be accompanied by an adult.
- Fishing and/or swimming is not permitted in golf course lakes. Golf balls not easily retrievable from the shoreline must be abandoned and thereafter become the property of the Recreation Centers. Human intrusion into golf course lakes may cause damage to lake sealants, adversely affect the environmental conditions controlled by the seal, and result in costly repair actions.
- Possession of range balls in other than designated areas is not permitted.
- Pets and non-golfers are not allowed on the golf course at any time.
- Follow normal rules of golf etiquette—
  1. Rake sand traps to a smooth surface, and replace rake in trap in a position which is parallel to the fairway.
  2. Fix ball marks on greens, and replace divots on tees. Fairway divots should be tamped down smoothly, *but not replaced.*
  3. Practicing on the golf course is allowed only in predesignated practice areas. Pitching is not allowed on the putting greens, but only in designated pitching/chipping green areas.
  4. If the hole in front of you is open, allow faster players to play through.
  5. To speed up play, groups should hit when ready. Abandon lost balls without undue delay, and practice continuous putting.

Golf Carts

Motorized carts are allowed on the course all year, subject to periodic maintenance restrictions. Carts should remain on the cart path until parallel to ball, and then drive in at 90 degrees. Once the ball is played, carts should either return to the cart path and the 90 degree rule or, if more expedient and practical, drive in the rough *(not fairway)* to the next lie.

- Pull carts are to remain a minimum of 15 feet from greens. They are not allowed between trap and green, in traps, or on either tees or greens. Golfers should avoid water soaked areas as much as possible. Designated parking is available behind each green.

Pairings

While foursomes are the preferred method of pairing golfers, management reserves the right to implement a fivesome policy, when necessary to enable maximum participation by members.

Greens Fees

Annual Prepaid Greens Fees Permit

The rate is established by the Governing Board and an applicant must be a current, paid-up member of the Recreation Centers to qualify. It is valid for a period of one year from the purchase date and must be renewed on subsequent anniversary dates in order to retain the annual status. If an annual prepaid cardholder decides not to purchase another prepaid greens fee permit on the renewal date, he/she will be ineligible for such a permit until the following year on that date, or he/she must accept retroactive issue of such permit. (A supplemental fee is also charged for each round played - see "Supplemental Fee," pg. 9.)

- A prepaid golf greens fee or prepaid gold cart permit is valid for 1 year from date of issue, and will be issued for a period of 1 year at a time. It is valid only for the person to whom it is issued, and cannot be loaned or transferred.
- There will be no extensions granted to prepaid permit expiration dates for time lost due to partial year physical or mental impairments. Specifically, an individual who sustains an injury or disability during the unexpired portion of the prepaid permit will not be granted a corresponding extension to the prepaid permit expiration date.
- The significant costs required to maintain 5 golf courses necessitate a revenue-generating system that is based on reasonably accurate predictions. As a program incentive to provide the volume of fixed revenue necessary to offset the high cost of maintenance, individuals are offered a preferred annual rate. Although prepaid permits are only issued on a 12 month basis, the income guarantee is considered to run concurrently from one permit to the next, unless allowed to expire by the holder.
  1. If an individual opts not to renew a prepaid permit on its expiration date, that is the individual's prerogative. However, since the preferred annual rate is based on sustaining a fixed level of revenue, and an "opt out" decision adversely affects that capability, the individual then forfeits the privilege for a preferred rate during the ensuing 12 month timeframe.
  2. Once a prepaid permit has been allowed to expire, the only way to reactivate the privilege during the ensuing 12 month timeframe is to accept issue retroactive to the expiration date of the previous card. Individuals not willing to accept retroactive issue may continue playing golf on Recreation Centers courses via daily greens fee paying procedures.
  3. An individual may reacquire a prepaid permit without retroactive issue 12 months following the expiration date of the previous permit.
- Refunds will only be granted under the following conditions:
  1. Member death. The beginning date for proration of refund will be the date of death as listed on the Death Certificate.
  2. Injuries or medical disabilities that preclude an individual from playing golf for the remainder of the unexpired portion of the permit. Written certification is required from a licensed medical practitioner, and must specifically certify that the injury or disability will prevent the individual from playing golf for the duration of the unexpired portion of the permit.
  3. At a minimum, an individual who purchases a prepaid greens fee permit or prepaid cart permit does so with the understanding that he/she is liable for payment of the first 4 months of permit, regardless of physical or mental impairment subsequently incurred. Once the 4 month minimum is satisfied, a request for refund is prorated from the date the request is received by the Recreation Centers. Refunds will not be prorated to include a retroactive period of time.

4. Once a prorated refund is granted, the individual subsequently becomes ineligible to purchase either a prepaid greens fee permit or prepaid cart permit during the timeframe for which the prorated refund was granted. Specifically, if a permit was valid from January 1 - December 31, and a refund was granted effective May 1, then the individual would be ineligible to purchase either a prepaid greens fee permit or a prepaid cart permit during the remaining May 1 - December 31 timeframe.

Daily Greens Fee Permit

This permit is available for either 9 holes or 18 holes and is payable at each course. (The daily golf fee includes a supplemental fee - see "Supplemental Fee," pg. 9.)

Summer Golf Permit

This special discounted golf permit is valid from May 15 through September 15, (valid two summers and allows for 20 rounds of golf). It is valid for 1 person and is not transferable.

Cart Fees

Annual Cart Trail Permits

Basic payment clauses are identical to those shown in "Annual Greens Fees" (see pg. 7). Permits can be purchased through the Recreation Centers Administration Office.

- Only two bags and two persons are allowed per cart.
- Permits are issued for use by the purchaser, his/her spouse, and their guests. Cart permits are not transferable and cannot be used by other Sun City West residents.
- Replacement permits (for damaged or soiled permits) will be issued free of charge as long as the original permit is surrendered. A replacement fee is applicable for lost, or otherwise misplaced cards.

Daily Cart Trail Fee

This fee is applicable to members and bona-fide guests who provide their own private cart and wish daily use privileges. This fee is payable at the Golf Pro Shop.

Daily Cart Rental Fee (Motorized and Pull)

Carts are available for either 9 holes or 18 holes and can be rented at the Golf Pro Shop for a nominal fee.

Lessons

Lessons are available at each golf course and can be contracted directly with any Pro Shop. Both individual and group lessons are available.

Other

Clubs are available for rent at each course. Driving ranges are also provided at each course with fees determined by the size of basket desired.

Tee-time Reservations

Advance reservations allow members the convenience of planning ahead. Reservations are taken one day in advance of the desired play date (executive-length courses) or four days in advance of desired play date (regulation-length courses).

- Executive-length Courses
  (Stardust GC & Echo Mesa GC)
  1. Members can reserve their tee-times in person, or by telephone. Those making reservations in person draw a random number which determines the order of tee-time assignment. The random draw assures that all members receive a fair and equitable chance for obtaining choice times. Once the random numbers are drawn, the tee-time assignments are allocated in numerical order.
  2. To allow equity to telephone callers, tee-time assignments are alternated; i.e., one telephone reservation interspersed by one personal reservation and so on.
  3. While random draw numbers can be acquired beginning at 6:50 a.m., actual tee-time assignments begin promptly at 7 a.m.
  4. One person makes a reservation for a group either in person or by phone.
- Regulation-length Courses
  (Pebblebrook, Grandview and Trail Ridge GC)
  1. Requests must be made in person and entered on a "Tee-Time Request Slip." The slips are deposited at the applicable Golf Pro Shop in the box labeled with the desired play date.

2. The box containing the requests will be emptied at 2:00 p.m., 4 days in advance of the desired play date. The draw will be in random sequence and accomplished by Pro Shop employees. Upon selection, first, second, and third choice tee-times will be assigned as available.
3. Only one tee-time request may be submitted for a given day (group players included). If golfers submit more than one request for a given day, they will be penalized by being given last priority for a tee-time.
4. Players who do not opt to participate 4 days in advance, may still obtain reserved tee-times as available. Telephone reservations will be accepted for desired play dates three days or less in advance (as available).

- Only members of the Recreation Centers may make an advance tee-time reservation. Guests are not authorized to obtain an advance reservation, but may obtain an open reservation on a first-come, first-serve basis.

Supplemental Fee

A supplemental fee of $1.00 per 9 hole round or $2.00 per 18 hole round is also charged for each round played. One half (½) the amount is used to defray routine operating expenses, and the balance is used to generate a capital investment fund (Golf Reserve Fund) for replacement of major golf maintenance equipment and/or improvement of golf course facilities. The fee is applicable to all members and guests using the courses and is assessed each time a member signs in to play a round. The fee is an additional per round charge for the annual prepaid cardholder, but is included in the published daily greens fee.

Bowling Center

Twenty four (24) lanes are available in the RHJ Recreation Center (Sport Pavilion). Automatic computerized scoreboards are provided as part of the regular bowling fee, while rental shoes and lockers are available at an additional (nominal) cost.

General Rules/Information

- Children under 12 years of age are not permitted to bowl. Children 12-16 years of age may bowl if supervised by an adult sponsor.
- Appropriate bowling attire is required, and upper body garments must be worn at all times. Bathing suits are not considerd appropriate attire. Bowling shoes are mandatory.
- For the convenience of handicapped patrons, we will attempt to provide end lanes whenever possible. For this purpose, handicapped persons desiring to bowl are encouraged to call the Sports Pavilion in advance and advise management of their desires.
- Food and drink is not allowed in the bowler's immediate area. Seating is available throughout the main concourse, or bowlers can use the adjacent concourse counters for this use.
- Normal rules of bowling etiquette will be followed at all times; e.g., a bowler should always yield to the bowler on the right and if ready, allow that individual to bowl first.

League Play

The primary league season runs from September 1 through April 30, with championship roll-offs conducted the first two weeks in May. While summer leagues are supported (mid-May through July 31), their limited size/number generally creates open lanes.

- Leagues are managed by league secretaries, who arrange for designated league time with the Bowling Center Manager. The Bowling Center posts a list of all leagues and corresponding team compositions/team availability for all residents desiring to participate.
- Once leagues and league schedules are approved by the Bowling Center Manager, they are given priority for reserved lane use during their designated times.
- League disputes are not a matter for Recreation Centers arbitration, but are more properly a function of local ABC or WIBC representatives (as applicable).

Open Play

Once league schedules are finalized, open bowling time is then determined. While we attempt to provide some form of open bowling at all times, the size of some leagues may sometimes preclude it. As a matter of policy, we attempt to provide a one lane separation between leagues and open play.

- If a machine malfunction occurs during league play, management reserves the right to move or preempt open bowlers in favor of the displaced league team.
- When lanes are full, and a waiting list established, a three-game limit is imposed for open bowlers. The waiting list is developed on a first-come, first-serve basis.
- While resident members are encouraged to call the Sports Pavilion to determine the status of lane availability, lane reservations for open bowling will not be accepted.

Bowling Reserve Fund Fee

Ten cents ($.10) is collected from all lineage fees and deposited into the Bowling Reserve Fund. This money is used to defray large capital repair and capital improvement projects.

Other

- The Bowling Center periodically promotes and/or coordinates special events and tournaments to enhance interest and enjoyment in the bowling program. For the most part, these events are open to all resident members.
- A beginners bowling program is offered periodically throughout the year—these programs are conducted free of charge or at nominal cost (depending on category of instruction provided).
- There are 800 bowling lockers available for rent on a calendar year basis. A waiting list is normally maintained for this service.
- A small resale counter is available which promotes routine bowling aids. Large bowling items (balls, shoes, bags, clothes) are not available.

Fitness Centers/Exercise Rooms

Located in each of the three Recreation Centers, the Fitness Centers are designed to provide low to medium range fitness activity for residents. While individual programs can be tailored by members for personalized fitness needs, the design emphasis of existing equipment is to provide a sound cardiovascular warm-up program. Low and heavy impact aerobics classes are periodically offered through established exercise/fitness clubs at the R.H. Johnson Social Hall.

Therapy Pools/Spa

Indoor therapy pools are located in each of the three Recreation Centers, in a room adjacent to the Fitness Centers. An outdoor heated spa is available in the RHJ Pool complex.

- Bathing suits must be worn in therapy pools/spa; street clothing of any type is not permitted. All patrons are required to take a shower before entering the therapy pools/spa.
- Members should be sensitive to the intended purpose of these facilities—the warm active waters are designed to loosen muscle group tightness and, in general, provide a feeling of invigoration as bodily pores are opened. Therapy pools/spa are *NOT* designed to cause weight loss.
- Patrons should normally restrict their use to 15 minute intervals. Since the warm waters are designed to relax the body, extended use may cause drowsiness—a situation not considered safe in an aquatic facility.
- Vigorous exercise in the pools is not in the best interest of the members; i.e., you would be exercising muscle groups that are being fully relaxed. The contra effect of exercise may cause injury, or further aggravate an existing injury.
- Persons with a heart condition, hypertension, or using prescribed medication should consult their physician before using a therapy pool/spa. Persons who have taken alcoholic beverages should not use these facilities.
- Children under the age of 16 are not permitted in the therapy pools/spa.
- There will be no food or drink allowed in or around these facilities.

Swim Pools

Outdoor heated pools are available at both the Johnson and Kuentz Recreation Centers, while an indoor pool is available at Beardsley Park. Recreation Centers pools are private membership pools. There is no lifeguard on duty and members/guests therefore participate at their own risk. Life buoys and shepherds crooks are readily available at poolside if an emergency should arise. Specialized equipment is available at each pool to facilitate use by the handicapped, or physically impaired. Unless weather conditions dictate otherwise, pool temperatures are designed to attain an average mean temperature of 84 degrees F (National standard for commercial pools).

Showers are required prior to each entry into the pool. Appropriate clothing is required—street clothes or street clothes combinations are not permitted.

- Children under the age of 4 years are not permitted in any pool. Children 4-16 years of age may swim from 10 a.m.-1 p.m. daily (11 a.m.-1 p.m. during the winter months) in the RHJ Pool only. All children must be signed in as guests and adult supervision must be provided for the duration of swim. Diving is authorized only in designated areas, and horseplay or unnecessarily boisterous behavior will not be tolerated. However, the pure definition of a "child" necessitates some flexibility in determining what is unacceptable behavior, and what is normal childlike behavior. We ask residents to be sensitive to this aspect during hours when children are authorized to swim. The governing factors in making an "unacceptable" determination in this area will be safety mindedness, and in maintaining reasonable decorum for the membership.

Food and alcoholic beverages are not permitted in or around the swim pool and adjacent deck areas. Soft drinks in non-glass containers are allowed in the deck areas only. Glass receptacles of any kind are not allowed in or around the pools and deck areas.

- Swim fins, face masks, inner tubes, or inflatable devices are not permitted in the pool unless a medical condition requires it. In such instances, a medical permit is required (available at Administration Office, physician's prescription required). Small children under the direct supervision of an adult may wear inflatable arm devices as a precautionary safety measure. While such use is at the discretion of the adult supervisor, the monitors should be advised upon entry.
- Any member or guest not abiding by stated, or otherwise obvious safety related rules may be asked to leave. The monitor's judgement, with respect to safety, proper decorum, and sanitation will prevail in all instances. Any complaint relating to a monitor's decision may be later appealed to the General Manager. However, the monitor's decision prevails until such appeal is heard.
- By preannounced schedule, pools may designate early morning reserved time for exercise or handicapped groups. The reserved timeframe allows for both proper care and instruction, as well as majority participation.
- The wheelchair ramp is self-serve and may be used at the discretion of the patron.
- A minimum of two swim lanes will be identified for lap swimming. One lane will be used for slow and intermediate pace swimmers and the other for fast pace swimmers. The remainder of the pool will be for open swim.

Racquetball/Handball Courts (2) (RHJ Activities Building)

- All persons desiring to use these facilities must sign in at the Monitor's Station.
- Children under the age of 16 years must be accompanied by an adult sponsor.
- Appropriate athletic apparel is required—street clothes are not permitted. Rubber sole athletic shoes are mandatory. Shoes with black soles, or material that otherwise marks the court floor are not authorized. Patrons are asked not to wear athletic shoes from an outside area to the courts.
- The use of eyewear or eyeguards is strongly encouraged.
- Only racquetball items are authorized on the courts. Patrons are asked to use "no mark" composition balls whenever possible.
- All courts are available for a one hour (on the hour) timeframe. Reservations may be made one day in advance and can be made in person, or by telephone. Consecutive reservations will not be accepted, and only one advance reservation (per day) is authorized.
- There will be a 10 minute grace period for the patron reserving the court, after which the court becomes available for open play.
- Courts not reserved as of game time become open courts to be used on a first-come, first-serve basis.

Tennis Courts

Located in the RHJ complex, the main tennis pavilion includes 15 regulation courts (6 lighted), and 8 platform tennis courts. The Fred P. Kuentz Recreation center offers an additional six regulation courts (two of which are lighted.)

General Rules Information

- Appropriate tennis apparel is required, and upper body garments must be worn at all times. Bathing suits are not considered appropriate apparel. Rubber soled tennis shoes are mandatory—street shoes are not allowed.
- Regardless of the availability of club-provided monitors, all members and guests must sign in at the Monitor's Station.
- "Prime time" is considered to be a time when all courts are full. During this time, there will be no lessons given. Single players will not be allowed to use the courts for practice, and the ball machine cannot be used. The above restrictions may be selectively lifted when there are a minimum of three (3) courts available for open play.
- Practice backboards can be used by eligible patrons whenever available.
- Courts cannot be held more than five minutes (past the designated start time) while one individual waits for an opponent, or partner.
- Children under the age of 16 must be accompanied by an adult sponsor. However, they are not allowed use of the courts during prime time.
- Any notice posted to the Tennis Court Bulletin Board must be cleared with the monitor, or an officer from the SCW Racquet Association.

Court Scheduling

Whenever possible, play will be scheduled and controlled by a monitor Sunday through Saturday.

- Eligible participants must establish their membership status by presenting a current membership card during sign-in.
- Reservations may be made one day in advance of the desired play date either in person, or by telephone (limit one reservation per day). Reservations will be taken ½ hour before the first period of daily play and may be made Monday through Saturday.
- Periods of play will be based on 1½ hour intervals. The starting time for the first period will be determined by the SCW Racquet Association and will be clearly posted on the Bulletin Board. Starting times will understandably change with the seasons.
- While courts are normally scheduled for instruction or individual play during the first two periods of the day only, this rule may be modified at the monitor's discretion, depending on the extent of court availability.
- Monitors will announce the beginning/ending of play periods. As long as individuals are waiting to play, prior period play time will not be extended and the courts must be vacated at the end of a period.

Use of Tennis Ball Machine

The responsibility for control and use of this machine has been delegated to the SCW Racquet Association.

- Prior to use by an individual, the SCW Racquet Association must ensure that proper safety and operational procedures are clearly understood.
- There is an established (nominal) fee to assist in maintaining the machine.
- The machine will not be used by an individual to generate personal monetary gain.

Billiard Room (RHJ Sports Pavilion)

- Children under the age of 16 years are not permitted to use this facility.
- Apropriate dress is required, with upper body garments required at all times. Bathing suits are not considered appropriate dress.
- This activity is a designated "No Smoking" area, and food and beverages are not permitted. Those members requiring an alternative may use the main concourse.
- Sitting on tables is not permitted. If the use of a bridge is not exercised, all other shots require that one foot remain on the ground.
- Play will be scheduled for one hour periods. As long as vacant tables exist, the one hour limit may be extended to accommodate members. There will be no reservation of tables.
- Players are not permitted to change tables without first notifying the monitor.

Mini-Golf (RHJ and Beardsley Park)

Children less than 6 years of age are not allowed to play mini-golf at the R.H. Johnson Recreation Center, but may play at Beardsley Park. Children 6-16 years must be accompanied by an adult sponsor.

- To speed up play, the number of strokes taken should be restricted to 5.
- Players must remain on the paved sidewalks between holes and avoid straying into the landscaped areas.
- Players may repeat the course as long as new players are not waiting to play. Priority for play will always be given to new players.

Snack Bars

Food and beverage facilities are located at each golf course and at the RHJ Sports Pavilion. They are open to all residents, guests, and visitors to Sun City West. Aside from proper conduct, the singular rule to abide by is proper dress; i.e., upper body garments and shoes must be worn at all times.

Other Sports Facilities

- Indoor Shuffleboard Courts (RHJ Sports Pavilion)

  Unless preannounced tournaments or club activities are scheduled, courts are maintained for open play. While play periods are generally for one hour duration, times may be extended by the monitor as long as new players are not waiting for court time. Equipment can be obtained from the monitor during sign-in.

- Artificial Turf/Outdoor Bocce Courts (RHJ Recreation Center/Adjacent to Mini-Golf)

  Unless preannounced club activities are scheduled, courts are maintained for open play. Courts are generally scheduled for one hour play periods, but times may be extended as long as new players are not waiting for court time. Equipment can be obtained from the monitor during sign-in.

- Walking/Jogging Track with Parcourse Fitness Circuit (RHJ Recreation Center/Adjacent to Lawn Bowling Courts and Fred P. Kuentz Recreation Center)

  The artificial turf ¼ mile track at our Johnson Center offers a resilient surface to lessen the impact on lower body joints. Electronically timed pacing lights are provided to allow individuals the ability to pace their workout in an individually tailored program. When not competing against time, members can take advantage of the Parcourse exercise stations placed strategically throughout the course. Following Parcourse circuit instructional signs, an individual can combine the cardiovascular advantages of walking/jogging with the related physical attributes of planned exercise. Both activities are open to residents and guests on a self-monitored basis. The track at the Fred P. Kuentz Recreation Center has a contemporary surface, and does not include an exercise fitness course. Upper body garments are required at all times while on jogging tracks.

- Softball Field (Adjacent to Fred P. Kuentz Recreation Center)

  Slow pitch softball is relatively new to Sun City West, but its popularity is increasing with the development of inner-city leagues.

- Horseshoe Courts (Adjacent to Beardsley Park Mini-Golf)

  Four landscaped courts are provided with equipment available at the adjacent Monitor's Station.

- Lawn Bowling (RHJ Recreation Center/Adjacent to Walking Track)

  The only four (4) contiguous, natural turf lawn bowling greens in the United States—play is year-round.

Picnic Ramadas/Outdoor Bandstand

The Beardsley Park Recreation Center offers outdoor picnic ramadas with grills and benches. Special musical programs are often promoted in this area using the bandstand as the program focal point. Advanced reservations for the ramadas can be made by calling the Administration Office, and a rental fee is applicable. When not reserved, ramadas are available on a first-come, first-serve basis, and there is no charge. A minimum of five ramadas are always available for the first-come, first-serve patron.

Social Hall Facilities

The RHJ Recreation Center provides a 900 seat multi-use Social Hall (small stage and kitchen capability) and 62-110 seat Lecture Hall (audio-visual capability). The Beardsley Park Recreation Center offers various meeting rooms and multi-purpose rooms; and the Fred P. Kuentz Recreation Center offers a 300 seat auditorium/theater as well as various multi-purpose rooms. In the majority, all large rooms can be configured to accommodate different size groups and needs. Rooms and specialized equipment can be rented on a ½ day or full day requirement. While resident groups have priority for use, commercial use can be authorized (higher rental rate) if it satisfies membership needs.

Library

In addition to Recreation Centers financial backing, the Library receives a major share of its operational funding from a chartered club (Friends of the Library). The majority of the Library staff is comprised of over 150 volunteers.

Affiliation

The library is affiliated with the Maricopa County Library System which allows for reciprocal privileges at all County libraries in Phoenix, Glendale, Scottsdale, Mesa and other smaller communities. Since the Library is available to all Maricopa County residents, a special card must be issued to patrons to enable access to the County's computerized circulation system. In addition to reciprocal book privileges, the County system also provides for long-term book loans, inter-library loans, and reference assistance.

Friends of the Library ("Friends")

"Friends" is a chartered club (non-profit organization) created especially to promote, support, and enrich the services of the Library. Much of their financial support is derived from collections received during the Annual Endowment Fund Drive. Other programs supported by "Friends" include twice-monthly book discussions, weekly films (shown at Stardust Theatre), and quarterly program meetings. Additionally, "Friends" offers a rental program with selections of currently popular books—typical charges are 10 cents per day, or 50 cents per week. These books are available on a first-come, first-serve basis.

Use of Circulation Materials (Books, Magazines, Records, Tapes)

- A special Library Card must be presented to check out Library materials. While there is no charge for the initial issue, a replacement fee will be charged for reissue.
- The borrowing period is two weeks and all items borrowed can be renewed. Older materials may be borrowed for extended periods, but a special request is required.
- Reference materials are not available for overnight checkout.
- Patrons may reserve books by purchasing and filling out a pre-printed postcard. When the book becomes available, the patron will be notified with the postcard. Books may not be reserved by phone.
- The fine imposed for overdue books is 5 cents per day (counting only those days the Library is open)—maximum fine is $1.00 per item. Patrons with overdue books may be notified by mail, or telephone. If an item is lost or destroyed, the patron must pay for the item, or replace it in kind.
- While the current issues of magazines do not circulate, older issues do.

Book Drop

The "Book Drop" is located near the front door and is provided for the convenience of patrons. The facility is to be used to return books and magazines *only* (during non-operating hours)—records and tapes are vulnerable to damage and are not to be put in the "Book Drop."

Inter-library Loan

This system enables a patron to take advantage of other library inventories by requesting an item from another library. The Library staff will assist patrons in filling out a loan request. Any books received by loans will be administered according to the rules of the sending library.

Reference Service

Reference questions may be posted by telephone, or in person. Assistance in answering reference questions may be obtained from other County library sources.

Village Store

This activity, located in the RHJ Arts and Crafts Village, serves as a sales medium for crafts items created by residents, and subsequently helps to promote the overall crafts program. Only those articles made wholly or in part in Recreation Centers facilities can be consigned to the Village Store for display and sale. A minimum of 80 percent of the resale price will be returned to the member. Ten percent (10%) is paid to the Recreation Centers (to assist in covering the salaries of Village Store monitors), and 10 percent is returned to the member's club (if required by club rules and regulations). Aside from routine operating supplies sold by clubs to their own members, all other resale items sold on Recreation Centers property must be consigned to the Village Store.

Chapter Four
Chartered Clubs

General

Any group of members who are interested in pursuing a particular hobby, vocation, or special field of interest may join together as a chartered club.

- Approval of club charters rests with the General Manager.
- Club rules and regulations will not conflict with the Recreation Centers Articles of Incorporation, or its Bylaws. Once approved, these rules will be clearly posted in respective club facilities.
- Club charters are subject to the availability of space, equipment, and facilities required by the group.
- Charters will not be issued to more than one club (of similar design and purpose) using the same dedicated facilities.

Membership

- Club membership can only be extended to members in good standing of the Recreation Centers.
- To be established as a chartered club, non-craft clubs must initially produce 50 paid-up first year members, and craft clubs must initially produce 25 paid-up members. Club meetings must be held on a regular basis.
- Honorary membership may not be granted to anyone who is not a member of the Recreation Centers.
- Guest privileges may be extended in the same manner as provided in the Recreation Centers. After a guest has accepted club hospitality for a reasonable amount of time, he/she would be expected to join.
- Clubs are responsible for periodically validating Recreation Centers membership status for all club members.

Bylaws and Organizational Structure

Each club will be chartered with an approved set of bylaws stating club purpose and function. Once approved, individual rules and regulations will be formulated by each club and filed with the Recreation Centers. Each club will be organized with a minimum of three officers; i.e., President, Vice-President, and Secretary/Treasurer.

Tax Exemption

The Recreation Centers will assist each club in filing for Arizona non-profit organization status. Subsequently, all clubs are responsible for satisfying all Federal and State tax liabilities.

Equipment and Facility Use

Recreation Centers equipment and facilities may be used without charge for normal club activities as long as safety awareness, proper decorum and reasonable care of equipment/facilities is provided by the club.

- The potential hazards associated with some crafts equipment require that it be operated only with qualified supervision. Clubs may prohibit equipment use to any individual who is unable or unwilling to use the equipment safely or correctly.
- While all facilities and programs within the physical confines of the Recreation Centers are available to the general membership, regular participation in some activities may be contingent upon membership in a chartered club. Regular membership in a chartered club is open to any member having a current and valid Recreation Centers membership card, or tenant's activity card. The Recreation Centers has delegated full-time operating responsibility to respective clubs in a conscious effort to provide low-cost programs in a necessarily structured and safe environment. In those facilities where participation is contingent upon club membership, the rationale is solely based on the need to protect both Recreation Centers and club-purchased investments, the essentiality of providing a safe and orderly working place, and the desire to establish a comprehensive leisure-time program. When not reserved/engaged by a group (club or other), general use rooms may be used by individuals on a 1st come, 1st serve basis.
- Regardless of membership status, club rules and regulations for the use of facilities/equipment will be observed by all.
- Whenever the demand for equipment use exceeds availability, all clubs shall equally and fairly allocate the use of equipment on a time or equivalent basis.

In ensuring that all club-purchased equipment is legally covered under provision of Recreation Centers insurance policies, all equipment approved for purchase by a chartered club (for regular use in a Recreation Centers facility) will become the property of the Recreation Centers.

Open Work Time

All arts & crafts will schedule their operating time to allow for a minimum 25% to be used by their membership for open workshop/general use time. This time will not be hindered by meetings, instructional classes, or other planned courses, but must be under the direction of a club monitor. If membership demand for equipment warrants, monitors should enforce club-designated time limits for the use of equipment to maximize member participation.

Finances

All bank accounts shall be in the name of the club and continue through succeeding administrations. Clubs generating gross annual income/cash flow in excess of $5,000 should seriously consider bonding for applicable club officers. All club finances will be properly documented/recorded, and subject to independent audit. The audit will be made available for review to the Recreation Centers (when deemed necessary). A financial statement shall be filed with the Recreation Centers annually by each club following close of a club's fiscal year.

Monitors

Clubs are required to provide a reasonably well-trained facility monitor during all operating hours (open time and club time). In the event a monitor is not provided when required, the club area will be closed.

Instructional Classes

- Instructions are provided in various arts, handicrafts, and sports activities for all Recreation Centers members. These classes are generally offered by the chartered clubs at reasonable rates. Unless a waiting list is employed, class registration is on a first-come, first-serve basis. Registration procedures are designed to provide all Recreation Centers members with a reasonable and equitable opportunity to obtain instruction.
- The use of facilities by Recreation Center members for the purpose of giving instructio for compensation is prohibited unless sponsored and supervised by a chartered club, or authorized by the Recreation Centers as part of a community-wide program.

Resale Operations

- Recreation Centers facilities are intended for the pursuit of hobby and other leisure-time activities, and not for individuals to manufacture goods/articles for personal monetary gain.
- Chartered clubs may offer member-made articles for sale, as long as a designated percentage of profit is returned to both the club and the Recreation Centers. Clubs are not authorized to sell finished products that were not produced in whole or in part within club facilities. In all instances, member-made articles may only be offered for sale (on Recreation Centers property) when consigned to the Village Store.
- Incidental equipment items and supplies related to club activities may be sold by a club as lor as some portion of the resale profit reverts to the club.

Charges and Contributions

- Clubs are not charged a fee for routine club use of Recreation Centers facilities; i.e., regularly scheduled meetings and facility sponsorship (as applicable). The Recreation Centers will only charge clubs for extra requirements (set-ups, seating arrangements, clean-up etc.) above the cost of work for routine club activity.
- Clubs function as a non-profit organization within Recreation Centers sponsorship. In this context, clubs are being supported by Recreation Centers membership dues. It is expected, therefore, that clubs generating excess monies, over and above reasonable operating expenses, will donate all or part of the excess to the Recreation Centers.

Recreation Centers Staff

General Manager . . . . . W.S. O'Donnell
Executive Assistant . . . . . Sandee Bennett
Controller . . . . . Dan Webb
Program Coordinator . . . . . Dee Anderson
Golf Course Managers
  Grandview . . . . . Gaylord Noblitt
  Pebblebrook . . . . . Sam Graziano
  Trail Ridge . . . . . Denny Green
  Echo Mesa . . . . . Ray Pilot
  Stardust . . . . . Harold Haber
Golf Maintenance Director . . . . . H.F. "Chip" Howard
Sports Pavilion Manager . . . . . Jerry Michael
Maintenance Director . . . . . Ron Randles

Telephone Numbers

Membership and General Administration 584-2050/2051
Executive Office 584-0622/0712
Advisory Board 584-6383
Chartered Clubs and Facility Scheduling 584-2052
Accounting and Computer Systems 584-0320/0022
RHJ Sports Pavilion 584-2407
RHJ Snack Bar 584-6629
Pebblebrook Golf Course . . 584-2401
Pebblebrook Snack Bar 584-5704
Grandview Golf Course . . . 584-2998
Grandview Snack Bar 584-6008
Stardust Golf Course 584-2916
Echo Mesa Golf Course . . . 584-0666
Trail Ridge Golf Course . . . 546-0858
Library 584-2405
Beardsley Swim Pool 584-6079
Johnson Swim Pool 584-2409
Kuentz Swim Pool 546-0728
RHJ Racquetball Courts . . . 584-7760
RHJ Tennis Courts 546-1376
Village Store 584-3800

Recreation Center Outline

Operational Hours

Activity	Winter Hours	Summer Hours
Administration	Monday-Friday: 8:00 a.m.-4:00 p.m.	Same
Golf	Daily: (Seasonal) 6:30 a.m. - 5:30 p.m.	Daily: (Seasonal) 5:30 a.m.- 5:30 p.m.
Golf Snack Bars	Daily: ½ hr. prior to ProShop - 5:00 p.m.	Daily: 5:30 a.m. - 5:00 p.m.
Swim Pools:		
RHJ Johnson	Daily: 11:00 a.m.-4:30 p.m.	June, July, August 10:00 a.m. - 9:00 p.m.
RHJ (only)	Kids Swim 11:00 a.m.-1 p.m	Kids Swim 10:00 a.m.-1 p.m.
Kuentz	Daily: 11:00 a.m. - 4:30 p.m.	June, July, August 8:00 a.m. - 9:00 p.m.
Beardsley	Monday-Saturday: 10:00 a.m.-8:00 p.m. Sunday: 10:00 a.m.-6:00 p.m.	Same as Winter Hours
Handicapped	By appointment - Beardsley Pool	
Fitness Centers & Therapy Pools		
BP	Monday - Saturday 8:00 a.m - 8:00 p.m. Sunday 10:00 a.m. - 6:00 p.m.	Same as Winter Hours
RHJ/Kuentz	Daily: 8:00 a.m. - 6:00 p.m.	June, July, August 8:00 a.m. - 9:00 p.m.
Mini Golf (BP)	Daily: 1:00 p.m.-5:00 p.m. (Seasonal)	Daily: 5:00 p.m. - 9:00 p.m. (Seasonal)
Mini Golf (RHJ)	Daily: 9:00 a.m.-6:00 p.m. (Seasonal)	Daily: 9:00 a.m. - 9:00 p.m. (Seasonal)
Activities Bldg (RHJ) (Arcade, PingPong, Bocce, Racquetball)	Daily: 9:00 a.m. - 6:00 p.m. (Seasonal)	Daily: 9:00 a.m. - 9:00 p.m. (Seasonal)
Library (RHJ)	10:00 a.m.-4:00 p.m. / Tue.-Sat.	10:00 a.m.-4:00 p.m. / Tue.-Sat.
Sports Pavilion (RHJ) (Bowling, Shuffleboard, Pool, Snack Shop)	(Hours may fluctuate slightly due to league play)	
	8:30 a.m.-11:00 p.m. / M,Tu,W,Th 8:30 a.m.-9:00 p.m. / Friday 10:00 a.m.-9:00 p.m. / Saturday Noon-9:00 p.m. / Sunday	9:00 a.m.-11:00 p.m. / M 9:00 a.m.-9:00 p.m. / T-F Noon-9:00 p.m. / Saturday Noon-5:00 p.m. / Sunday
Village Store: (RHJ)	9:00 a.m.-4:00 p.m. / M-F (Seasonal)	9:00 a.m.-4:00 p.m. / M-F (Seasonal) 9:00 a.m.-1:00 p.m. (July & August)
Craft Shops (General)	8:00 a.m.-4:00 p.m. / M-F	8:00 a.m.-4:00 p.m. / M-F

(RHJ / RHJohnson Rec Ctr, BP / Beardsley Park Rec Ctr, K / Kuentz Rec Ctr)

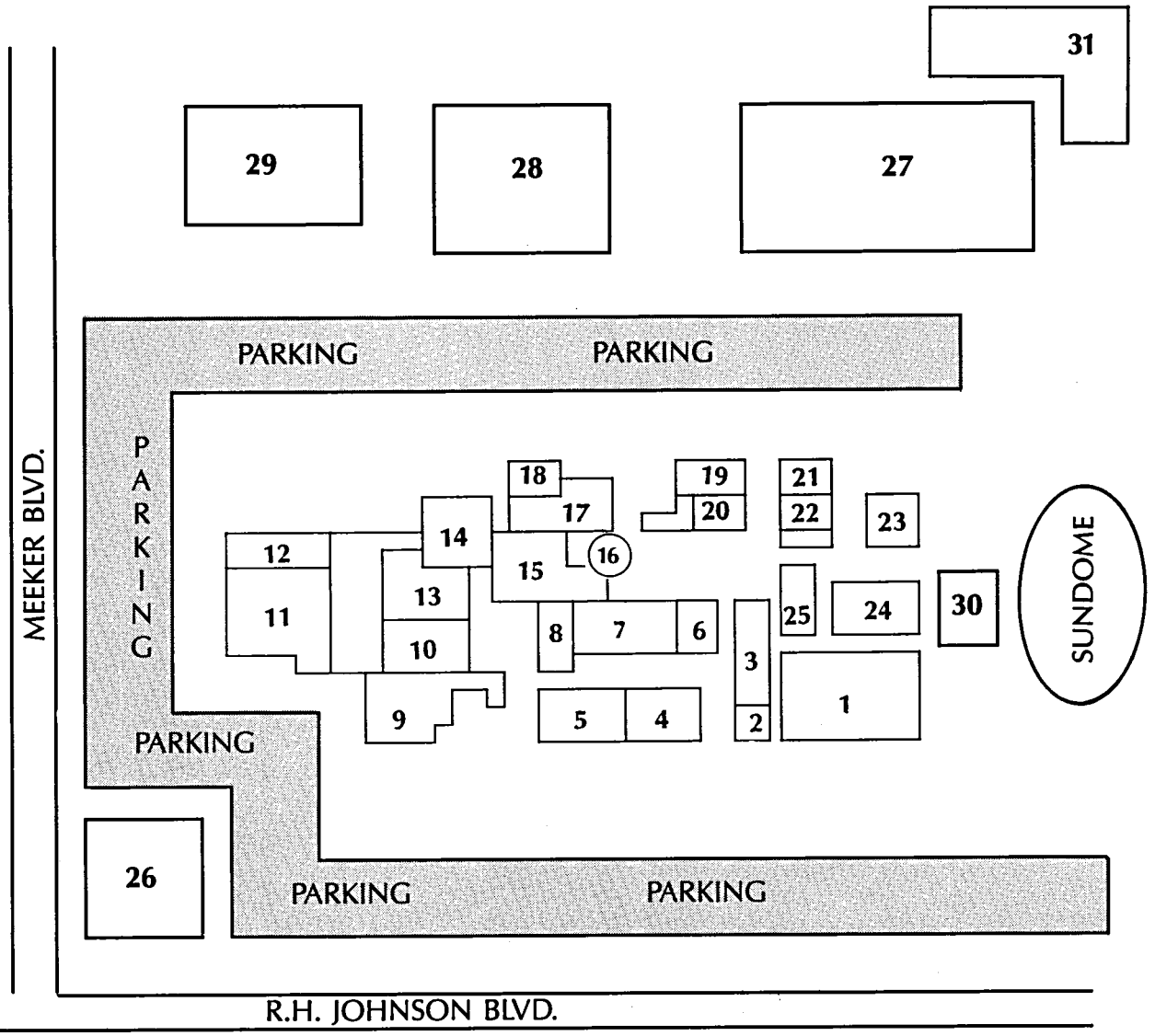
Recreation Center Outline

Operational Hours

Activity	Winter Hours	Summer Hours
Administration	Monday-Friday: 8:00 a.m.-4:00 p.m.	Same
Golf	Daily: (Seasonal) 6:30 a.m. - 5:30 p.m.	Daily: (Seasonal) 5:30 a.m.- 5:30 p.m.
Golf Snack Bars	Daily: ½ hr. prior to ProShop - 5:00 p.m.	Daily: 5:30 a.m. - 5:00 p.m.
Swim Pools:		
RHJ Johnson	Daily: 11:00 a.m.-4:30 p.m.	June, July, August 10:00 a.m. - 9:00 p.m.
RHJ (only)	Kids Swim 11:00 a.m.-1 p.m	Kids Swim 10:00 a.m.-1 p.m.
Kuentz	Daily: 11:00 a.m. - 4:30 p.m.	June, July, August 8:00 a.m. - 9:00 p.m.
Beardsley	Monday-Saturday: 10:00 a.m.-8:00 p.m. Sunday: 10:00 a.m.-6:00 p.m.	Same as Winter Hours
Handicapped	By appointment - Beardsley Pool	
Fitness Centers & Therapy Pools		
BP	Monday - Saturday 8:00 a.m - 8:00 p.m. Sunday 10:00 a.m. - 6:00 p.m.	Same as Winter Hours
RHJ/Kuentz	Daily: 8:00 a.m. - 6:00 p.m.	June, July, August 8:00 a.m. - 9:00 p.m.
Mini Golf (BP)	Daily: 1:00 p.m.-5:00 p.m. (Seasonal)	Daily: 5:00 p.m. - 9:00 p.m. (Seasonal)
Mini Golf (RHJ)	Daily: 9:00 a.m.-6:00 p.m. (Seasonal)	Daily: 9:00 a.m. - 9:00 p.m. (Seasonal)
Activities Bldg (RHJ) (Arcade, PingPong, Bocce, Racquetball)	Daily: 9:00 a.m. - 6:00 p.m. (Seasonal)	Daily: 9:00 a.m. - 9:00 p.m. (Seasonal)
Library (RHJ)	10:00 a.m.-4:00 p.m. / Tue.-Sat.	10:00 a.m.-4:00 p.m. / Tue.-Sat.
Sports Pavilion (RHJ) (Bowling, Shuffleboard, Pool, Snack Shop)	(Hours may fluctuate slightly due to league play)	
	8:30 a.m.-11:00 p.m. / M,Tu,W,Th	9:00 a.m.-11:00 p.m. / M
	8:30 a.m.-9:00 p.m. / Friday	9:00 a.m.-9:00 p.m. / T-F
	10:00 a.m.-9:00 p.m. / Saturday	Noon-9:00 p.m. / Saturday
	Noon-9:00 p.m. / Sunday	Noon-5:00 p.m. / Sunday
Village Store: (RHJ)	9:00 a.m.-4:00 p.m. / M-F (Seasonal)	9:00 a.m.-4:00 p.m. / M-F (Seasonal) 9:00 a.m.-1:00 p.m. (July & August)
Craft Shops (General)	8:00 a.m.-4:00 p.m. / M-F	8:00 a.m.-4:00 p.m. / M-F

(RHJ / RHJohnson Rec Ctr, BP / Beardsley Park Rec Ctr, K / Kuentz Rec Ctr)

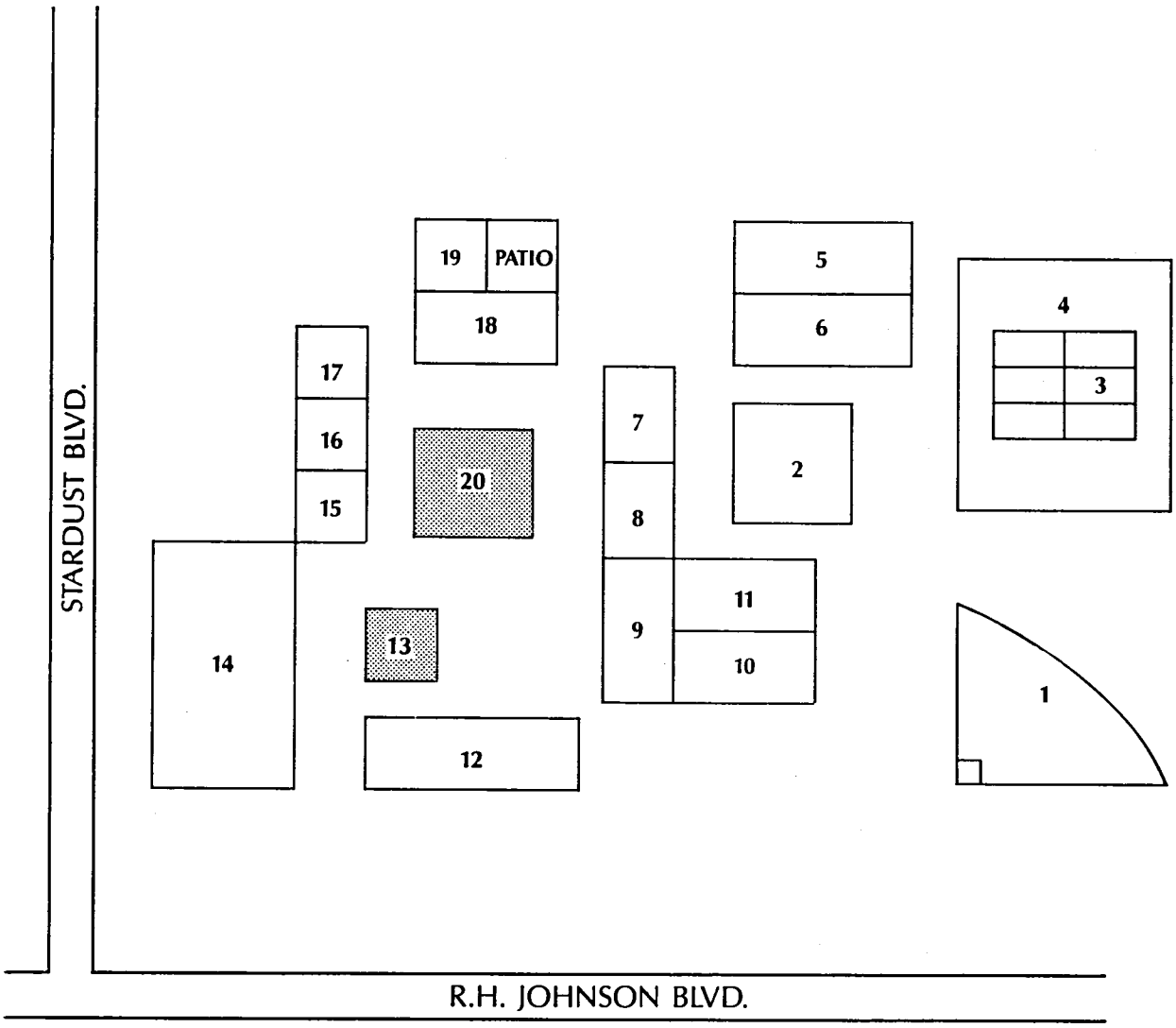
R.J. Johnson Recreation Center



Legend

1. SOCIAL HALL
2. REC CENTER ADMINISTRATION
3. CERAMICS
4. LAPIDARY
5. SILVERSMITH
6. MODEL RAILROAD
7. SEWING
8. VILLAGE STORE
9. LECTURE HALL
10. BILLIARD ROOM
11. BOWLING LANES
12. SNACK BAR
13. SHUFFLEBOARD
14. LOCKER ROOMS
15. SWIM POOL
16. OUTDOOR SPA
17. THERAPY POOLS
18. FITNESS CENTER
19. MAINTENANCE & PURSHASING
20. RACQUETBALL COURTS
21. PING PONG
22. GAMES ARCADE
23. BOCCE COURTS - #1
24. MINI GOLF
25. BOCCE COURTS - #2
26. LIBRARY - #2
27. TENNIS COURTS
28. LAWN BOWLING
29. TRACK/PARCOURSE
30. CHILDREN'S PLAYGROUND
31. PET PARK

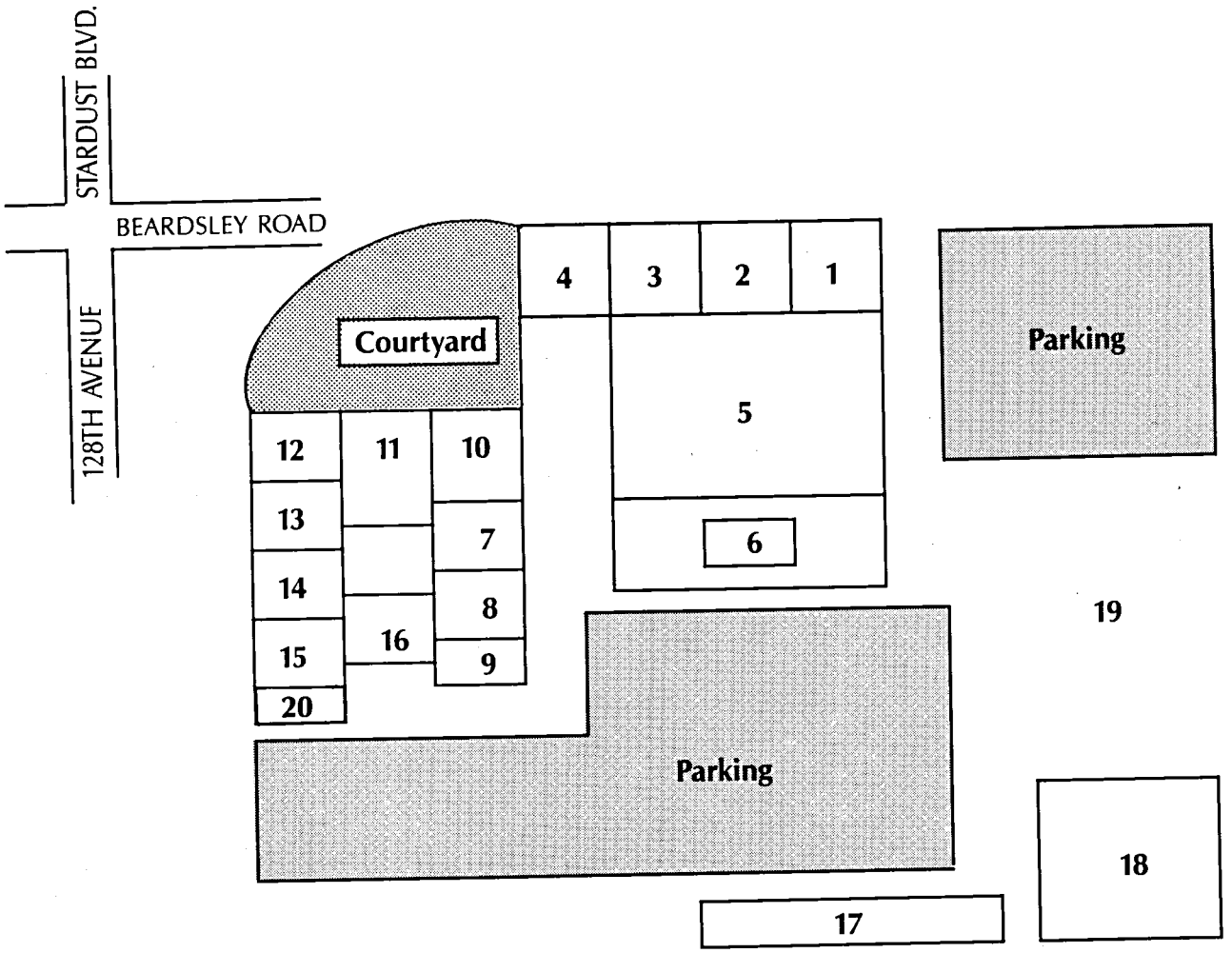
Fred P. Kuentz Recreation Center



Legend

1. SOFTBALL FIELD
2. SWIM POOL
3. TENNIS COURTS
4. TRACK
5. METAL SHOP
6. WOOD SHOP
7. MULTI-PURPOSE ROOM #2
8. LEATHER ROOM #1
9. LOCKER ROOMS
10. THERAPY POOL
11. FITNESS CENTER
12. WOMENS CLUB
13. COURTYARD
14. THEATER
15. MULTI-PURPOSE ROOM #5
16. MULTI-PURPOSE ROOM #4
17. MULTI-PURPOSE ROOM #3
18. ART
19. WEAVING
20. COURTYARD

Beardsley Park Recreation Center



Legend

1. THERAPY POOL
2. FITNESS CENTER
3. LOCKER ROOMS
4. GREENHOUSE
5. SWIM POOL
6. PATIO/SUN DECK
7. CARD ROOM #1
8. CARD ROOM #2
9. CARD ROOM #3
10. MEN'S CLUB
11. CARD ROOM #4
12. STAINED GLASS
13. COPPER COOKERS
14. PHOTOGRAPHY
15. CLAY/POTTERY
16. CHINA/BASKETRY
17. HORSESHOES
18. MINI-GOLF
19. PICNIC RAMADAS/BANDSTAND
20. COMPUTER

TRAFFIC IMPACT STUDY

OF

SUN CITY WEST

FOR

DEL WEBB CORPORATION

BY

STANLEY CONSULTANTS, INC.
3117 North 16th Street
Phoenix, Arizona 85016

DECEMBER 1991

INTRODUCTION

Sun City West

Sun City West is a planned adult community consisting of approximately 10,800 dwelling units, containing service and activity centers providing for most of the daily needs of the residents. These include a health center and hospital, six churches of various denominations, seven golf courses, three community shopping centers, several restaurants, several financial institutions, three recreation centers, community service center, vacation center, service station, and the ASU Sundome. The existing development is bounded by Bell Road on the south, Grand Avenue on the southwest, Deer Valley Drive on the north and El Mirage Road on the east.

Planned Development Expansion

The Del Webb Corporation has been completing the construction of dwellings at an annual rate of 600 units. Approximately 2,700 homes remain to be constructed within the existing site south of Deer Valley Drive.

The Del Webb Corporation is planning an expansion site of 878 acres bounded by Deer Valley Drive on the south, the planned Estrella Freeway on the north, 1/4 mile east of 135th Avenue on the east and 1/4 mile east of 151st Avenue on the west as indicated on Figure 1. This site is planned for the development of approximately 3,000 dwelling units and a golf course. It is anticipated that the 2,700 units in the existing development and the 3,000 units in the expansion area will be completed by the year 2000.

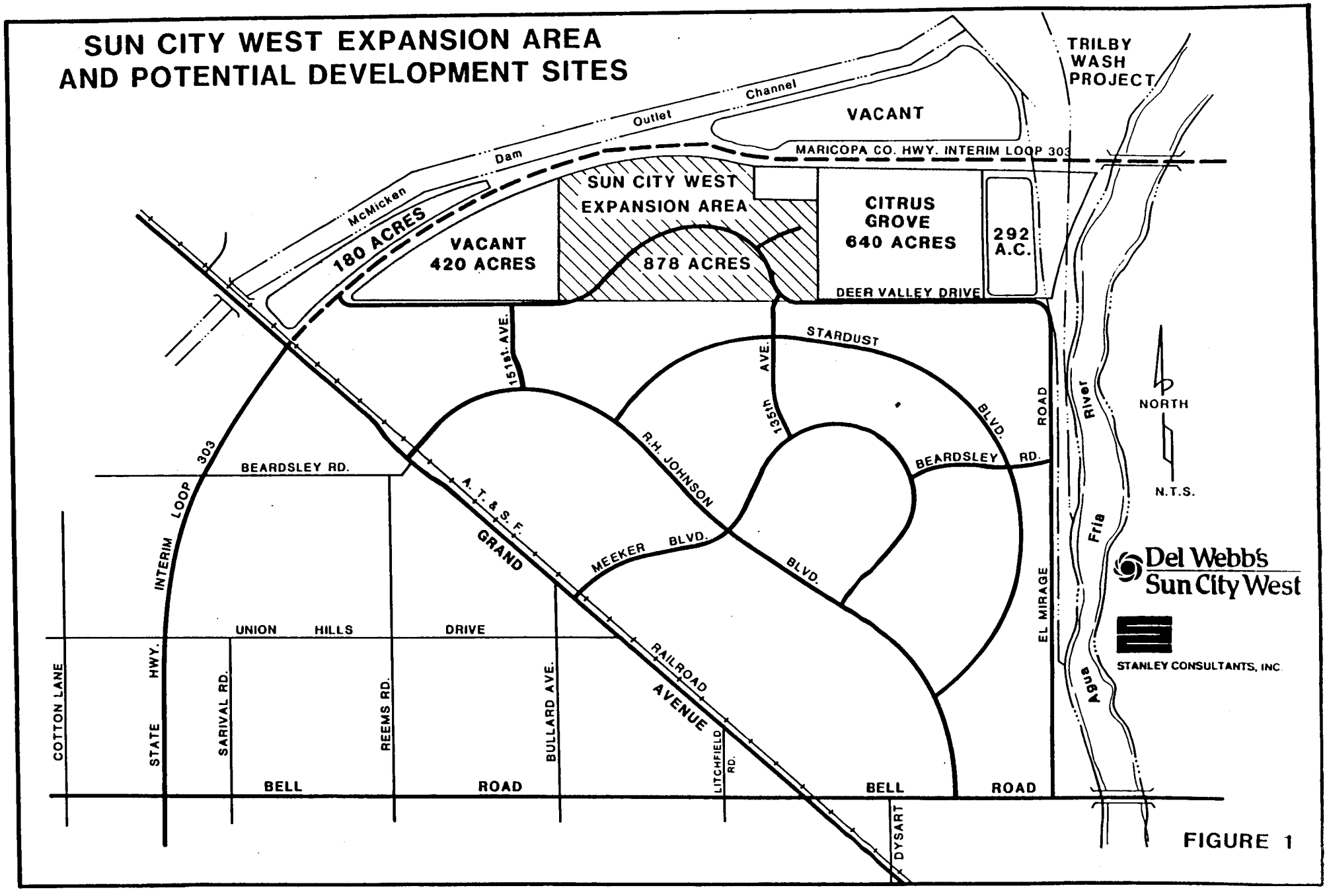
Other Potential Developments

Figure 1 shows the principal arterial and collector street system in and surrounding Sun City West, the planned Sun City West expansion site, and other potential development sites.

There is additional land available for potential development by others, north of Deer Valley Drive. These include the following sites: 932 acres east of the planned expansion site of which 640 acres is currently utilized as citrus grove, and 292 acres stands vacant and will support the development of approximately 2,800 dwelling units; a vacant site of 420 acres, west of the planned expansion site, having the potential for the development of 1,260 dwelling units, and; 180 acres between the proposed Estrella Freeway alignment and the McMicken Dam Outlet channel, would accommodate 550 dwelling units. It is anticipated that these potential sites, with a total capacity for 4,610 dwelling units, would not be developed until after the year 2000. These potential development sites would rely on their access from the roadway system serving Sun City West and from the Estrella Freeway (Interim Loop 303).

Programmed Highway Improvements

The five year construction program (FY '92-'96) of the Arizona Department of Transportation (ADOT) includes funding for the widening of Grand Avenue from 99th Avenue northwesterly to the Estrella Freeway. It is planned that Grand Avenue will be reconstructed as a four-lane median divided roadway, with turn bays at the major intersection. ADOT is also completing the construction of an interim two-lane roadway along the Estrella Freeway (Loop 303) between I-10 and Grand Avenue. The Maricopa County Highway Department has programmed the construction of an interim two-lane roadway along the Estrella Freeway


SUN CITY WEST EXPANSION AREA
AND POTENTIAL DEVELOPMENT SITES
TRILBY WASH PROJECT
VACANT
McMicken Dam Outlet Channel
MARICOPA CO. HWY. INTERIM LOOP 303
SUN CITY WEST EXPANSION AREA
878 ACRES
180 ACRES
VACANT 420 ACRES
CITRUS GROVE 640 ACRES
292 A.C.
DEER VALLEY DRIVE
151st AVE.
135th AVE.
STARDUST BLVD.
BEARDSLEY RD.
R.H. JOHNSON BLVD.
MEEKER BLVD.
EL MIRAGE ROAD
Agua Fria River
NORTH
N.T.S.
Del Webb's Sun City West
STANLEY CONSULTANTS, INC.
INTERIM LOOP 303
A. T. & S. F. GRAND RAILROAD AVENUE
UNION HILLS DRIVE
COTTON LANE
STATE HWY.
SARIVAL RD.
REEMS RD.
BULLARD AVE.
LITCHFIELD RD.
DYSART
BELL ROAD
FIGURE 1

alignment (Loop 303) from Grand Avenue to Lake Pleasant Road. These routes will provide improved access south to I-10, northeast to Lake Pleasant, and further northeast to I-17, via Carefree Highway.

Roadway Characteristics and Classifications

The functional classification of urban roadways are usually based on adjacent land uses, continuity of the roadway system and traffic volumes. In Maricopa County, the roadways system is a basic grid network, with major arterial streets spaced at approximately one mile intervals and secondary arterial streets or major collector streets located at the one-half mile points. Typically, the section line (arterial) streets have continuity through a major portion of the county, except where physical or topographic barriers prevent their continuance.

In the Sun City West area, Bell Road and Grand Avenue serve as major arterial streets. R. H. Johnson Boulevard serves as a major (high-volume) collector street with termini at Grand Avenue and Bell Road. Meeker Boulevard, Stardust Boulevard and El Mirage Road serve as residential collector streets.

Deer Valley Drive serves as an arterial street in Phoenix where it has continuity between 35th Avenue and Cave Creek Road. For the remainder of its length in Phoenix and the county, it is discontinuous, consisting of one-mile sections serving as collector or residential streets. Deer Valley Drive, adjacent Sun City West, extends from El Mirage Road on the east to a point approximately 4.5 miles to the west and ending just short of the McMicken Dam Outlet Channel. In the future, Deer Valley Drive will be terminated to the west at a connection to the Interim Loop 303 (Proposed Estrella Freeway). When the Sun City West Expansion area and

the other potential development sites are fully developed, Deer Valley Drive will functionally serve as a residential collector street. The following physical constraints restrict the extension of Deer Valley Drive: to the east by the Agua Fria River and its broad floodplain; to the west by the McMicken Dam Outlet Channel, and the A.T. & S.F. Railroad. The future connection of Deer Valley Drive to Interim Loop 303 will not provide route continuity for Deer Valley Drive. Since this route will not have continuity over a long distance nor serve major through traffic volumes, it is recommended that Deer Valley Drive be classified as a collector street and be routed to provide maximum benefit to the user.

Scope of Study

The purpose of this study is to document the traffic impacts of the proposed site developments on the area roadway system. The scope of Stanley Consultants' work included the following surveys and analyses:

- Data Collection The number of lanes on the principal arterial and collector roadway system and the key intersections in the area were documented. Traffic counts were conducted on the access streets to Sun City West from Grand Avenue and Bell Road. Meetings and discussions were held with the staff of the Maricopa County Highway Department (MCHD), the Maricopa Area Governments Transportation Planning Office (MAGTPO) and the Arizona Department of Transportation (ADOT). Information was obtained on future roadway improvement plans, existing traffic count data, and future traffic projections for the roadway system.

- Direction of Traffic Approach Directional distribution of traffic to the site was developed from observations of the distribution characteristics of the Sun City West traffic and adjusted for future conditions considering the planned roadway improvements and the distribution of population/employment in the area.

- Site Traffic Generation The projected 24 hour and the AM and PM peak hour trips entering and leaving Sun City West was based on data collected on the traffic generation of the existing development. These data were correlated with the trip generation factors from the publication, Trip Generation, 4th Edition, 1987 published by the Institute of Transportation Engineers.

- Future Traffic Projections The projected trip generation for the years 2000 and 2010 of the planned and potential site developments were assigned to the roadway system and combined with the projected traffic on the roadway system external to Sun City West.

- Capacity Analyses Capacity analyses were performed at key intersections in Sun City West and on the adjacent arterial roads.

TRAFFIC ANALYSES

Existing Traffic Volumes

Traffic volume counts (24 hour counts by 1 hour intervals) were obtained on the access streets to Sun City West from Grand Avenue and Bell Road. Table 1 itemizes the traffic entering and exiting Sun City West on R.H. Johnson Boulevard at Grand Avenue, Meeker Boulevard at Grand Avenue, R.H. Johnson Boulevard at Bell Road, and El Mirage Road at Bell Road. The total inbound and outbound trips amounted to 32,244 per 24 hour period. At the time of the counts (February 1991), there were approximately 10,800 dwelling units in Sun City West. This equates to approximately 3.0 average weekday external vehicle trip ends per dwelling unit.

Based on nationally recognized data, the total average daily trips per dwelling unit (internal and external) are estimated to be 3.30 for a retirement community. [1] Typically the average daily trips per dwelling unit for Single-Family Detached Housing is 10.0. [2] Therefore, Sun City West has a very low external trip generation per dwelling unit since many of the services for residents are provided internally. In addition, a significant amount of internal travel by residents is by electric golf carts. This type of residential community with many of the services provided internally, minimizes the contribution to air pollution in the valley. The future availability and use of electric cars will be an ideal mode of travel accepted by the residents of Sun City West due to their relatively short trips and familiarity with electric golf carts.

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[1]Trip Generation, 4th Edition, page 424, Retirement Community (250), published by the Institute of Transportation Engineers.

[2]Trip Generation, 4th Edition, page 256, Single-Family Detached Housing, (210), published by the Institute of Transportation Engineers.

TABLE 1

EXISTING TRAFFIC VOLUMES

Location	24 Hour In	24 Hour Out	Volume Total
R.H. Johnson Boulevard East of Grand Avenue	357	407	764
Meeker Boulevard East of Grand Avenue	2,623	2,588	5,211
R.H. Johnson Boulevard North of Bell Road	10,152	9,956	20,108
El Mirage Road North of Bell Road	3,150	3,011	6,161
TOTAL	**16,282**	**15,962**	**32,244**

Counts taken February 26 and 27, 1991.

Typically, the peak traffic periods in an urban area are between 7:00 - 9:00 A.M. and 4:00 - 6:00 P.M. The peak traffic hours on streets in Sun City West are between 11:00 A.M. - 12:00 noon and 3:00 - 4:00 P.M.

Year 2000 Traffic Projections

By the year 2000, the Del Webb Corporation will have completed the remaining 2,700 dwelling units in the western section of Sun City West and the 3,000 units in the planned expansion site. It is projected that these 5,700 dwelling units will generate an additional 17,020 average weekday vehicle trips for a total of 49,265 weekday trips. These trips were assigned to the arterial and collector street system in Sun City West and to the external roadways such as Bell Road, Grand Avenue and Interim Loop 303. Traffic volumes on these external roadways were expanded at an annual rate of 4 percent from the base year of 1989.

The 24 hour two-way traffic assignments are presented on Figure 2. The levels of service for key intersections in the area, as determined by the 1985 Highway Capacity Manual analysis procedure, are tabulated on Table 2. Capacity analysis calculations for each intersection are located in Appendix A. These analyses provide detailed information on intersection lane arrangements, projected peak hour traffic volumes, signal timing and phasing, intersection delay and level of service.

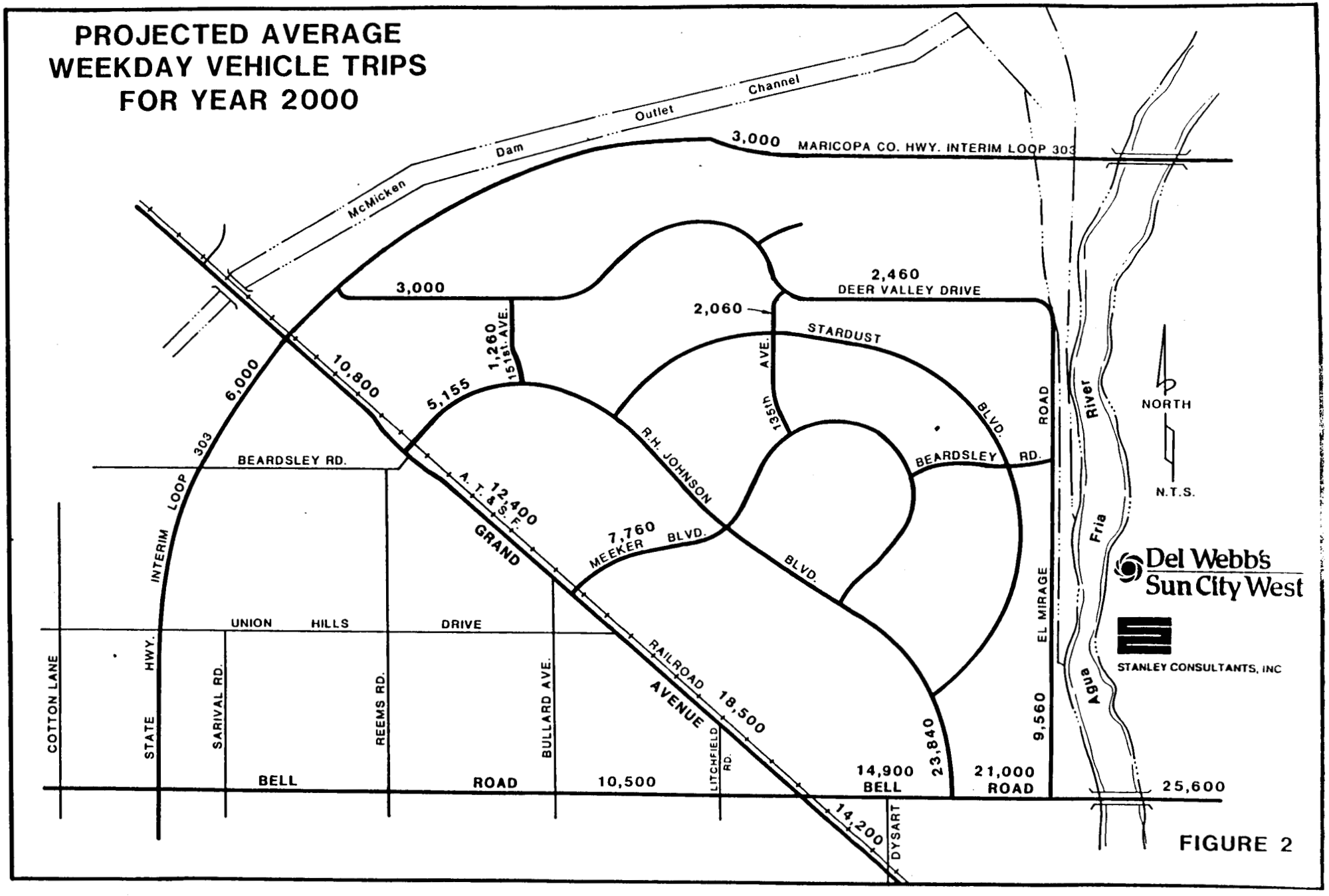
PROJECTED AVERAGE
WEEKDAY VEHICLE TRIPS
FOR YEAR 2000
McMicken Dam Outlet Channel
3,000
MARICOPA CO. HWY. INTERIM LOOP 303
3,000
2,460
DEER VALLEY DRIVE
2,060
STARDUST
BLVD.
1,260
151st. AVE.
135th AVE.
6,000
10,800
5,155
BEARDSLEY RD.
INTERIM LOOP 303
R.H. JOHNSON
BLVD.
BEARDSLEY RD.
EL MIRAGE ROAD
12,400
A. T. & S. F.
GRAND
7,760
MEEKER BLVD.
UNION HILLS DRIVE
RAILROAD AVENUE
18,500
COTTON LANE
STATE HWY.
SARIVAL RD.
REEMS RD.
BULLARD AVE.
LITCHFIELD RD.
BELL ROAD
10,500
14,200
DYSART
14,900
BELL
23,840
21,000
ROAD
9,560
25,600
Agua Fria River
NORTH
N.T.S.
Del Webb's
Sun City West
STANLEY CONSULTANTS, INC

FIGURE 2

TABLE 2

INTERSECTION LEVEL OF SERVICE

YEAR 2000

Intersection	Level of Service A.M.	Level of Service P.M.
Grand Avenue and Meeker Blvd.	B	B
Grand Avenue and Bell Road	B	B
Bell Road and R.H. Johnson Blvd.	B	B
Bell Road and El Mirage Road	B	B
R.H. Johnson Blvd. and Meeker Blvd.	A	A
R.H. Johnson Blvd. and Stardust Blvd.	A	A

Year 2010 Traffic Projections

There are no known plans to develop the additional acreage north of Deer Valley Drive (Identified in Figure 1). However, it was determined to conduct a "worst case" analysis assuming that the remaining 1,532 acres are fully developed by the year 2010. Assuming development of 3 dwelling units per acre, this would amount to 4,600 additional dwelling units. It is projected that these units would generate an additional 13,735 average weekday vehicle trips for a total of 63,000 daily trips by 2010. These trips were assigned to the internal and external roadways. In addition, traffic volumes on Grand Avenue and Bell Road were expanded at an annual rate of 4 percent, from the base year of 1989.

The 24 hour two-way traffic assignments are illustrated on Figure 3. The Levels of Service for key intersections in the area are presented on Table 3. Capacity analysis calculations are located in Appendix B. Detailed information on intersection lane arrangements, projected peak hour traffic volumes, signal timing and phasing, intersection delay and level of service are provided for each intersection analyzed.

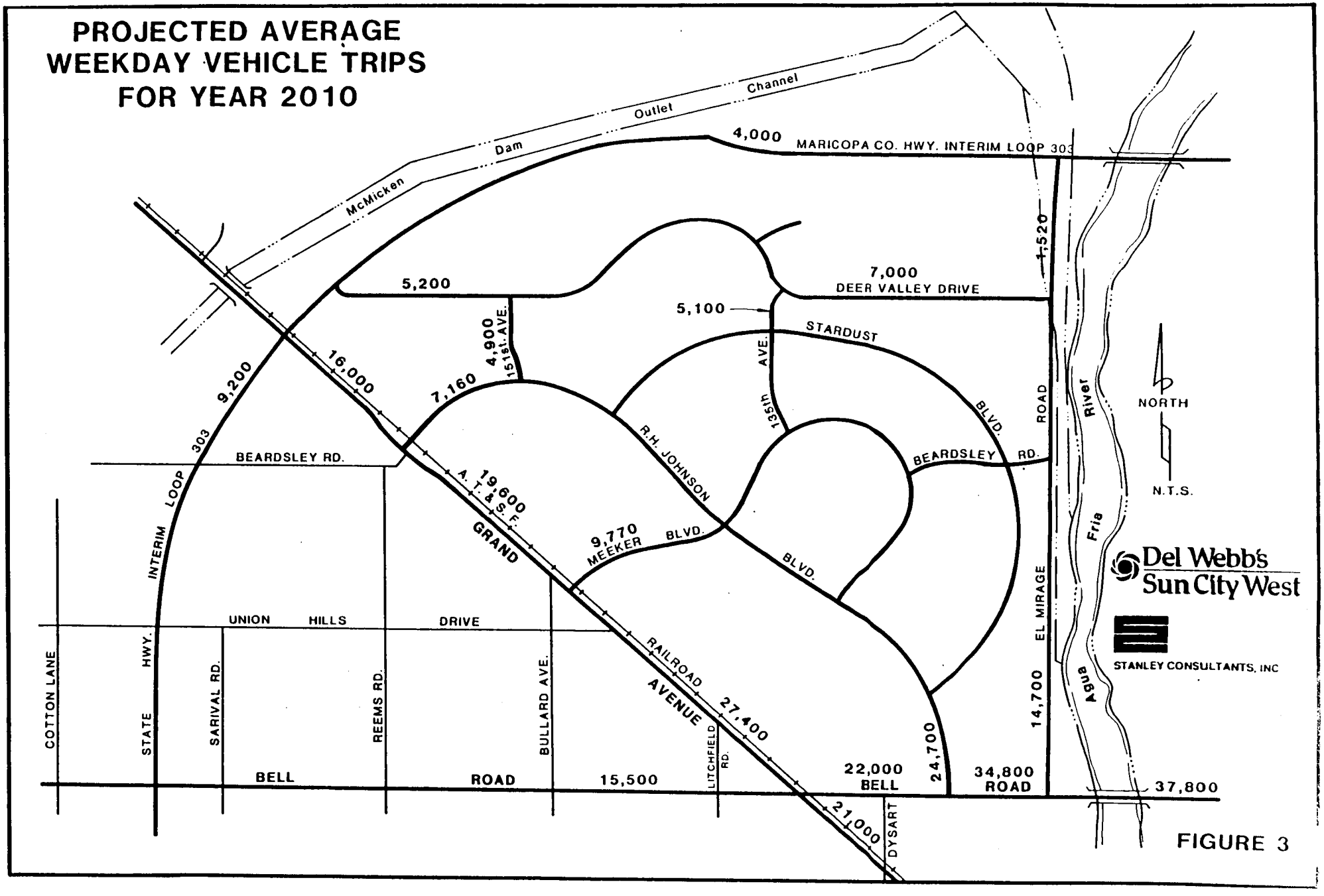
PROJECTED AVERAGE
WEEKDAY VEHICLE TRIPS
FOR YEAR 2010
McMicken Dam Outlet Channel
4,000
MARICOPA CO. HWY. INTERIM LOOP 303
1,520
5,200
7,000
DEER VALLEY DRIVE
5,100
STARDUST
BLVD.
4,900
151st. AVE.
135th AVE.
9,200
16,000
7,160
R.H. JOHNSON
BLVD.
BEARDSLEY RD.
BEARDSLEY RD.
INTERIM LOOP 303
19,600
A.T.&S.F.
GRAND
9,770
MEEKER
BLVD.
BLVD.
UNION HILLS DRIVE
RAILROAD
AVENUE
27,400
24,700
14,700
EL MIRAGE ROAD
River
Fria
Agua
NORTH
N.T.S.
Del Webb's
Sun City West
STANLEY CONSULTANTS, INC
COTTON LANE
STATE HWY.
SARIVAL RD.
REEMS RD.
BULLARD AVE.
LITCHFIELD RD.
BELL ROAD
15,500
22,000
BELL
34,800
ROAD
37,800
21,000
DYSART

FIGURE 3

TABLE 3

INTERSECTION LEVEL OF SERVICE

YEAR 2010

Intersection	Level of Service A.M.	Level of Service P.M.
Grand Avenue and Meeker Blvd.	B	B
Grand Avenue and Bell Road	B	C
Bell Road and R.H. Johnson Blvd.	C	C
Bell Road and El Mirage Road	C	C
R.H. Johnson Blvd. and Meeker Blvd.	A	A
R.H. Johnson Blvd. and Stardust Blvd.	A	A

SUMMARY AND CONCLUSIONS

Sun City West is a planned adult community containing the basic financial, retail, entertainment, recreational and religious services for its residents. There are currently 10,800 dwelling units in this development. The Del Webb Corporation is planning the development of 5,700 additional homes, to be completed in the year 2000, for a total of 16,500 dwelling units. There is an additional 1,532 acres of land north of Deer Valley Drive available for potential development by others. For a "worst case" analysis it was assumed that 4,610 additional units could be built by the year 2010, for a total of 21,110 dwelling units.

Sun City West has a relatively low average daily trip generation rate of 3.0 per dwelling unit. This is demonstrated by the fact that all of the signalized intersections in the development operate at Level of Service A. Even with the additional planned development by the year 2000, and the other potential developments by the year 2010, these intersections will operate in the Level of Service A to B range. This equates to minimum delay and contribution to air pollution.

The signalized access streets to Sun City West at their intersections with Bell Road and Grand Avenue will operate at Level of Service B in the year 2000 and Level of Service C in the year 2010, during peak traffic hours. This is an optimum operating condition when compared with the majority of signalized intersections in the metropolitan area.

The connection of Deer Valley Drive to the Interim Loop 303 2-lane roadway and ultimately to the proposed Estrella Freeway will be of benefit to the area as well as Sun City West. This connection will reduce the traffic demand on Grand Avenue and Bell Road. It is important that the Corporation Commission approve the Interim Loop 303 roadway crossing of the railroad

adjacent to Grand Avenue to provide a continuous route between Interstate 10 and Lake Pleasant Road, and reduce the demand on Grand Avenue and Bell Road.

In the ultimate development of Sun City West, Deer Valley Drive will extend from El Mirage Road on the east to Loop 303 on the west. The following physical constraints will restrict the extension of Deer Valley Drive beyond these limits: the Agua Fria River; the McMicken Dam Outlet Channel, and; the A.T. & S.F. Railroad. Since this road will not have continuity over a long distance, nor serve major through traffic volumes, it is recommended that Deer Valley Drive be classified as a collector street and a design speed of 45 miles per hour be established.

APPENDIX A

APPENDIX B

APPENDIX A

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/EL MIRAGE ROAD
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-27-1991
TIME.....11:00 AM - 12:00N
COMMENT.....ANALYSIS YEAR: 2000

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	100	100	40	250	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	830	690	200	190	:	T	12.0	T	12.0	T	12.0	T	12.0
RT	100	200	80	130	:	T	12.0	T	12.0	R	12.0	R	12.0
RR	0	0	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
WB	LT	X				SB	LT	X	X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
GREEN		40.0	0.0	0.0	0.0	GREEN		16.0	22.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	4.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.526	0.456	15.4	C	12.0	B
	T	0.565	0.456	11.9	B		
	R	0.153	0.456	9.3	B		
WB	L	0.571	0.456	16.8	C	11.5	B
	T	0.470	0.456	11.1	B		
	R	0.307	0.456	10.1	B		
NB	L	0.074	0.478	9.7	B	17.2	C
	T	0.462	0.256	18.7	C		
	R	0.219	0.256	17.1	C		
SB	L	0.468	0.478	12.7	B	15.8	C
	T	0.439	0.256	18.5	C		
	R	0.356	0.256	17.9	C		

INTERSECTION: Delay = 13.1 (sec/veh) V/C = 0.517 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/EL MIRAGE ROAD
AREA TYPE.....OTHER
ANALYST.......JAH
DATE..........05-27-1991
TIME..........3:00 PM - 4:00 PM
COMMENT.......ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	85	110	50	170	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	700	840	250	130	:	T	12.0	T	12.0	T	12.0	T	12.0
RT	85	250	90	90	:	T	12.0	T	12.0	R	12.0	R	12.0
RR	0	0	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
WB	LT	X				SB	LT	X	X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
GREEN		40.0	0.0	0.0	0.0	GREEN		16.0	22.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	4.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.691	0.456	24.4	C	12.2	B
	T	0.477	0.456	11.2	B		
	R	0.130	0.456	9.2	B		
WB	L	0.471	0.456	14.0	B	11.9	B
	T	0.572	0.456	12.0	B		
	R	0.384	0.456	10.6	B		
NB	L	0.085	0.478	9.7	B	18.1	C
	T	0.578	0.256	20.1	C		
	R	0.246	0.256	17.3	C		
SB	L	0.343	0.478	11.4	B	14.8	B
	T	0.300	0.256	17.6	C		
	R	0.246	0.256	17.3	C		

INTERSECTION: Delay = 13.2 (sec/veh) V/C = 0.577 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/R.H. JOHNSON BLVD.
AREA TYPE.....OTHER
ANALYST.......JAH
DATE..........05-27-1991
TIME..........11:00 AM - 12:000 N
COMMENT.......ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	70	80	80	340	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	450	370	520	560	:	T	12.0	T	12.0	LT	12.0	T	12.0
RT	130	300	150	220	:	TR	12.0	TR	12.0	T	12.0	T	12.0
RR	0	0	0	0	:		12.0		12.0	R	12.0	TR	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	31.8	3
WB	0.00	2.00	N	0	0	0.95	10	N	31.8	3
NB	0.00	2.00	N	0	0	0.95	10	N	25.8	3
SB	0.00	2.00	N	0	0	0.95	10	N	25.8	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X		X	
	TH	X					TH			X	
	RT	X					RT			X	
	PD	X					PD			X	
WB	LT	X				SB	LT	X	X	X	
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD	X					PD			X	
GREEN		36.0	0.0	0.0	0.0	GREEN		6.0	10.0	26.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.280	0.411	13.6	B	12.6	B
	TR	0.453	0.411	12.5	B		
WB	L	0.275	0.411	13.5	B	13.3	B
	TR	0.543	0.411	13.3	B		
NB	L	0.362	0.378	16.1	C	17.0	C
	LT	0.538	0.300	17.3	C		
	R	0.349	0.300	16.1	C		
SB	L	0.682	0.522	15.6	C	13.2	B
	TR	0.430	0.411	12.3	B		

INTERSECTION: Delay = 14.0 (sec/veh) V/C = 0.574 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/R.H. JOHNSON BLVD.
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-27-1991
TIME.....3:00 - 4:00 PM
COMMENT.....ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	50	90	80	320	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	380	460	520	540	:	T	12.0	T	12.0	LT	12.0	T	12.0
RT	110	370	160	210	:	TR	12.0	TR	12.0	T	12.0	T	12.0
RR	0	0	0	0	:		12.0		12.0	R	12.0	TR	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X		X	
	TH	X					TH			X	
	RT	X					RT			X	
	PD	X					PD			X	
WB	LT	X				SB	LT	X	X	X	
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD	X					PD			X	
GREEN		36.0	0.0	0.0	0.0	GREEN		6.0	10.0	26.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.270	0.411	13.5	B	12.2	B
	TR	0.383	0.411	12.0	B		
WB	L	0.268	0.411	13.4	B	14.6	B
	TR	0.673	0.411	14.7	B		
NB	L	0.348	0.378	15.9	C	17.0	C
	LT	0.538	0.300	17.3	C		
	R	0.373	0.300	16.3	C		
SB	L	0.642	0.522	14.3	B	12.8	B
	TR	0.413	0.411	12.2	B		

INTERSECTION: Delay = 14.1 (sec/veh) V/C = 0.622 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/GRAND AVENUE
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-28-1991
TIME.....11:00 AM - 12:00 N
COMMENT.....ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	25	25	45	275	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	405	260	385	570	:	T	12.0	T	12.0	T	12.0	T	12.0
RT	75	190	20	45	:	TR	12.0	TR	12.0	TR	12.0	TR	12.0
RR	0	0	0	0	:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH	X					TH	X			
	RT	X					RT	X			
	PD	X					PD	X			
WB	LT	X				SB	LT	X			
	TH	X					TH	X			
	RT	X					RT	X			
	PD	X					PD	X			
GREEN		40.0	0.0	0.0	0.0	GREEN		42.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.062	0.456	10.4	B	10.2	B
	TR	0.335	0.456	10.2	B		
WB	L	0.065	0.456	10.4	B	10.2	B
	TR	0.328	0.456	10.2	B		
NB	L	0.135	0.478	10.0	B	9.2	B
	TR	0.265	0.478	9.1	B		
SB	L	0.613	0.478	14.9	B	11.4	B
	TR	0.404	0.478	9.9	B		

INTERSECTION: Delay = 10.5 (sec/veh) V/C = 0.477 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/GRAND AVENUE
AREA TYPE.....OTHER
ANALYST.......JAH
DATE..........05-28-1991
TIME..........3:00 - 4:00 PM
COMMENT.......ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	15	35	70	185	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	270	395	580	380	:	T	12.0	T	12.0	T	12.0	T	12.0
RT	50	285	30	30	:	TR	12.0	TR	12.0	TR	12.0	TR	12.0
RR	0	0	0	0	:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH	X					TH	X			
	RT	X					RT	X			
	PD	X					PD	X			
WB	LT	X				SB	LT	X			
	TH	X					TH	X			
	RT	X					RT	X			
	PD	X					PD	X			
GREEN		42.0	0.0	0.0	0.0	GREEN		40.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.050	0.478	9.6	B	8.9	B
	TR	0.213	0.478	8.8	B		
WB	L	0.070	0.478	9.7	B	10.3	B
	TR	0.472	0.478	10.4	B		
NB	L	0.166	0.456	11.0	B	10.8	B
	TR	0.418	0.456	10.7	B		
SB	L	0.586	0.456	15.8	C	11.7	B
	TR	0.282	0.456	9.9	B		

INTERSECTION: Delay = 10.6 (sec/veh) V/C = 0.528 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..GRAND AVENUE/MEEKER BOULEVARD
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-28-1991
TIME.....11:00 AM - 12:00 N
COMMENT.....ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY						
	EB	WB	NB	SB	:	EB		WB		NB		SB
LT	30	0	0	360	:	L 12.0	T	12.0		12.0	L	12.0
TH	560	375	0	0	:	T 12.0	T	12.0		12.0	R	12.0
RT	0	270	0	40	:	T 12.0	R	12.0		12.0		12.0
RR	0	100	0	0	:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	8.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	8.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH				
	RT						RT				
	PD	X					PD	X			
WB	LT					SB	LT	X			
	TH	X					TH				
	RT	X					RT	X			
	PD	X					PD	X			
GREEN		36.0	0.0	0.0	0.0	GREEN		46.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.097	0.411	12.4	B	12.3	B
	T	0.422	0.411	12.3	B		
WB	T	0.283	0.411	11.4	B	11.5	B
	R	0.289	0.411	11.5	B		
SB	L	0.482	0.522	10.8	B	10.4	B
	R	0.054	0.522	6.8	B		

INTERSECTION: Delay = 11.5 (sec/veh) V/C = 0.456 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..GRAND AVENUE/MEEKER BOULEVARD
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-28-1991
TIME.....3;00 - 4:00 pm
COMMENT.....ANALYSIS YEAR: 2000

	VOLUMES				:	GEOMETRY						
	EB	WB	NB	SB	:	EB		WB		NB		SB
LT	40	0	0	270	:	L	12.0	T	12.0	12.0	L	12.0
TH	375	560	0	0	:	T	12.0	T	12.0	12.0	R	12.0
RT	0	360	0	30	:	T	12.0	R	12.0	12.0		12.0
RR	0	100	0	0	:		12.0		12.0	12.0		12.0
					:		12.0		12.0	12.0		12.0
					:		12.0		12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	8.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	8.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH				
	RT						RT				
	PD	X					PD	X			
WB	LT					SB	LT	X			
	TH	X					TH				
	RT	X					RT	X			
	PD	X					PD	X			
GREEN		41.0	0.0	0.0	0.0	GREEN		41.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.177	0.467	10.6	B	9.5	B
	T	0.249	0.467	9.4	B		
WB	T	0.372	0.467	10.1	B	10.1	B
	R	0.390	0.467	10.3	B		
SB	L	0.404	0.467	12.2	B	11.8	B
	R	0.045	0.467	8.4	B		

INTERSECTION: Delay = 10.3 (sec/veh) V/C = 0.397 LOS = B

APPENDIX B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/EL MIRAGE ROAD
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-25-1991
TIME.....11:00 AM - 12:00 N
COMMENT.....ANALYSIS YEAR: 2010

	VOLUMES					GEOMETRY						
	EB	WB	NB	SB	:	EB		WB		NB		SB
LT	150	140	60	380	: L	12.0	L	12.0	L	12.0	L	12.0
TH	1230	1020	310	300	: T	12.0	T	12.0	T	12.0	T	12.0
RT	150	300	120	200	: T	12.0	T	12.0	R	12.0	R	12.0
RR	0	0	0	0	: R	12.0	R	12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	26.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X	X			NB	LT	X	X		
	TH		X				TH		X		
	RT		X				RT		X		
	PD		X				PD		X		
WB	LT	X	X			SB	LT	X	X		
	TH		X				TH		X		
	RT		X				RT		X		
	PD		X				PD		X		
GREEN		4.0	38.0	0.0	0.0	GREEN		12.0	20.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0	YELLOW		4.0	4.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.685	0.522	20.3	C	18.2	C
	T	0.880	0.433	18.9	C		
	R	0.242	0.433	10.5	B		
WB	L	0.639	0.522	17.7	C	14.5	B
	T	0.730	0.433	14.7	B		
	R	0.484	0.433	12.2	B		
NB	L	0.166	0.411	12.8	B	22.9	C
	T	0.785	0.233	26.5	D		
	R	0.359	0.233	18.9	C		
SB	L	1.050	0.411	76.5	F	46.6	E
	T	0.759	0.233	25.4	D		
	R	0.599	0.233	21.6	C		

INTERSECTION: Delay = 23.1 (sec/veh) V/C = 0.870 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/EL MIRAGE ROAD
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-26-1991
TIME.....3:00 - 4:00 PM
COMMENT.....ANALYSIS YEAR: 2010

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	125	170	70	260	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	1020	1240	380	200	:	T	12.0	T	12.0	T	12.0	T	12.0
RT	125	170	150	140	:	T	12.0	T	12.0	R	12.0	R	12.0
RR	0	0	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X	X			NB	LT	X	X		
	TH		X				TH		X		
	RT		X				RT		X		
	PD		X				PD		X		
WB	LT	X	X			SB	LT	X	X		
	TH		X				TH		X		
	RT		X				RT		X		
	PD		X				PD		X		
GREEN		6.0	36.0	0.0	0.0	GREEN		10.0	22.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0	YELLOW		4.0	4.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.491	0.522	12.1	B	14.7	B
	T	0.769	0.411	16.3	C		
	R	0.131	0.667	3.5	A		
WB	L	0.667	0.522	17.9	C	20.9	C
	T	0.935	0.411	23.5	C		
	R	0.178	0.667	3.7	A		
NB	L	0.164	0.411	12.7	B	25.8	D
	T	0.878	0.256	31.2	D		
	R	0.410	0.256	18.4	C		
SB	L	0.797	0.411	28.2	D	22.7	C
	T	0.462	0.256	18.7	C		
	R	0.383	0.256	18.1	C		

INTERSECTION: Delay = 19.9 (sec/veh) V/C = 0.865 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/R.H. JOHNSON BLVD.
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-27-1991
TIME.....11:00 AM - 12:000 N
COMMENT.....ANALYSIS YEAR: 2010

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	100	110	80	440	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	680	560	460	440	:	T	12.0	T	12.0	LT	12.0	T	12.0
RT	190	450	230	230	:	TR	12.0	TR	12.0	T	12.0	T	12.0
RR	0	0	0	0	:		12.0		12.0	R	12.0	TR	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	31.8	3
WB	0.00	2.00	N	0	0	0.95	10	N	31.8	3
NB	0.00	2.00	N	0	0	0.95	10	N	25.8	3
SB	0.00	2.00	N	0	0	0.95	10	N	25.8	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X		X	
	TH	X					TH			X	
	RT	X					RT			X	
	PD	X					PD			X	
WB	LT	X				SB	LT	X	X	X	
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD	X					PD			X	
GREEN		36.0	0.0	0.0	0.0	GREEN		6.0	10.0	26.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.786	0.411	34.5	D	16.7	C
	TR	0.679	0.411	14.8	B		
WB	L	0.643	0.411	21.3	C	18.0	C
	TR	0.818	0.411	17.6	C		
NB	L	0.315	0.378	15.5	C	17.0	C
	LT	0.476	0.300	16.8	C		
	R	0.536	0.300	17.8	C		
SB	L	0.840	0.522	24.6	C	16.7	C
	TR	0.373	0.411	12.0	B		

INTERSECTION: Delay = 17.1 (sec/veh) V/C = 0.713 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/R.H. JOHNSON BLVD.
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-27-1991
TIME.....3:00 - 4:00 PM
COMMENT.....ANALYSIS YEAR: 2010

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	80	140	80	440	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	550	680	490	440	:	T	12.0	T	12.0	LT	12.0	T	12.0
RT	160	540	250	220	:	TR	12.0	TR	12.0	T	12.0	T	12.0
RR	0	0	0	0	:		12.0		12.0	R	12.0	TR	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	26.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X		X	
	TH	X					TH			X	
	RT	X					RT			X	
	PD	X					PD			X	
WB	LT	X				SB	LT	X	X	X	
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD	X					PD			X	
GREEN		36.0	0.0	0.0	0.0	GREEN		6.0	10.0	26.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.947	0.411	75.9	F	19.4	C
	TR	0.555	0.411	13.4	B		
WB	L	0.601	0.411	18.7	C	29.6	D
	TR	0.988	0.411	30.8	D		
NB	L	0.311	0.378	15.5	C	17.3	C
	LT	0.507	0.300	17.1	C		
	R	0.582	0.300	18.5	C		
SB	L	0.861	0.522	26.7	D	17.5	C
	TR	0.367	0.411	11.9	B		

INTERSECTION: Delay = 21.9 (sec/veh) V/C = 0.803 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/GRAND AVENUE
AREA TYPE.....OTHER
ANALYST.......JAH
DATE.........05-28-1991
TIME.........11:00 AM - 12:00N
COMMENT.......ANALYSIS YEAR:2010

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	40	35	65	410	: L	12.0	L	12.0	L	12.0	L	12.0
TH	595	390	570	840	: T	12.0	T	12.0	T	12.0	T	12.0
RT	110	280	35	65	: TR	12.0	TR	12.0	TR	12.0	TR	12.0
RR	0	0	0	0	:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT		X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
WB	LT	X				SB	LT	X	X		
	TH	X					TH	X	X		
	RT	X					RT	X	X		
	PD	X					PD		X		
GREEN		26.0	0.0	0.0	0.0	GREEN		20.0	32.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	4.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.250	0.300	18.3	C	20.0	C
	TR	0.747	0.300	20.1	C		
WB	L	0.236	0.300	18.2	C	20.0	C
	TR	0.740	0.300	20.1	C		
NB	L	0.486	0.367	18.8	C	15.0	C
	TR	0.516	0.367	14.6	B		
SB	L	0.688	0.633	11.2	B	7.2	B
	TR	0.448	0.633	5.5	B		

INTERSECTION: Delay = 14.2 (sec/veh) V/C = 0.639 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..BELL ROAD/GRAND AVENUE
AREA TYPE.....OTHER
ANALYST.......JAH
DATE..........05-28-1991
TIME..........3:00 - 4:00 PM
COMMENT.......ANALYSIS YEAR:2010

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB
LT	25	55	100	275	L	12.0	L	12.0	L	12.0	L	12.0
TH	400	580	855	560	T	12.0	T	12.0	T	12.0	T	12.0
RT	75	420	50	45	TR	12.0	TR	12.0	TR	12.0	TR	12.0
RR	0	0	0	0		12.0		12.0		12.0		12.0
						12.0		12.0		12.0		12.0
						12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
WB	LT	X				SB	LT	X	X		
	TH	X					TH		X		
	RT	X					RT		X		
	PD	X					PD		X		
GREEN		34.0	0.0	0.0	0.0	GREEN		8.0	36.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	4.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.209	0.389	14.0	B	12.9	B
	TR	0.388	0.389	12.9	B		
WB	L	0.171	0.389	13.7	B	19.4	C
	TR	0.853	0.389	19.7	C		
NB	L	0.238	0.544	8.3	B	14.3	B
	TR	0.689	0.411	14.9	B		
SB	L	0.919	0.544	41.6	E	21.3	C
	TR	0.462	0.411	12.6	B		

INTERSECTION: Delay = 17.4 (sec/veh) V/C = 0.790 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..GRAND AVENUE/MEEKER BOULEVARD
AREA TYPE.....OTHER
ANALYST.......JAH
DATE..........05-28-1991
TIME..........11:00 AM - 12:00 N
COMMENT.......ANALYSIS YEAR: 2010

	VOLUMES					GEOMETRY						
	EB	WB	NB	SB	:	EB		WB		NB		SB
LT	40	0	0	500	:	L	12.0	T	12.0	12.0	L	12.0
TH	900	600	0	0	:	T	12.0	T	12.0	12.0	R	12.0
RT	0	370	0	50	:	T	12.0	R	12.0	12.0		12.0
RR	0	100	0	0	:		12.0		12.0	12.0		12.0
					:		12.0		12.0	12.0		12.0
					:		12.0		12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	11.3	3
WB	0.00	2.00	N	0	0	0.95	10	N	11.3	3
NB	0.00	2.00	N	0	0	0.95	10	N	25.8	3
SB	0.00	2.00	N	0	0	0.95	10	N	25.8	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH				
	RT						RT				
	PD	X					PD	X			
WB	LT					SB	LT	X			
	TH	X					TH				
	RT	X					RT	X			
	PD	X					PD	X			
GREEN		41.0	0.0	0.0	0.0	GREEN		41.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.195	0.467	10.8	B	11.8	B
	T	0.598	0.467	11.8	B		
WB	T	0.399	0.467	10.2	B	10.3	B
	R	0.405	0.467	10.4	B		
SB	L	0.749	0.467	18.0	C	17.2	C
	R	0.075	0.467	8.6	B		

INTERSECTION: Delay = 12.5 (sec/veh) V/C = 0.673 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..GRAND AVENUE/MEEKER BOULEVARD
AREA TYPE.....OTHER
ANALYST.....JAH
DATE.....05-28-1991
TIME.....3;00 - 4:00 pm
COMMENT.....ANALYSIS YEAR: 2010

	VOLUMES					GEOMETRY						
	EB	WB	NB	SB	:	EB		WB		NB		SB
LT	50	0	0	370	:	L 12.0	T	12.0		12.0	L	12.0
TH	600	900	0	0	:	T 12.0	T	12.0		12.0	R	12.0
RT	0	500	0	40	:	T 12.0	R	12.0		12.0		12.0
RR	0	100	0	0	:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0
					:	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.95	10	N	8.5	3
WB	0.00	2.00	N	0	0	0.95	10	N	8.5	3
NB	0.00	2.00	N	0	0	0.95	10	N	20.5	3
SB	0.00	2.00	N	0	0	0.95	10	N	20.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH				
	RT						RT				
	PD	X					PD	X			
WB	LT					SB	LT	X			
	TH	X					TH				
	RT	X					RT	X			
	PD	X					PD	X			
GREEN		46.0	0.0	0.0	0.0	GREEN		36.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.610	0.522	19.5	C	9.0	B
	T	0.356	0.522	8.2	B		
WB	T	0.534	0.522	9.4	B	9.5	B
	R	0.536	0.522	9.7	B		
SB	L	0.629	0.411	17.5	C	16.8	C
	R	0.068	0.411	10.4	B		

INTERSECTION: Delay = 10.6 (sec/veh) V/C = 0.618 LOS = B

Archaeological Consulting Services Ltd.

AN ARCHAEOLOGICAL SURVEY FOR A POTENTIAL EXPANSION OF SUN CITY WEST, MARICOPA COUNTY, ARIZONA

Prepared by:
Connie L. Stone

Submitted by:
Archaeological Consulting Services, Ltd.
Margerie Green, Principal
February 1, 1991

Introduction

Archaeological Consulting Services, Ltd. (ACS) conducted a cultural resource survey of private land directly north of Sun City West. The purpose was an inventory and assessment of cultural resources that might be affected by real estate development associated with future expansion of the community. The survey was requested by Mr. Arnie Lahlun of Stanley Consultants, on behalf of the Del Webb Corporation. Four sites and numerous isolated finds were recorded within the project area. These archaeological remains included two prehistoric artifact scatters, 46 prehistoric isolated finds, two historic sites associated with early twentieth century homesteading, and 63 historic isolated finds.

Project Area

The project area incorporates 1,100 acres (445 ha) directly north of Deer Valley Road, between Sun City West to the south and the McMicken Dam outlet channel to the north. The area encompasses the western half of Section 15, the entire area of Section 16, and the eastern quarter of Section 17 within Township 4 North, Range 1 West (Gila and Salt River Baseline and Meridian) (Figure 1).

The survey area appears level but gently slopes to the southeast, with elevations ranging from 1,320 ft (397 m) to 1,270 ft (382 m). Major washes flow toward the southeast. The creosote flats are typical of the lower basin zones within the Sonoran Desert. Creosotebushes are the dominant vegetation. Low shrubs such as brittlebush, which are often associated with creosote, are conspicuously rare. Short grasses grow on the alluvial flats. Mesquite and palo verde trees border the washes, and scattered saguaro and barrel cacti are more frequent at the higher elevations within the northeastern portion of the project area. Within the past century, the overall density of the vegetation has likely been diminished by groundwater pumping for agriculture, livestock grazing, and the disruption of natural drainage patterns by the construction of the McMicken Dam outlet channel and, to its north, the Beardsley Canal.

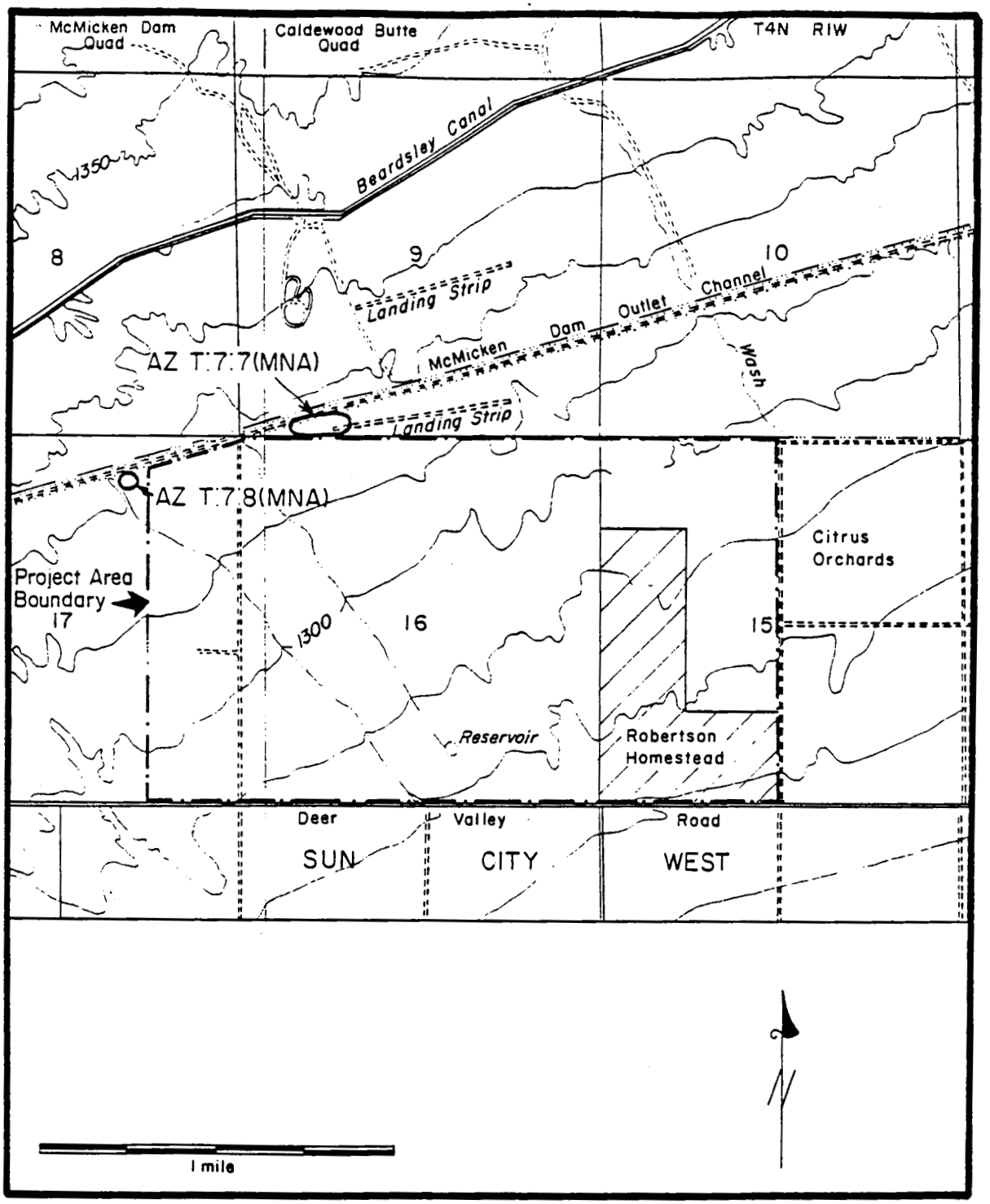

Figure 1. Portions of the USGS 7.5' McMicken Dam and Calderwood Butte topographic quadrangles showing the location of the project area, nearby archaeological sites, and the historic Robertson homestead.

Aside from a small number of low gravel-covered rises in the western half of the project area, the ground surface is covered by sparse gravel overlying the sandy loam substrate. The surface has been subjected to sheet wash and, in a few areas, headward erosion. Modern ground disturbance has resulted from road construction at the southern perimeter of the project area and airstrip construction at its northern margin. Near the half-section point between Sections 16 and 17, a road leads westward to the remains of a recent house, beyond which lies a large trash dump containing construction debris and plant trimmings. The trash dump may have covered cultural materials; prehistoric artifacts were found in its vicinity. Otherwise, sparse vegetation afforded excellent surface visibility of archaeological materials throughout the project area.

Previous Research and Cultural Background

Prior to the fieldwork, cultural resource files were checked at the State Historic Preservation Office and Arizona State Museum (ASM) for the presence of previously recorded sites in or near the project area. Only a single parcel of 5 acres (2 ha) within the project area, located at the extreme southeastern corner of Section 16, had been surveyed (Madsen 1984). No sites or isolated finds have been previously recorded within the project area. However, a survey of the Palo Verde to Westwing transmission line, adjacent to the McMicken Dam outlet channel, located two prehistoric sites immediately north of the area (Stein et al. 1977) (Figure 1). The Museum of Northern Arizona (MNA) conducted the survey, as well as additional investigations at one of the sites.

Site AZ T:7:8(MNA) (NA15,138) was a small artifact scatter, measuring 10 m (33 ft) by 20 m (66 ft), at the edge of a wash in the northeastern corner of Section 17. The site contained pottery characteristic of the Hohokam cultural tradition, chipped stone flakes, and basalt manos. It appeared to have been a plant processing station. Site AZ T:7:7(MNA) (NA15,137) was a more substantial artifact scatter, covering 50 m (164 ft) N-S by 300 m (984 ft) E-W, located within a wedge-shaped area between the McMicken Dam outlet channel, the adjacent modern airstrip, and the northern boundary of Section 16. Since the site would have been difficult to avoid during transmission line construction, MNA conducted a program of data recovery. Investigative procedures included a random sample surface collection of 25% of the site area and excavation of 20 1 m^2 test units (Yablon 1979:10). Recovered artifacts included 505 ceramic sherds, classified into the following Hohokam-affiliated types: 70% phyllite-tempered Wingfield Plain; 23% sand-tempered Gila Plain, Salt variety; 2% highly micaceous Gila Plain, Gila variety; and 5% red-on-buff decorated sherds. Also recovered were 34 chipped stone specimens consisting of flakes, cores, scrapers, and hammerstones. Fragments of grinding stones included 14 trough metate specimens, three slab metate pieces, and six whole or fragmentary manos. Test excavations indicated no subsurface features and a site depth of less than 10 cm (4 in).

Characteristics of the decorated sherds indicated occupation during the Colonial and Sedentary periods, from approximately A.D. 700 to 1100. The site lacked structures or discrete activity areas indicative of year-round habita-

tion. Yablon (1979:20) argued that the quantity, types, and spatial patterning of artifacts suggested repeated seasonal occupations. Based on the presence of trough metates, generally associated with the cultivation and processing of maize, he concluded that the local Hohokam may have practiced floodwater farming along washes carrying runoff southward from the Hieroglyphic Mountains. Insufficient evidence precluded an evaluation of the relative importance of farming, as opposed to the use of wild floral and faunal resources. AZ T:7:7(MNA) was probably a larger site disturbed by the construction of the McMicken Dam outlet channel and dike. However, a recent survey of the Mead to Phoenix transmission line route by MNA, directly north of the channel, located no sites within that area (Keller 1986).

South of the project area, ACS surveyed the northern quarter of Section 20, now under development as a neighborhood within Sun City West (Rankin 1988). The area contained nine prehistoric isolated finds, predominantly metate fragments and whole manos.

Bontrager and Stone (1987) surveyed the margins of Grand Avenue (U.S. 60) between El Mirage and the Beardsley Canal. Near the community of Beardsley, they found a historic trash scatter probably deposited during the early 1920s.

Historic materials were also found along Reach 9 of the Granite Reef Aqueduct route, roughly 5 mi (8 km) north of the project area (Brown 1977). Recorded sites included two homesteads dating to the early 1920s. Informant interviews revealed that during the early 1900s, a stagecoach station was situated near a spring at the southwestern edge of Bunker Peak, a mountain located 2.5 mi (4 km) northwest of the project area. Four prehistoric sites along the aqueduct were artifact scatters ranging up to 30 m (98 ft) in diameter. Typically situated on low gravel rises within 100 m (328 ft) from large washes, these scatters incorporated Hohokam red-on-buff and red ware ceramics, Wingfield Plain sherds, and chipped and ground stone implements manufactured from basalt. They may have been temporary plant gathering and processing areas. An additional prehistoric site incorporated a series of linear rock alignments that may have functioned as check dams or agricultural terrace borders. At one of the artifact scatters, incised Gila Butte Red-on-buff sherds indicated an early Colonial period occupation, perhaps extending back to A.D. 500. The dominant plain ware type at that site was Gila Plain, rather than Wingfield Plain, the latter being more common in this region along the Agua Fria River (Brown 1977:18).

Prehistoric seasonal camps, temporary camps, or resource processing stations in the desert basins may have been used by inhabitants of more permanent camps or villages situated near more dependable water sources, such as the Agua Fria River or springs in the Hieroglyphic Mountains. The river, about 5 mi (8 km) east of the project area, supported numerous Hohokam farming villages, whose inhabitants employed a variety of agricultural strategies incorporating canal irrigation, terraced and bordered fields, and rainwater diversion systems (Green and Effland 1985). Sites along the Agua Fria River include pithouse villages and stone pueblos, limited activity loci, and rock art. They have been dated to the Colonial through early Classic periods of the Hohokam cul-

tural sequence, from about A.D. 500 to 1200. Some archaeologists regard this area as the northern periphery of the Hohokam territorial range, perhaps colonized by migrants from the Hohokam heartland along the lower Salt and middle Gila rivers. The area appears to have been used less intensively after A.D. 1150. The Northeastern Yavapai, more mobile people who drew proportionately greater sustenance from wild plants and game, historically occupied the region.

Miners moved into the area during the late 1800s. By 1890, major wagon roads included Grand Avenue between Phoenix and Wickenburg, and a road from Phoenix to Prescott along the Agua Fria River. The late nineteenth century witnessed the first historic effort to dam the Agua Fria for diversion of the water into irrigation systems (Green and Effland 1985:21). In 1893, W. H. Beardsley formed the Agua Fria Construction Company to build a dam and primary canal. Construction began in 1893, but was suspended due to financial difficulties. With support from financier Donald C. Waddell, the Beardsley Land and Investment Company finally completed the Waddell Dam and Beardsley Canal by 1925. Beardsley and his partners sold out to the Pacific Development Company of Los Angeles, which purchased over 39,00 acres (15,783 ha) west of the Agua Fria River. A promotional campaign to draw settlers to the planned agricultural paradise was extinguished by the onset of the Great Depression (Green and Effland 1985:23).

Survey Methodology

The fieldwork was conducted between January 10 and January 16, 1991, by crews of four persons including Connie Stone (Field Director), Dave Barz, Eric Baunach, Peg Davis, and Ted Silk. The crew traversed successive north-south transects, each a mile long, spaced at intervals of 20 m (66 ft). Spatial concentrations of cultural resources were marked with colored flagging tape and metal tags.

Survey Results

Given the barren appearance of the creosote flats, the survey revealed an unexpectedly high number and variety of cultural materials. Altogether, the survey documented two prehistoric sites, 46 prehistoric isolated finds, two historic sites, and 63 historic isolated finds. Relative densities vary, but cultural materials are scattered throughout the project area (Figure 2).

Prehistoric Sites

The two prehistoric sites are artifact scatters situated along washes in the western portion of the project area. Site boundaries are drawn to encompass discrete concentrations of artifacts, labeled as separate loci, and relatively high densities of isolated finds.

AZ T:7:52(ASM)

This site, which is located in the northwestern corner of Section 16, likely

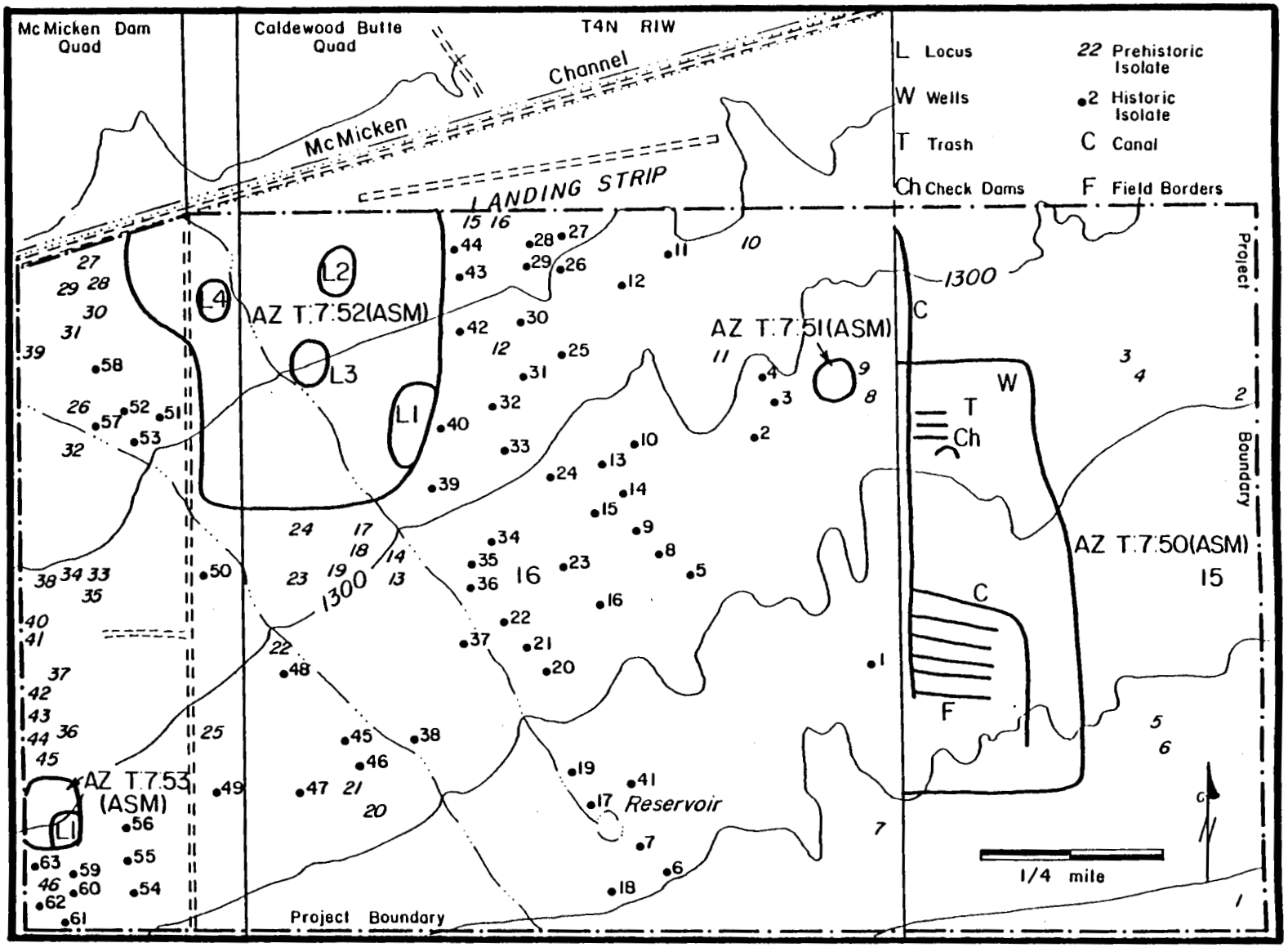

Figure 2. Archaeological sites and isolated finds within the project area.

represents a southern extension of AZ T:7:7(MNA) (Figures 1,2). It covers an area approximately 650 m (2,132 ft) N-S by 600 m (1,968 ft) E-W. Four loci, two of which are situated on low gravel rises, contain relatively dense concentrations of lithic and ceramic artifacts but no obvious features. Away from the relatively stable gravel rises, lower alluvial areas contain isolated finds, possibly redeposited by sheet wash. The 46 recorded isolates include single occurrences and small concentrations of artifacts distributed throughout the site area. Fifteen isolates consist of 20 or fewer ceramic sherds, primarily Wingfield Plain. Sand-tempered and micaceous Gila Plain are also present. Red-on-buff sherds include specimens datable to the Colonial period, associated with micaceous Gila Plain. Thirteen isolated finds consist of whole or fragmentary metates and manos, manufactured primarily from basalt. One specimen appears to be a portion of a trough metate. Nine chipped stone isolates include cores, flakes, and hammerstones of basalt and greenstone. The remaining isolated finds include small concentrations of multiple artifact types and three historic artifacts: a forged horseshoe, an evaporated milk can, and a bottle.

Locus 1 covers an area approximately 200 m (656 ft) N-S by 100 m (328 ft) E-W, at the southeastern margin of AZ T:7:52(ASM) (Figure 2). This area of heavy sheet wash, located downstream from the other loci, may represent an area of secondary deposition. At least 50 potsherds include reddish-brown and smudged Wingfield Plain, sand-tempered Gila Plain, and sand-tempered sherds containing gold mica particles. Other scattered artifacts include at least five metate fragments, a circular mano, and several flakes of fine-grained basalt or dacite.

Locus 2, most proximate to AZ T:7:7(MNA), incorporates an area approximately 70 m (230 ft) in diameter, with a core concentration of artifacts situated on a low gravel rise measuring about 30 m (98 ft) in diameter (Figure 2). At least 500 sherds, 30 specimens of ground stone, and 10 chipped stone artifacts are incorporated within the locus. Wingfield Plain again predominates, with sand-tempered Gila Plain and Hohokam buff ware sherds also present. There are also a few sherds of thin, lightly polished, sand-tempered brown ware. These specimens appear similar to Yavapai pottery types, which would indicate use of the locus over a long time span by different cultural groups. A similar mix of pottery types was collected from a site north of the White Tank Mountains (Brown and Stone 1982:108).

Locus 3, located roughly at the center of AZ T:7:52(ASM), covers an area 80 m (262 ft) N-S by 75 m (246 ft) E-W (Figure 2). Within an area of headward erosion, artifacts are visible in arroyo walls, below the present ground surface. Although the cultural deposits appear to be shallow, there is a distinct possibility of subsurface artifacts or features. This area, adjacent to a major wash, likely has experienced periods of deposition that may have buried cultural materials. The artifact scatter contains at least 300 sherds including Wingfield Plain, sand-tempered and micaceous Gila Plain, and red-on-buff sherds, one of which probably dates to the Colonial period; a basin metate fragment; two heavily used manos; two basalt hammerstones; a chert core; and at least 20 flakes of fine-grained basalt.

Locus 4 incorporates an artifact scatter over an area approximately 55 m (180 ft) N-S by 45 m (147 ft) E-W (Figure 2). Situated on a low gravel rise, this locus contains over 200 potsherds, at least five hammerstones, more than 20 chipped stone artifacts, and at least 10 whole or fragmentary grinding implements. One mano is a rectangular two-hand type commonly associated with the use of trough metates. Wingfield Plain is the dominant utility pottery. Decorated sherds include an incised specimen indicative of a Colonial period occupation. Later use of the locus is indicated by the presence of a Gila Red sherd with a distinctive Gila shoulder, characteristic of the Classic period post-dating A.D. 1100.

In summary, AZ T:7:52(ASM) contains a diverse assemblage of utilitarian artifacts and decorated pottery attributable primarily to Hohokam occupation. The few datable artifacts indicate that the area may have been used repeatedly between A.D. 500 and 1200, and perhaps later by the historic Yavapai. In the relative proportions of artifact types, the predominance of Wingfield Plain pottery, and the conspicuous presence of cores and hammerstones among lithic specimens, the artifact assemblage appears quite similar to the collection recovered from AZ T:7:7(MNA).

AZ T:7:53(ASM)

This site encompasses an area approximately 150 m (492 ft) N-S by 120 m (394 ft) E-W, located in the southwestern corner of the project area (Figure 2). Locus 1 is a relatively dense artifact scatter, covering an area 65 m (213 ft) N-S by 55 m (180 ft) E-W, on a low gravel rise adjacent to a mesquite bosque. Grinding implements predominate. Observed artifacts include at least six slab metate fragments, 11 whole or fragmentary manos of basalt and granite, four sherds, and two greenstone cores. The area likely contains additional fragments of ground stone. Outlying isolates include 10 slab metate fragments and a greenstone scraper.

Prehistoric Isolated Finds

Prehistoric isolates, predominantly grinding implements, reach their highest densities in the vicinities of sites AZ T:7:52 and T:7:53(ASM). However, they are distributed throughout the project area (Figure 2). Table 1 summarizes the nature of the prehistoric isolated finds.

Discussion of Prehistoric Materials

The artifact scatters are similar, in density and assemblage composition, to sites previously recorded along the Palo Verde to Westwing transmission line (Stein et al. 1977; Yablon 1979) and the Granite Reef Aqueduct (Brown 1977). Those sites were interpreted as plant processing areas, temporary camps, and seasonal camps. By virtue of its numerous manos and its proximity to a remnant mesquite bosque, AZ T:7:53(ASM) probably represents an area where plant resources were processed. Isolated artifacts in the site's vicinity consist primarily of grinding implements. The tools may have been left there and

Table 1. Prehistoric Isolated Finds Within the Project Area.

Isolate No.	Description
1	oval basalt unifacial mano, light use
2	oval granite mano fragment
3	oval granite bifacial mano
4	oval granite unifacial mano
5	basin metate fragment of porphyritic igneous material
6	oval granite hammerstone
7	two basalt metate fragments
8	oval fine-grained basalt unifacial mano
9	whole slab metate, one use surface, metamorphic material
10	bifacial mano fragment, metamorphic material
11	unutilized dacite core
12	reddish-brown schist-tempered potsherd
13	circular unifacial mano fragment, igneous material
14	circular basalt bifacial mano fragment
15	slab metate fragment of vesicular basalt, both sides used; four phyllite-tempered Wingfield Plain potsherds
16	circular bifacial granite mano; oval bifacial granite mano; quartz hammerstone; pestle of metamorphic (?) material, both ends battered
17	basalt slab metate fragment, one use surface
18	oval basalt unifacial mano fragment
19	oval basalt unifacial mano fragment
20	greenstone flake
21	two basalt hammerstones; a Wingfield Plain potsherd
22	vesicular basalt bifacial mano fragment
23	vesicular basalt slab metate fragment, two surfaces ground
24	vesicular basalt metate fragment, two surfaces ground
25	two Wingfield Plain potsherds
26	one greenstone flake; a micaceous Gila Plain potsherd
27	dacite tertiary flake
28	basalt unifacial mano fragment
29	one Wingfield Plain potsherd; one sand-tempered potsherd
30	seven Wingfield Plain potsherds
31	one Wingfield Plain potsherd
32	five Wingfield Plain potsherds
33	vesicular basalt metate fragment
34	four sand-tempered potsherds
35	quartzite secondary flake
36	scatter of 25-30 cobbles, 1 x 2 m; no artifacts
37	granite slab metate fragment
38	metate fragment
39	greenstone flake
40	whole slab vesicular basalt metate, two use surfaces
41	two vesicular basalt metate fragments; oval granite granite bifacial mano; granite bifacial mano fragment

Table 1. continued

Isolate No.	Description
42	oval granite bifacial mano
43	two granite mano fragments; three vesicular basalt mano fragments
44	basalt slab metate fragment; basalt mano fragment; fine-grained rhyolite flake
45	two oval bifacial mano fragments of vesicular basalt
46	oval vesicular basalt unifacial mano fragment

reused over multiple seasons.

AZ T:7:52(ASM) incorporates a more diverse assemblage including plain and decorated pottery, grinding implements, hammerstones, and chipped stone cores and flakes. As Yablon (1979) noted, the lack of obvious features, discrete activity areas, or substantial trash deposits at AZ T:7:7(MNA) indicate that the area was not occupied on a year-round basis. However, the assemblage diversity and the conspicuous presence of grinding implements indicates temporary or seasonal camping, perhaps over several hundred years, by small groups. Yablon (1979:20) suggested that floodwater farming was a major activity, based on the presence of trough metate fragments, a "lack of evidence" for wild resource exploitation, and the opinion that "the local environment was probably unfavorable for such exploitation to be conducted on a large scale."

It is possible that floodwater farming was practiced, during years of favorable summer rainfall, along the major washes. However, seasonal harvests of mesquite beans may have offered a stronger impetus for prehistoric use of this area. The legumes produced by mesquite trees, available during the summer, were a nutritious and dependable resource, one of the most important wild foods used by native inhabitants of the desert. Although wooden mortars and pestles generally were used for initial processing of the sticky mesquite pods, many historic Indian groups used metates and manos for further processing into a finer meal (Doelle 1976:55). Historic records reveal that the project area once was covered by dense thickets of mesquite and paloverde trees. In 1894, dense vegetation impeded the progress of General Land Office (GLO) surveyor A. T. Colton, as described in his survey notes on file at the state office of the U. S. Bureau of Land Management (BLM). During the past century, a drastic reduction in mesquite can probably be attributed to lowering of the water table by groundwater pumping and disruption of natural drainage patterns by the construction of the Beardsley Canal and McMicken Dam outlet channel.

Hohokam families or task groups may have ventured into the project area from nearby villages or from camps closer to springs in the Hieroglyphic Mountains. Additional survey evidence from surrounding areas is necessary to evaluate those alternatives. Groups also may have traveled from villages along the Agua Fria River, about 5 mi (8 km) east of the prehistoric sites. At first

consideration, this seems unlikely, as abundant mesquite likely existed along the river. Yet, mesquite groves along the Agua Fria may have been depleted by clearing for fuel and agricultural fields (Dove 1984). In addition, Indian groups often traveled far to gather mesquite beans when agricultural harvests failed. Compositional studies of ceramics can indicate manufacturing areas and relationships among sites within regions. Distinctive basalt sources in the Hohokam northern periphery may have been used to manufacture grinding implements exported to the heartland. In the future, it may be possible to trace the origins of pottery and grinding implements and to determine the affiliations of groups who inhabited outlying desert camps.

Historic Sites

Whereas prehistoric sites and isolates are concentrated in the western portion of the project area, the two historic sites are located in its eastern area, along the section line between Sections 15 and 16 (Figure 2). Both historic sites appear to be remnants of early twentieth century homesteading.

AZ T:7:50(ASM)

This site incorporates wells, trash deposits, canals, and a field system extending over an area approximately 1,000 m (3,280 ft) N-S by 350 m (1,148 ft) E-W, within the westernmost quarter of Section 15 (Figures 1 and 2). Figure 2 depicts the distribution of features within the site. Two wells, situated only 10 m (33 ft) apart, are located at the site's northern margin. One of the wells, possibly dug by hand, is a hole approximately 3 m (10 ft) in diameter, filled with trash consisting primarily of a crumpled sheet metal liner or tank, and a metal mattress frame. The other well was probably drilled. It is marked by a pipe approximately 25 cm (10 in) in diameter, surrounded by square nails and wire that suggest the former existence of a windmill. The larger well represents a hazard, since the trash obscures the existence of a deep hole. The survey crew marked this feature with wide yellow flagging tape labeled "DANGER." Caution should be exercised in its vicinity.

The wells are surrounded by a scatter of metal, glass, and ceramic trash. Although the crew expected to find evidence of a structure, no concrete or earthen house foundations were observed. Such structural components as wooden beams, sheet metal, and window glass are also absent.

A series of rock check dams or field borders are located southwest of the wells and trash scatter. Three linear rock alignments are linked to earthen berms, approximately 50 cm (20 in) high, that extend in a perpendicular direction from an old canal. The canal runs parallel to the section line. The berms are approximately 30 m (98 ft) long, and the rock alignments range from 15 m (49 ft) to 20 m (66 ft) long. Buried rocks indicate that the earthen berms might incorporate additional segments of rock alignments. The berms and rock alignments range from 50 cm (20 in) to 1 m (39 in) wide, and distances between them range from 20 m (66 ft) to 30 m (98 ft). The crew initially interpreted these features as check dams, but instead they appear to have been borders of rectangular field plots. About 35 m (114 ft) south of the linear alignments is

a U-shaped rock alignment; its function is uncertain.

As shown in Figure 2, a canal parallels the section line. Near the northern edge of Section 15, it has been obliterated by modern ground disturbance. This canal likely originated at the Beardsley Canal, located 1 mi (1.6 km) to the north. In the southern portion of AZ T:7:50(ASM), a branch canal borders a system of parallel earthern berms that appear to have functioned as field borders. Within this area, obviously disturbed (tilled?) ground supports a particularly dense growth of native grasses.

Such well-preserved agricultural systems are rarely found at historic sites in Arizona (Stein 1989). Vegetation bordering the canals and berms rendered them visible on an aerial photo blueprint provided to ACS by the Del Webb Corporation. Inspection of the original aerial photo could clarify the extent and configuration of the agricultural system.

The trash at AZ T:7:50(ASM) consists of hundreds of fragments of metal, glass, and ceramic artifacts. Metal artifacts include food cans, coffee and tea tins, meat tins, tool parts, a portion of a cast iron stove, an enamel coffee pot lid (blue granite ware), cartridge cases, shotgun shells, and glass-lined zinc Mason jar caps. Parts of a shearing instrument indicate that sheep may have been kept at the farm, perhaps supported by alfalfa raised there. Other artifacts include bottle and jar fragments; sherds of milk glass, sun-colored amethyst glass, and blue Ball jars; and pieces of porcelain china dinner ware. Table 2 summarizes the initial dates and, where applicable, the final manufacturing dates for distinctive artifacts found at the two historic sites and as isolated finds within the project area. Sources for this information include Toulouse (1971) for glass ware; Lehner (1988) for porcelain; Simonis (1990) for evaporated milk cans; and for information on artifacts found at historic sites within Arizona, Hull-Walski and Ayres (1989), Stein (1981, 1988), and Stone (1990).

Manufacturing dates of historic artifacts indicate most intensive use of the area between 1910 and 1945. A high proportion of purple glass indicates an occupation prior to 1920. Manganese, a decolorizing agent imported from Germany, became unavailable during World War I. Glass containing manganese turns amethyst or purple when exposed to ultraviolet rays. The totality of the evidence indicates that AZ T:7:50(ASM) was occupied or used primarily during the 1910s, 1920s, and 1930s.

Plat books and homestead patents on file at the BLM state office revealed that the site area coincides with the Robertson homestead (Figure 1). Orval A. Robertson received patent (#590595) to 160 acres (65 ha) in 1917, under the provisions of the Enlarged Homestead Act of 1909. The law required that claims be cultivated in non-native crops. A 1912 amendment changed the residency requirement from five to three years, but the homesteader had the option of being absent from the claim for five months of each year. Thus, Robertson probably filed his claim between 1910 and 1915, dates consistent with the artifact assemblage at AZ T:7:50(ASM). The records show that an earlier homesteading entry, filed in 1891, was cancelled. In general, land was not

Table 2. Manufacturing Dates for Historic Artifacts Within the Project Area.

Artifacts	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960
Sites										
glass-lined zinc Mason jar lids	1869									
U.S. Cartridge Co. "CLIMAX" shell	1870	.....	.....	.....	.....	.....	.....	1936		
sun-colored amethyst/purple glass		1880	.....	.....	1915					
hole-in-cap fruit/vegetable cans			1890	.....	.....	.....	1930			
Winchester No. 12 "REPEATER" shell				1901	.....	.....	.....	1938		
Crown Potteries china				1902	.....	.....	.....	.....	.....	1955
Remington UMC No. 12 "NITRO CLUB" shell					1910					
"BEST FOODS" jar						1922				
CLOROX bottle							1929			
Owens-Illinois glass							1929	.....	.....	1954
Patent numbers on Owens-Illinois bottles								1934	.....	1954
Royal porcelain								1933		
Isolated Finds										
hole-in-cap F/V cans			1890	.....	.....	.....	1930			
milk can types, diameter and height in inches (Simonis 1990):										
#5 2 8/16 2 8/16				1903	...	1914				
#10 2 15/16 4 4/16						1917	....	1929		
#12 2 15/16 3 14/16						1917	....	1929		
#15 2 7/16 2 8/16						1920	...	1931		
#17 2 8/16 2 6/16							1931	.....	1948	
#18 2 15/16 3 14/16, "Punch here"							1935	...	1945	
Hazel-Atlas glass						1920	.....	.....	.....	1964
Diamond glass						1924				
Owens-Illinois bottle (Heinz patent #213)							1929	..	1940	
Illinois Pacific Coast glass							1930	.	1932	
PUREX bleach bottle								1939		
Owens-Illinois "Duraglas"								1940	.....	1963
"RAVENNA" dinnerware, Shenango China Co.										1960
Wheaton glass									1946	

available for homesteading until it had been surveyed and subdivided into sections by the GLO (Stein 1989). The GLO survey of Township 4 N, Range 1 W was not officially filed until 1896. Colton, the surveyor, observed that there were no settlers within the township at that time.

The examined records do not indicate the nature of land use or changes in ownership after the land was patented in 1917. The datable artifacts and the probable linkage of the canal to the Beardsley Canal, completed in 1925, indicate that the Robertson homestead was farmed through the 1930s. It is possible that the northern field area bordered by rock alignments, close to the wells, was cultivated to fulfill the legal homesteading requirements and later incorporated into an expanded system of fields linked to the canal. It is difficult to interpret the lack of obvious structural remains. Evidence from other desert homesteads indicates the possibility of rather insubstantial shelters such as tent houses, dugouts, or structures erected on dirt floors. Houses often were dismantled and carted away. It is possible that the homestead was occupied periodically rather than continously. Shelter remnants may have been too ephemeral to be readily visible to the survey crew.

In addition to the historic materials, several prehistoric artifacts are scattered through the area encompassed by AZ T:7:50(ASM). These isolated finds include three whole slab metates, two whole manos, and a mano fragment.

AZ T:7:51(ASM)

This site is a trash scatter, covering an area approximately 70 m (230 ft) N-S by 60 m (197 ft) E-W, within the northeastern quarter of Section 16 (Figure 2). It contains several hundred fragments of sun-colored amethyst glass, porcelain, crockery, and blue Mason jars; more than 30 metal cans and a few buckets; and a few green and blue bottles. Similarities in artifact types, and the site's proximity to AZ T:7:50(ASM), suggest that it served as a domestic trash dump for the users of that site.

Historic Isolated Finds

Historic isolates, consisting primarily of cans and bottles, are scattered throughout Section 16 and the eastern quarter of Section 17 (Figure 2). BLM records show that the latter area was patented by cash entry, a procedure that allowed homesteaders to purchase land in lieu of fulfilling residency requirements. Henry N. Lewellen received patent (#834343) to 160 acres (65 ha) in 1921. The records hold no evidence of homesteading in Section 16. The dispersed distribution of the cans and bottles indicates that cowboys might have stopped for a quick meal while tending to livestock, since this area has been used for grazing cattle. Table 3 summarizes the nature of the historic isolated finds within the project area.

Table 3. Historic Isolated Finds Within the Project Area.

Isolate No.	Description
1	metal heater or wood stove
2	3 hole-in-cap (HC) metal cans
3	1 HC can
4	1 HC can
5	small trash dump, 10 m in diameter: sanitary cans, bottles, dinner ware fragments, and a bicycle dating dating to the 1950s at the earliest
6	2 HC cans
7	1 HC can
8	1 HC can
9	2 HC cans
10	3 HC cans
11	1 HC can
12	bottle, trademark D in keystone symbol; possibly manufactured by Knox Co., Denver plant, 1945-1951
13	Kreml hair tonic bottle
14	2 HC cans
15	1 HC can
16	1 HC can
17	12-gauge shell manufactured in Hungary
18	1 HC can
19	1 HC can
20	7 HC cans
21	brown beverage bottle
22	brown PUREX bottle; BEST FOODS bottle, Diamond glass; 2.5 oz clear glass medicine bottle, Hazel-Atlas glass; clear octagonal bottle, Diamond glass, labeled "Superior Products, Phoenix"
23	1 HC can
24	1 evaporated milk can, type #18 (see Table 2)
25	3 HC cans
26	clear condiment bottle, Hazel-Atlas glass
27	1 HC can
28	clear bottle, Owens-Illinois glass
29	Heinz condiment bottle, Owens-Illinois glass
30	clear bottle
31	1 HC can
32	3 HC cans
33	1 HC can
34	1 HC can
35	brown beverage bottle fragment, Owens-Illinois glass; enamel (pale blue granite ware) cooking pot
36	clear Mason jar fragment
37	1 evaporated milk can, type #12 (see Table 2)
38	1 evaporated milk can, type #5 (see Table 2)

Table 3. continued

Isolate No.	Description
39	1 evaporated milk can, type #17 (see Table 2)
40	Karo Syrup bottle, Owens-Illinois "Duraglas"; 2 evaporated milk cans, type #18 (see Table 2)
41	body of early 1950s Mercury sedan
42	1 evaporated milk can, type #18 (see Table 2)
43	1 HC can
44	clear pint bottle, Owens-Illinois glass
45	1 HC can
46	2 brown pharmaceutical bottles, Wheaton glass, post-1946
47	1 evaporated milk can, type #15; 2 HC cans; Heinz Heinz bottle, patent 211; brown beverage bottle, Illinois Pacific Coast glass; "Ravenna" dinner ware
48	1 HC can
49	1 HC can
50	1 HC can
51	rock alignment parallel to section line road, 15 m long, up to 2 m wide, 80-90 rocks; no associated artifacts; function uncertain
52	1 HC can
53	1 evaporated milk can, type #10
54	2 HC cans
55	2 HC cans
56	1 HC can
57	1 HC can, 1 enamel (gray granite ware) cooking pot
58	1 HC can
59	1 HC can
60	1 HC can
61	80-90 cans, including evaporated milk cans, type #12; 1 enamel (gray granite ware) cooking pot; fragments of glass and porcelain; single dumping episode
62	1 HC can
63	50-60 cans including HC cans; single dumping episode

Recommendations

Isolated cultural materials have been adequately recorded in areas outside of the defined site boundaries; they can yield little further information. In those zones of the project area, cultural resources pose no constraints on future development. Development of the south half of Section 16 poses no threat to existing cultural resources, if the bordering archaeological sites are avoided or, if necessary, protected by fences.

The four sites recorded within the project area are potentially eligible for nomination to the National Register of Historic Places, by virtue of the fol-

lowing qualities: they retain sufficient physical integrity to yield information on prehistoric and historic activities; the historic sites are more than 50 years old; and under "criterion D", the sites are likely to yield information important in prehistory and history. Therefore, additional archaeological investigation is recommended for these sites prior to development.

Prehistoric Sites

The prehistoric sites, AZ T:7:52 and T:7:53(ASM), can yield information regarding changes through time in Hohokam use of desert basin resources. Although much archaeological work has taken place along the Agua Fria River, there is relatively limited knowledge of settlement patterns, economic strategies, and social affiliations of groups who occupied the desert zone west of the Agua Fria. Brown (1977) suggested that this was a zone of interaction between the river-based Hohokam and inhabitants of the mountainous country to the north. Raw material studies of ceramics and grinding implements could yield information regarding the geographic and social ties of the site users.

At the prehistoric sites, further investigations should focus on the five areas of relatively high artifact density designated as numbered loci. These areas include low gravel rises that have been subjected to relatively minimal disturbance from erosion. Surface collection and artifact analysis should be supplemented by subsurface testing to determine the depth of the cultural deposits and the presence of subsurface features. Soil deposition appears to have buried artifacts at some of the loci, although investigations at nearby AZ T:7:7(MNA) revealed that the depth of that site did not exceed 10 cm (4 in). Pollen or flotation samples from subsurface archaeological contexts could indicate whether floodwater farming took place along the washes, as suggested by Yablon (1979).

Historic Sites

The historic sites, AZ T:7:50 and T:7:51(ASM), can yield information regarding the history of homesteading and early irrigation systems in the desert regions of Arizona. Although homesteading was a "major factor in the settlement and growth of Arizona" (Stein 1989:2), only a few historic homesteads have received detailed study. AZ T:7:50(ASM) is particularly interesting in several respects. The first serious attempt to settle and farm the area culminated in the successful conveyance of a title patent. In general, failures outnumbered successes for desert homesteading claims. A locally high water table, soil labeled as "first rate" by the surveyor Colton, and the proximity of major roads may have contributed to the success of the Robertson homestead. The field borders, rock alignments, and canals are a significant aspect of the site. Stein (1989:11) noted that "of all the man-made features at homesteads, agricultural fields are probably the most elusive." Study of the agricultural system at AZ T:7:50(ASM) could reveal how homesteaders coped with the challenge of desert farming. The site may also offer information relevant to the history of the Beardsley Canal and its effects on historic settlement of the area west of the Agua Fria River.

Archaeological studies of the historic sites should involve the collection and analysis of artifacts, a search for evidence of structural features or latrine deposits, and mapping of the agricultural system and other features. The examination of aerial photos could aid in site mapping. Archaeological analyses could help reveal the nature of homestead life and the homesteaders' ties to the larger community and the Arizona economy through time. Additional documentary studies could reveal the history of ownership and occupancy of the site after the original patent was granted to Robertson. There appear to have been two major motives for homesteading. During the Great Depression of the 1930s, homesteading offered one of the few options for obtaining property at little cost other than labor and persistence. An alternative motive was the acquisition of land for immediate or eventual financial gains. Patented land, which cost little in monetary terms, was often sold soon after receipt of the patent. Robertson may have foreseen an increase in the value of his land upon the completion of the planned Beardsley Canal. Potentially productive documentary sources include homesteading case files maintained at the National Archives, deed indices maintained by the County Recorder, and old city directories and newspapers.

Information and artifacts recovered from studies of the prehistoric and historic sites could be used in interpretive exhibits displayed at Sun City West recreational and cultural centers. Many residents would be interested in the history of their community, which has evolved from an Indian food gathering ground, to an area farmed by resourceful homesteaders, to a thriving modern city.

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SHPO STANDARDIZED REPORT ABSTRACT

AGENCY:

PROJECT TITLE: Sun City West Expansion

DATE OF REPORT: February 1, 1991

AGENCY PROJECT NUMBER:

ACS PROJECT NUMBER: 90-095

PROJECT DESCRIPTION: Inventory and assessment of cultural resources that might be affected by proposed expansion of Sun City West.

LOCATION: north of Deer Valley Road, east of Grand Avenue, and south of the McMicken Dam Outlet Channel
USGS 7.5' McMicken Cam and Calderwood Butte topographic quadrangles
Township 4 North, Range 1 West, Sections 15-17 north

NUMBER OF SURVEYED ACRES: 1100

METHODOLOGY: Five people walked parallel transects across the survey area, spaced 20 m apart.

NUMBER OF SITES: 4

NUMBER OF ELIGIBLE SITES: 4

LISTING OF ELIGIBLE SITES: AZ T:7:50-53(ASM)

COMMENTS: The prehistoric sites, AZ T:7:52 and T:7:53(ASM), can yield information regarding changes through time in Hohokam use of desert basin resources. Although much archaeological work has taken place along the Agua Fria River, there is relatively limited knowledge of settlement patterns, economic strategies, and social affiliations of groups who occupied the desert zone west of the Agua Fria.

The historic sites, AZ T:7:50 and T:7:51(ASM), can yield information regarding the history of homesteading and early irrigation systems in the desert regions of Arizona.

ACS

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February 22, 1991

Mr. Tim Goodrich
Del Webb's Sun City West
13950 Meeker Boulevard
P.O. Box 1705
Sun City West, Arizona 85372-1705

Dear Mr. Goodrich:

As described in the ACS survey report for the project area north of Sun City West, two prehistoric sites and two historic sites exist within the area. The prehistoric sites, AZ T:7:52 and T:7:53(ASM), are artifact scatters that contain information relating to the prehistoric subsistence economies and social networks of Hohokam groups who utilized the area between A.D. 500 and 1200. At the larger site, AZ T:7:52(ASM), four relatively small areas contain the majority of artifacts. Information from the remainder of the site area has already been recovered during the survey, through the recording of isolated artifacts. The historic sites, AZ T:7:50 and T:7:51(ASM), contain information regarding homesteading between A.D. 1910 and 1940, the nature of historic farming strategies and irrigation systems, and the effects of the Beardsley Canal on historic settlement of the area west of the Agua Fria River.

The sites are considered to be potentially eligible for nomination to the National Register of Historic Places. The National Register is an official listing of significant prehistoric and historic cultural resources. Eligibility is based on the following characteristics: physical integrity, a lack of severe damage or disturbance; an age greater than 50 years; and the applicability of at least one of four major criteria of site significance. The sites within the project area display sufficient integrity and antiquity, and they conform to "Criterion D": sites "that may be likely to yield information important in prehistory or history."

Potential eligibility does not mean that sites must be preserved, or that official nomination procedures must be followed. In fact, these four sites are <u>not</u> worthy of preservation. Instead, efforts must be made to recover the information that the sites can yield. To parapharse Robert Gasser, Compliance Officer for State Historic Preservation Office, the determination of eligibility to, as opposed to actual nomination to, the National Register is a bureaucratic means for making sure that the cultural resources are investigated (personnel communication, February 21, 1991). Actions that could affect the sites are subject to review by the State Historic Preservation Officer, who is responsible for ensuring compliance with federal and state legislation regarding historic preservation.

The State Historic Preservation Office (SHPO), directed by Dr. Shereen Lerner, is a division of the Arizona State Parks, located at 800 W. Washington Street in Phoenix. The survey report should be submitted to the SHPO for review, along with the enclosed "SHPO Standardized Report Abstract". The allotted review period is 30 days upon receipt of the report. It is likely that the

SHPO staff will concur with our recommendation for data recovery at the sites. Once data recovery has been accomplished, the sites would pose no constraints to development.

The initial step in data recovery involves preparation of a data recovery plan that must be submitted to the SHPO for a 30-day review period. Following preparation, review, and approval of a data recovery plan, investigations will involve fieldwork, documentary research, laboratory analyses, and report preparation. Although fieldwork will be necessary, it will not be excessively laborious or time-consuming. Fieldwork will primarily involve site mapping, surface artifact collections, and limited test excavations. The sites do not appear to contain deep cultural deposits that would require costly excavations, and the artifact concentrations are limited in area. We estimate a period of four to six weeks for fieldwork. Laboratory analyses, documentary research, and report preparation could take an additional four to five months. We caution that although these are reasonable estimates, they might not conform to those within a carefully prepared data recovery plan. The entire process, from review of the survey report to submission of a final research report, should take less than a year.

Finally, if a portion of the project area is transferred to the Arizona Department of Transportation (ADOT), then ADOT would be responsible for data recovery at the sites within the transferred area. If this is the case, then the cover letter from the Del Webb Corporation to the SHPO should explain that situation.

Thank you for your cooperation, and please contact us if you require additional information or clarification.

Sincerely,

Connie L. Stone

Connie L. Stone, Ph.D.
Project Director

cc Arne Lahlum, Stanley Consultants

ENVIRONMENTAL PROPERTY EVALUATION
DEL E. WEBB DEVELOPMENT COMPANY
SUN CITY WEST EXPANSION
MARICOPA COUNTY, ARIZONA

WT JOB NO. 7111K031

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ENVIRONMENTAL PROPERTY EVALUATION

SUN CITY WEST EXPANSION
NORTH OF DEER VALLEY DRIVE NEAR 139TH AVENUE
MARICOPA COUNTY, ARIZONA

Prepared for:

DEL E. WEBB DEVELOPMENT COMPANY
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Prepared by:

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February 13, 1991

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Phone Number - (602) 437-3737

Registered Professional Engineer (Civil)
CERTIFICATE NO.
19397
FRANK
COSTELLO
Date Signed
ARIZONA, U.S.A.

Tammy E. Dignan, Project Manager

Frank Costello, P.E.

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APPENDICES

Appendix A

Figure 1	Vicinity Map
Figure 2	Site Plan
Figure 3	Groundwater Map

Appendix B — Photographic Log

ENVIRONMENTAL PROPERTY EVALUATION
DEL E. WEBB DEVELOPMENT COMPANY
SUN CITY WEST EXPANSION
MARICOPA COUNTY, ARIZONA

WT JOB NO. 7111K031

SECTION 1.0
INTRODUCTION

This section presents general project information and work scope.

1.1 PROJECT AUTHORIZATION

This report presents the results of an environmental property evaluation conducted for the Sun City West Expansion located north of Deer Valley Drive near 139th Avenue in Maricopa County, Arizona. WT was retained by Mr. Tim Goodrich of Del E. Webb Development Company to perform the evaluation and was authorized to proceed as stipulated in WT's Proposal No. 7111A036.

1.2 PROJECT OBJECTIVE AND SCOPE OF WORK

The objective of this environmental property evaluation was to survey the potential for hazardous or toxic substance contamination from past or present uses of the site or properties within one-half mile. Conclusions and recommendations for further actions in this report are subject to modification if subsequent information is developed by WT or others.

The scope of services for the project included the following activities:

- On-site survey of present conditions
- Off-site touring of properties within one-half mile of the site
- Regulatory agency and historical records review
- Data evaluation
- Report of findings and conclusions
- Development of recommendations.

SECTION 2.0
SITE INFORMATION

The following site information was developed from on-site observations and records reviews.

2.1 LOCATION

The subject property is located within Section 15, 16, and 17 of Township 4 North, Range 1 West of the Gila River Baseline and Meridian, Maricopa County. The subject property is located north of Deer Valley Drive near 139th Avenue in Maricopa County, Arizona (see Figure 1, Appendix A).

The site boundaries and properties adjacent to the subject property are as follows:

- o North: Private property with an abandoned ultralight air strip and McMicken Dam Diversion Channel
- o East: Undeveloped land used primarily for livestock grazing
- o South: Deer Valley Drive with residential property beyond
- o West: Undeveloped land.

2.2 SITE DESCRIPTION

The subject property consists of approximately 960 acres that occupies the southwest quarter and one-half of the northwest quarter of Section 15; all of Section 16; and the southeast quarter of the southwest quarter of Section 17 of Township 4 North, Range 1 West.

The subject property is undeveloped and sparsely covered with native desert vegetation. Evidence of agricultural usage of the subject property is not indicated. Numerous well-beaten livestock tracks were observed throughout the subject property indicating present land use for the grazing of livestock. No buildings or structures were observed on the subject property.

Several areas of domestic dumping consisting of construction debris, automobile tires, and metal scraps were observed on the subject property. The debris piles were primarily noted in the southern portions of Sections 16 and 17.

A concrete stock watering tank was observed on the southeast portion of Section 16. The tank was dry at the time of the on-site survey. A broken PVC pipe and ditch were located adjacent to the stock watering tank. The ditch was approximately one foot in depth and 50 feet in length. The apparent use of the PVC pipe and ditch were to fill the stock watering tank for livestock use.

Electrical service to the subject property is provided by Arizona Public Service (APS). During the on-site survey, a pole-mounted capacitor bank was identified on the southwest corner of Section 16. The capacitor bank appeared to be in good condition and no visible signs of leakage were noted.

No surface staining or chemically distressed vegetation indicative of accidental or intentional dumping of hazardous waste were observed on the subject property.

The following structures were identified outside the boundaries of the subject property:

- North: An abandoned house; an abandoned well; the frame to a metal garage; the frame to a previously screened building; a landing strip for airplanes; high tension power lines (running parallel to the subject property); McMicken Dam Diversion Channel; APS pad-mounted transformer (not in service) with evidence of leakage; two 55-gallon steel drums used for trash collection.
- South: A barbed wire fence and a drainage ditch (both running parallel to the subject property).
- West: Two overhead, pole-mounted transformers located northwest of Section 16 and owned by APS. The transformers appeared to be in good condition and no visible signs of leakage were noted during the survey.

2.3 TOPOGRAPHY AND DRAINAGE

The subject property is at an elevation ranging from 1,390 to 1,430 feet above mean sea level. Natural drainage patterns generally flow south/southwest. Storm water drainage follows the natural drainage patterns. Several dry washout areas were observed throughout the subject property.

2.4 GEOLOGY AND GROUNDWATER

Geology and hydrogeology of a site can be of use in assessing the likelihood that material from a leak or spill could migrate, and in which direction migration may occur.

2.4.1 Geology

The subject property is located in an area designated by the Arizona Department of Water Resources (ADWR) as the Phoenix Active Management Area (AMA). The Phoenix AMA is in the Basin and Range physiographic province and is bounded to the east by the Mazatzal, Usery, Goldfield, and Superstition Mountains; to the south by the Sacaton, Sierra Estrella, South Mountains, and the Buckeye Hills; to the west by the White Tank Mountains; and to the north by the Hieroglyphic, Wickenburg, New River Mountains, and the New River Mesa. The bordering mountains are composed chiefly of igneous and metamorphic rock.

The Phoenix AMA is divided into several sub-basins. The sub-basins are broad alluvial basins filled by over a thousand feet of sedimentary deposits consisting primarily of silt, sand, clay, and gravel. The East and West Salt River Valley Sub-basins (the two main sub-basins in the Phoenix AMA) are separated by the Phoenix Mountains, Papago Buttes, and Union Hills. The subject property is located in the West Salt River Valley Sub-basin.

2.4.2 Groundwater

Three main water bearing units comprise the basin-fill deposits. These units in descending order are the Quaternary Upper Alluvial Unit (UAU), the Quaternary and Tertiary Middle Fine-grained Unit (MFU), and the Tertiary Lower Conglomerate Unit (LCU). The upper alluvial unit is the primary source of groundwater in the West Salt River Valley Sub-basin. Groundwater is usually unconfined, but semi-confined conditions exist in areas where there is an increase of finer-grained materials.

According to the latest Arizona Department of Water Resources publication, Report No. 12 dated 1986 (see Figure 3, Appendix A), the water table in the area of the subject property lies approximately 396 to 456 feet below the existing land surface. The regional groundwater flow is generally to the south/southwest. However, groundwater flow direction may vary depending on local groundwater pumping.

Groundwater contamination from natural and anthropogenic sources is widespread in the Phoenix AMA. A number of wells sampled outside the half mile study area and within the boundaries of the West Salt River Sub-basin have measurable levels of volatile organic compounds (VOCs). However, no measurements of groundwater quality taken below the subject property, which would confirm or deny groundwater contamination were found during our records review.

SECTION 3.0
RECORDS REVIEW

During the literature search, records were reviewed at or obtained from the following agencies and companies.

- U. S. Environmental Protection Agency (EPA), Region 9
- Arizona Department of Environmental Quality (ADEQ)
- Arizona Department of Water Resources (ADWR)
- U.S. Geological Survey (USGS)
- LandisCor Aerial Survey
- Arizona Public Service (APS)

The purpose of the review was to assess the potential for hazardous materials from previous on-site and nearby activities. The results of the review are discussed in the following sections.

3.1 ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

ADEQ's Hazardous Waste Compliance Unit has listed facilities that have undergone a Resource Conservation and Recovery Act (RCRA) inspection or compliance action for potential violations of the Arizona State Hazardous Waste Management Act.

A review of the January 28, 1991 listing revealed no past or present hazardous waste compliance actions located within one-half mile of the subject property.

The ADEQ Water Quality Assurance Revolving Fund (WQARF) Responsiveness Summary 1989-1990 priority list was reviewed to determine if the subject property lies within the boundaries of an existing or proposed project. The WQARF program is the State of Arizona equivalent to the federal Superfund program or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

A review of this document revealed that the subject property is not located within one-half mile of any WQARF study sites.

ADEQ annually prepares a report entitled "The Annual Report on Arizona Groundwater Quality Sampling Results & Enforcement Actions", which discusses groundwater quality throughout the state. The 1987 Annual Report, dated January 1, 1988; the 1988 Annual Report, dated June 30, 1989; and the 1989 Annual Report, dated July 1, 1990, were reviewed to determine the groundwater quality beneath the subject property and the half-mile study area.

These reports contained insufficient data to adequately define the groundwater quality beneath or within one-half mile of the subject property.

The Arizona Open and Closed Solid Waste Landfills and Solid Waste Dumps List, which is maintained by the ADEQ Solid Waste Unit, identifies the locations of solid waste landfills and solid waste dumps which are presently operating or closed.

A review of this list revealed no open or closed solid waste dumps or landfills within one-half mile of the subject property.

The Arizona CERCLA Information and Data System (ACIDS) is a list maintained by the ADEQ Office of Waste Programs; it contains locations subject to environmental contamination investigation by ADEQ. The inclusion of a particular facility on this list does not necessarily mean that the location is contaminated, is causing contamination or is in violation of state or federal statutes and regulations. This list implies that due to the nature of activities conducted at these locations the potential for the previously mentioned conditions exist.

A review of the September 14, 1990 release of this document listed no ACIDS facilities within one-half mile of the subject property.

3.2 U.S. ENVIRONMENTAL PROTECTION AGENCY

The RCRA database, maintained by EPA, lists facilities in Arizona that have notified EPA of hazardous waste activity. The notifiers may engage in the generation, transportation, treatment, storage, and/or disposal of hazardous wastes.

Our review of the January 1, 1991 database revealed no notifiers located within one-half mile of the subject property.

The federal Superfund was authorized to finance the cleanup of hazardous waste sites throughout the United States. A computer database of abandoned or inactive facilities -- the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) -- has been developed to support CERCLA activities. After a potential site is discovered by the EPA, it is entered into the database and a preliminary site assessment is done. If warranted, a site investigation is performed after which a site can be proposed for remedial action and placed on the National Priorities List (NPL).

No abandoned or inactive hazardous waste sites listed in the April 1990 CERCLIS status report are located on or within one-half mile of the subject property.

3.3 ELECTRIC UTILITIES

Electric power to the property is provided by APS. However, no on-site electrical transformers or improvements were observed on the subject property.

3.4 U.S. GEOLOGICAL SURVEY/LANDISCOR AERIAL SURVEY

Topographic maps from the USGS and aerial photographs from LandisCor Aerial Survey were reviewed to identify past uses and characteristics of the subject property. Historical aerial photographs, maps, and atlases may reveal past activities that could contribute to environmental degradation. A brief description of each map, photograph, and its corresponding date follows.

- **December 20, 1981 - LandisCor Aerial Survey**

  This photograph depicts:

  - The subject property is native desert, undeveloped land
  - Landing air strip, McMicken Dam Diversion Channel, and house to the north of subject property
  - Agricultural land to east of subject property
  - Undeveloped land to west of subject property
  - Deer Valley Drive is paved with asphalt and south of the subject property. Cleared areas apparently intended for residential use of Sun City West are south of the road.

- **December 18, 1984 - LandisCor Aerial Survey**

  This photograph depicts:

  - No changes to subject property or areas to the east and west
  - Landing air strip, diversion channel, and house still present to the north of subject property. In addition, a large structure (the screened building noted in Section 2.2) north of the subject property had been constructed
  - Increased development of residential area to south of subject property

- **November 29, 1988 - LandisCor Aerial Survey**

  This photograph depicts:

  - No changes to subject property or areas to the north, east, and west
  - Increased development of residential area to south of subject property

- **October 3, 1990 - LandisCor Aerial Survey**

  This photograph depicts:

  - Subject property and surrounding areas appear as it did during the on-site survey.

SECTION 4.0
POTENTIAL SOURCES OF CONTAMINATION

Commonly encountered potential or actual sources of contamination are discussed in this section.

4.1 SURFACE STAINING

During the on-site review, the subject property was surveyed for areas of staining or soil discoloration that would suggest intentional or accidental spillage of potentially hazardous substances.

No surface stains were observed on the subject property during the survey.

4.2 UNDERGROUND STORAGE TANKS (USTs)

The ADEQ October 28, 1990 UST list was reviewed to determine the number and location of registered USTs on or within one-half mile of the subject property.

This list did not reveal any registered USTs on or within one-half mile of the subject property. Additionally, no pipes, vents or structures that would indicate the presence of USTs were observed on-site during the on-site survey.

4.3 LEAKING UNDERGROUND STORAGE TANKS (LUSTs)

The ADEQ LUST incident file, dated December 31, 1990, was reviewed to determine if any release incidents have been reported within one-half mile of the subject property.

The listing did not reveal any reported LUST incidents on or within a one-half mile radius of the subject property.

4.4 DRYWELLS

The ADEQ August 10, 1990 Drywell Registration list was reviewed to determine the presence of registered drywells on the subject property.

This list did not reveal any registered drywells located on the subject property. Additionally, no drywells were observed on the subject property.

SECTION 5.0
FINDINGS AND CONCLUSIONS

Based on the review of available records and on and off-site touring, WT concludes the following.

- The subject property consists of 960 acres of native desert, undeveloped land.
- The topography of the subject property is essentially level, with site-specific drainage directed towards the southwest.
- Depth to groundwater in the area is approximately 396 to 456 feet below land surface.
- Insufficient data exists to adequately characterize groundwater beneath the subject property.
- Several areas of domestic dumping consisting of construction debris, automobile tires, and metal scraps were observed on the south portions of the subject property.

- A concrete watering tank and PVC pipe were observed on the subject property. No buildings or structures were observed.
- One capacitor bank was observed on the southwest corner of Section 16. No evidence of leakage was noted.
- No surface staining or chemically distressed vegetation indicative of accidental or intentional dumping of hazardous waste were observed on the subject property.
- No RCRA-permitted notifiers are located on or within one-half mile of the subject property.
- The subject property is not located within one-half mile of a WQARF study area.
- No Arizona CERCLA facilities lie on or within one-half mile of the subject property.
- No open or closed solid waste dumps or landfills are located on or within one-half mile of the subject property.
- No RCRA compliance actions have been reported on or within one-half mile of the subject property.
- No registered USTs are located on or within one-half mile of the subject property.
- No LUST incidents have been reported on or within one-half mile of the subject property.

SECTION 6.0
RECOMMENDATIONS

Based on the review of available records and on-site and off-site touring, WT recommends no further environmental studies be conducted at this time.

SECTION 7.0
EPE LIMITATIONS

The scope of this evaluation is limited to: observations made during the on-site review; and reviews of readily available published and unpublished reports, literature, and aerial photographs. As a result, these conclusions are based on information supplied by others, professional expertise, and interpretations by qualified personnel.

The focus of the site evaluation was to assess the likelihood of hazardous or toxic substance contamination resulting from past and current uses of the site and adjacent properties. As a result, this evaluation does not highlight the presence of the following conditions unless they were the express concerns of contacted personnel, report and literature authors or the work scope.

- Naturally occurring toxic or hazardous substances in the subsurface soils, geology, and water.
- Toxicity of substances common in current habitable environments, such as stored household products, building materials, and consumables.
- Contaminants or contaminant concentrations that are not a concern now, but may be under future regulatory standards.

We are unable to predict events that may occur after our site visit, such as illegal dumping or accidental spillage.

There is no evaluation which is thorough enough to absolutely exclude the presence of hazardous substances at any site. Therefore, if none are identified as part of a limited scope of work, such a conclusion should not be construed as a guaranteed absence of such materials; it is merely the result of the evaluation.

We have performed our services for this project in accordance with our agreement and understanding with Del E. Webb Development Company. This document and the information contained herein have been prepared solely for the use of Del E. Webb Development Company and their assigned parties.

This environmental property evaluation was performed by WT under a limited scope of services per our agreement. It is possible, despite the use of reasonable care and interpretation, WT may have failed to identify regulatory violations or the presence of hazardous substances or underground tanks. WT assumes no responsibility for conditions that we did not specifically evaluate or conditions that were not generally recognized as environmentally unacceptable at the time this report was prepared.

SECTION 8.0
REFERENCES

- Arizona Department of Water Resources Hydrologic Map Series Report No. 12 dated 1986.
- USGS McMicken Dam Quadrangle dated 1957 and revised in 1981.
- LandisCor Aerial Survey aerial photographs dated 1981, 1984, 1988, and 1990.
- The ADEQ 1989-1990 Annual Water Quality Assurance Revolving Fund (WQARF) Project Priority list.
- The 1987 Annual Report on Arizona Groundwater Quality Sampling Results and Enforcement Actions, prepared by ADEQ dated January 1, 1988.
- The 1988 Annual Report on Arizona Groundwater Quality Sampling Results and Enforcement Actions, prepared by ADEQ dated June 30, 1989.
- The 1989 Annual Report on Arizona Groundwater Quality Sampling Results and Enforcement Actions, prepared by ADEQ dated July 1990.
- The Federal Superfund (CERCLA) status report dated April 1990 and State Superfund (WQARF) list, prepared by ADEQ dated January 1989 and updated December 1990.
- The Arizona Department of Environmental Quality RCRA Compliance Log dated January 28, 1991.
- The U.S. EPA RCRA Database dated January 1, 1991.
- The Arizona Department of Environmental Quality Underground Storage Tank Registration list dated October 28, 1990.
- Leaking Underground Storage Tank (LUST) File Listings, prepared by ADEQ dated December 31, 1990.
- The Arizona Department of Environmental Quality Drywell Registration List dated August 10, 1990.
- The Directory of Arizona Closed Solid Waste Landfills and Closed Solid Waste Dumps, prepared by ADEQ dated September 1990.
- The Arizona Directory of Municipal Solid Waste Landfills and Rubbish Landfills, prepared by ADEQ dated January 1990.
- The Arizona CERCLA Information and Data System (ACIDS) list, prepared by ADEQ dated September 14, 1990.
- CERCLIS Status Report dated April 1990.
- Permitted Facilities (to discharge to groundwater), prepared by ADEQ dated January 10, 1991.
- Existing Facilities (waiting for discharge permit), prepared by ADEQ dated January 10, 1991.

APPENDIX A

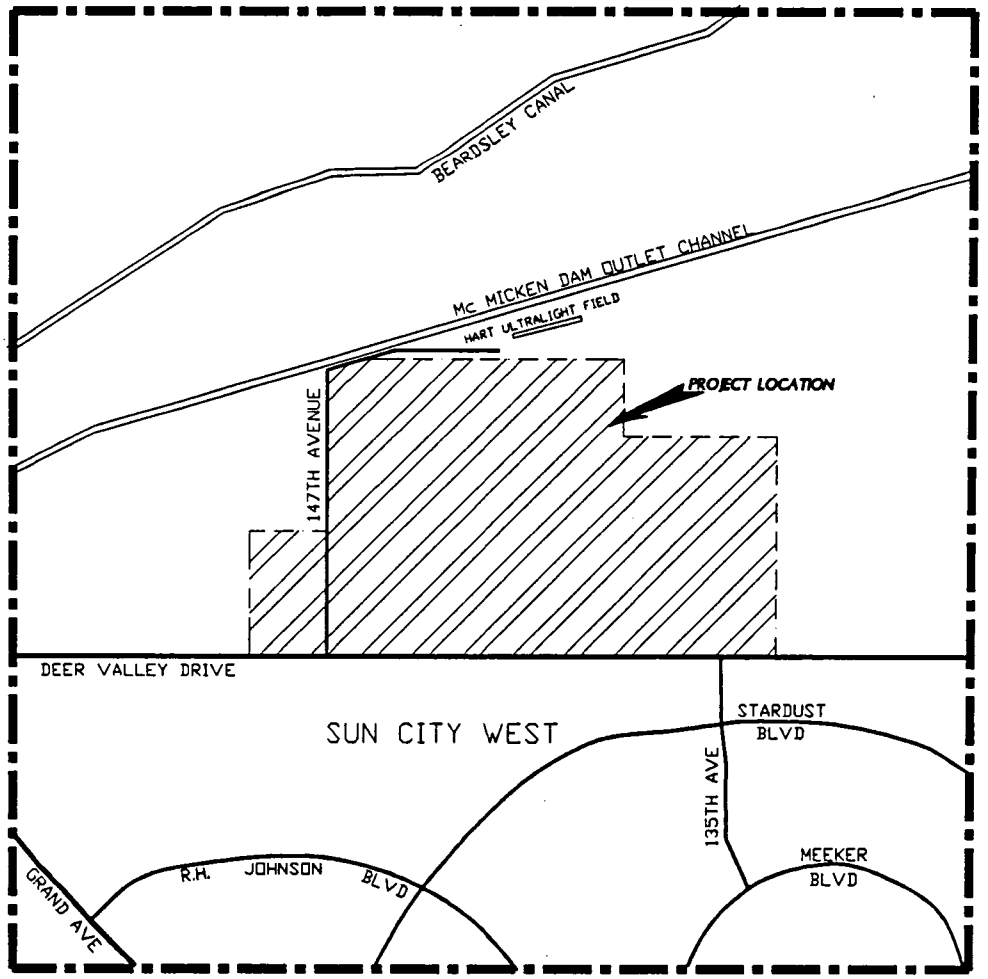
Environmental Property Evaluation

Del Webb Development Company

Sun City West Expansion

Vicinity Map

Figure 1



LEGEND:

- ▲ UST LOCATION
- ▼ LEAKING UST LOCATION
- ⊖ AZ CERCLA SITE
- ⧗ RCRA NOTIFIER LOCATION
- ⋈ RCRA COMPLIANCE LOCATION

• NONE OF THESE SITES WERE FOUND WITHIN 1/2 MILE RADIUS OF THE PROJECT

N

NOT TO SCALE

JOB NO. 7111K031

REVIEWED	F. COSTELLO
PREPARED	M. ENTERLINE

WESTERN TECHNOLOGIES INC.
The Quality People

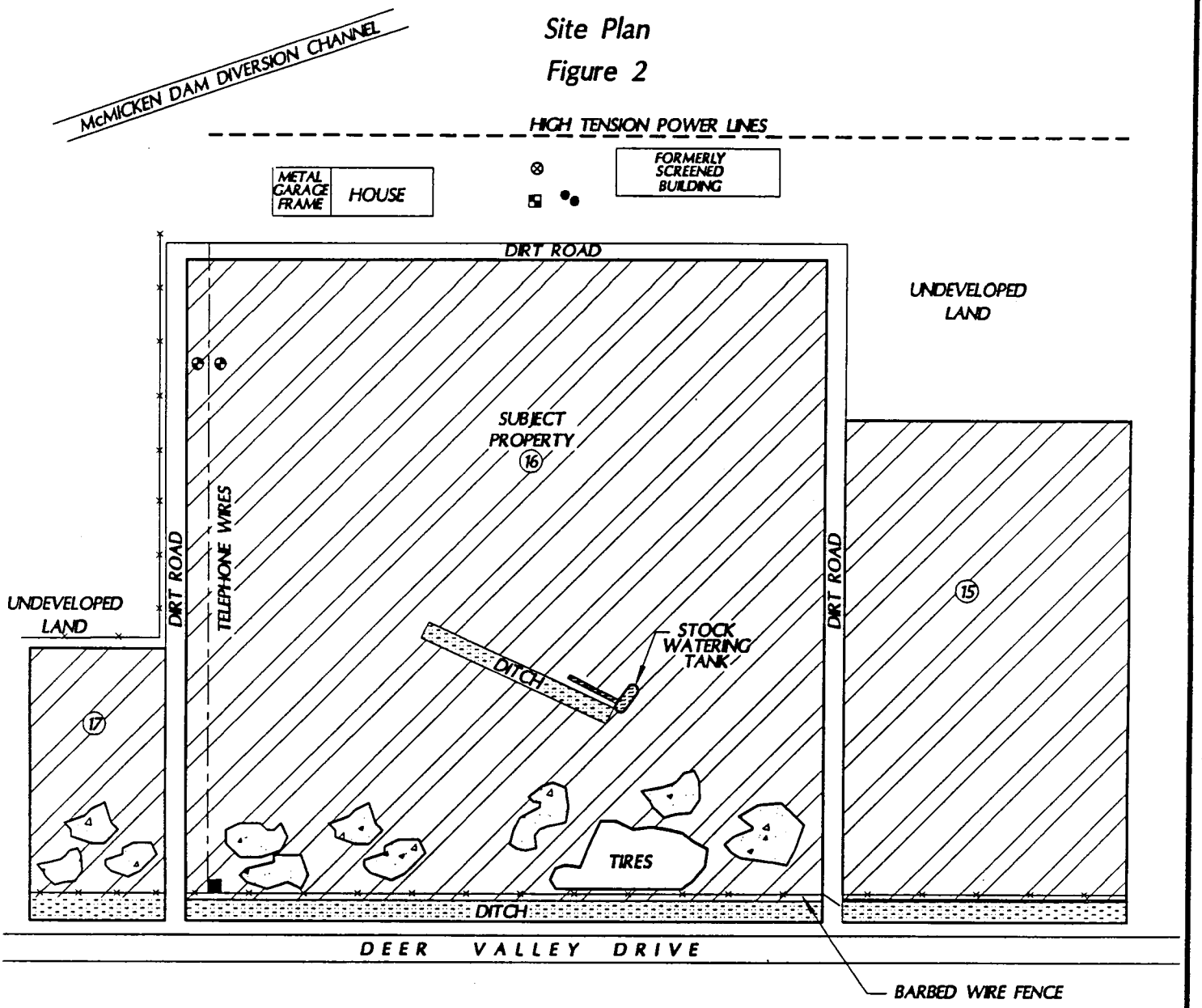
Environmental Property Evaluation

Del Webb Development Company

Sun City West Expansion

Site Plan

Figure 2



LEGEND:

- (15) SECTION NUMBER
- ⊗ WELL
- ■ CAPACITOR BANK
- PAD-MOUNTED TRANSFORMER
- POLE-MOUNTED TRANSFORMER
- BROKEN PVC PIPE
- ● 55 GALLON STEEL TRASH DRUMS
- DOMESTIC DUMPING AND CONSTRUCTION DEBRIS

N

NOT TO SCALE

JOB NO. 7111K031

REVIEWED	F. COSTELLO
PREPARED	K. EPPLEY

WESTERN TECHNOLOGIES INC.
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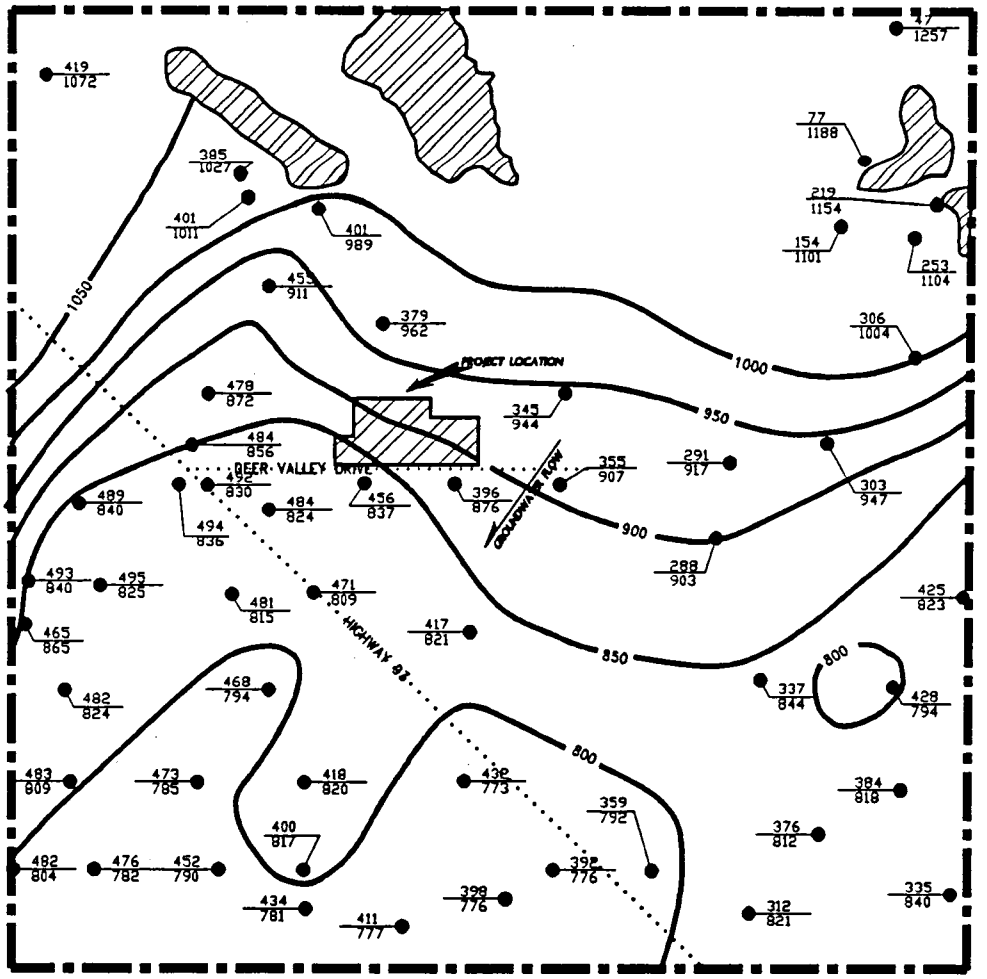
Environmental Property Evaluation

Del Webb Development Company

Sun City West Expansion

Groundwater Depth & Flow Direction Diagram

Figure 3



LEGEND:

198/924 — *WELL FIELD CHECKED IN 1982—First number, 198, is depth to water in feet below land surface. Second number, 924, is the altitude of the water level in feet above mean sea level.*

1050 — *WATER LEVEL CONTOUR—Shows altitude of the water level. Contour interval 50 feet. Datum is mean sea level.*

**Map borrowed from Arizona Department of Water Resources—D.W.R. Hydrologic Map Series Report No. 12, Sheet 1 of 3.*

N

NOT TO SCALE

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PREPARED	M. ENTERLINE

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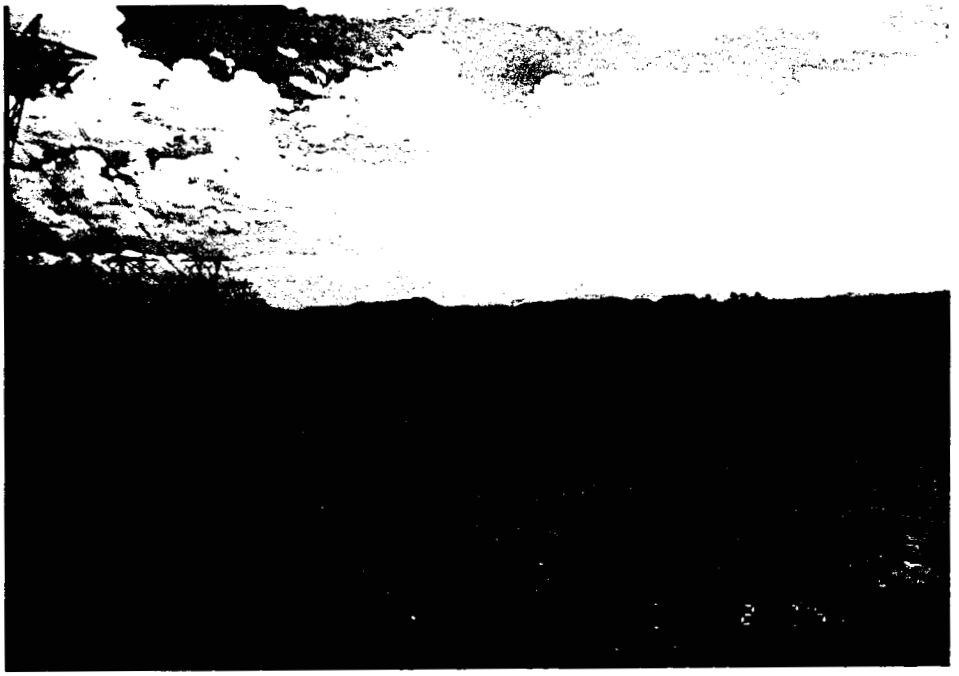
APPENDIX B

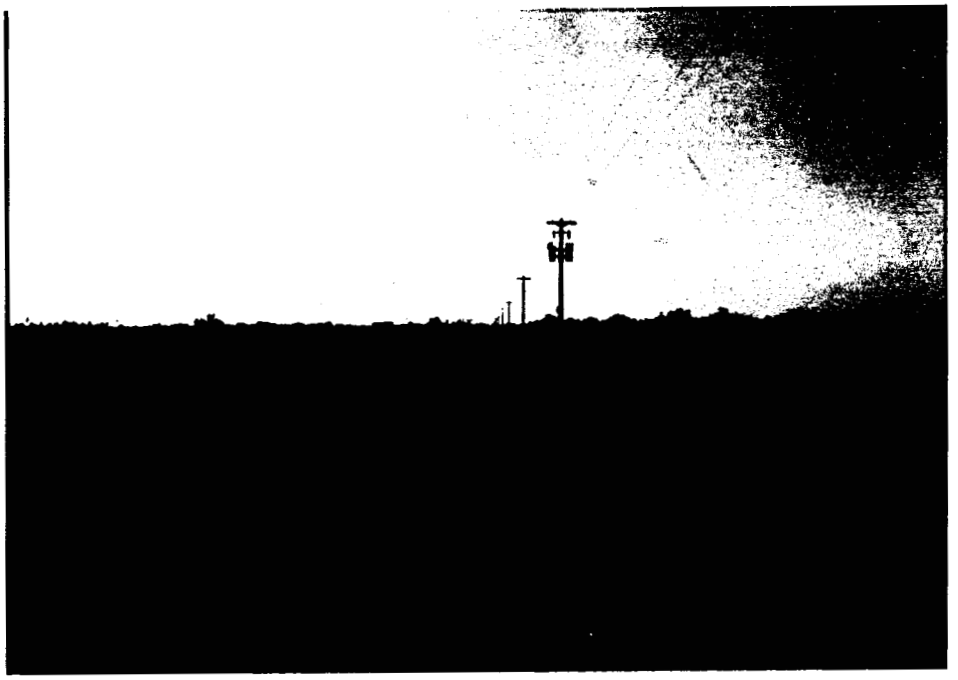
Del E. Webb Development
WT Job No. 7111K031

Photograph No. 1
View of Northern Boundary of Section 15 Facing East

Photograph No. 2
View of Southern Boundary of Section 15 Facing East

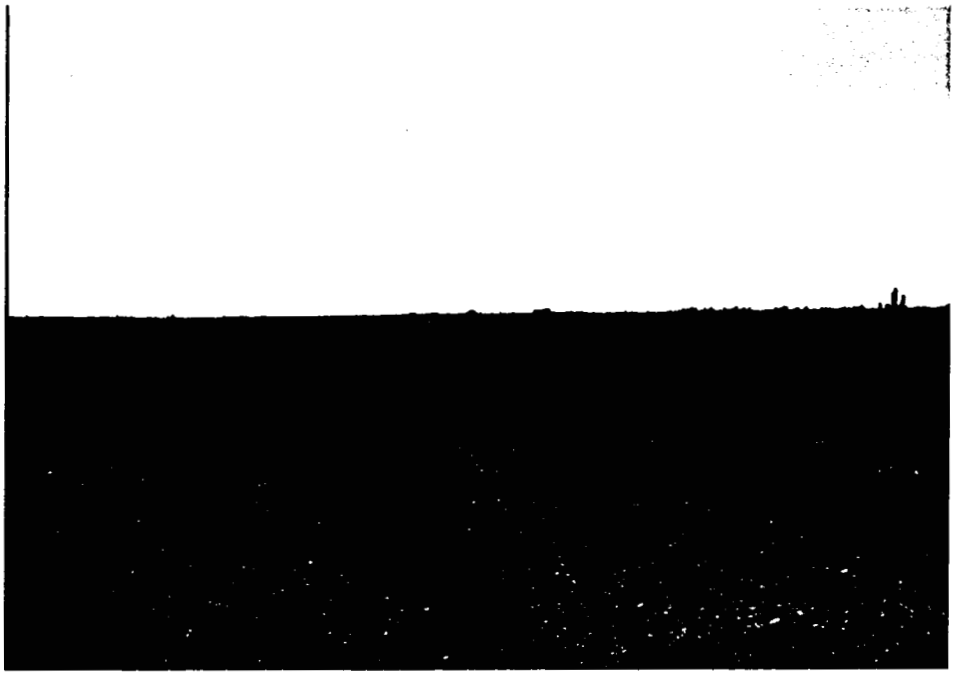


Photograph No. 3
View of Northern Boundary of Section 16 Facing East



Photograph No. 4
View of Western Boundary of Section 16 Facing South

Del E. Webb Development
WT Job No. 7111K031



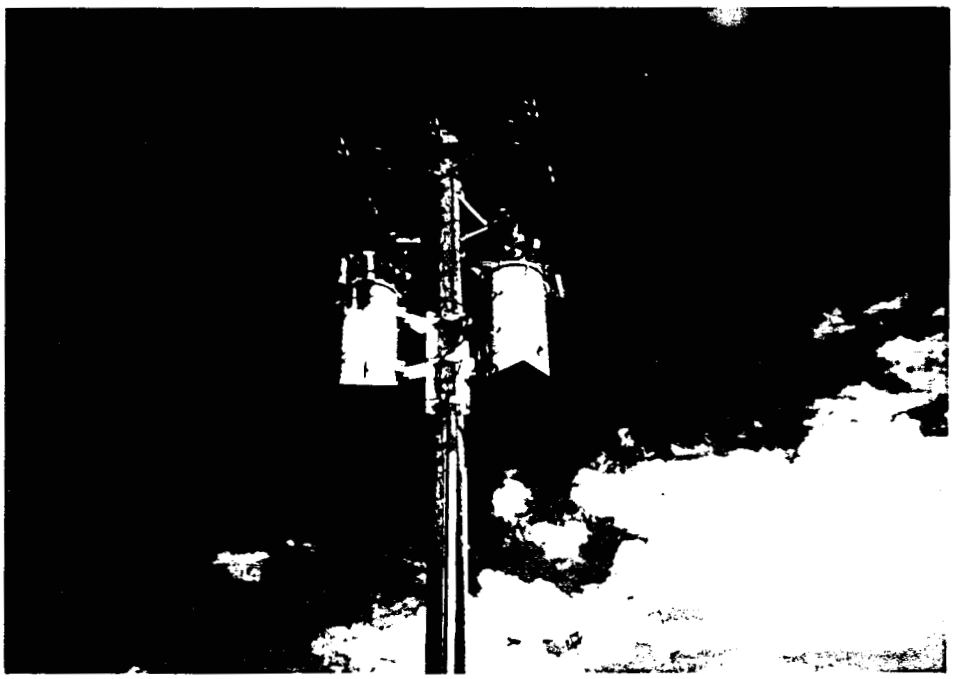
Photograph No. 5
View of Eastern Boundary of Section 16 Facing South

Photograph No. 6
View of Southern Boundary of Section 16 Facing East

Photograph No. 7
View of Northern Boundary of Section 17 Facing West

Photograph No. 8
Typical Construction Debris on Southern Portions of Sections 16 and 17 of the Subject Property

Photograph No. 9
Concrete Stock Watering Tank on Southeast Portion
Section 16 of the Subject Property



Photograph No. 10
Two Overhead, Pole-Mounted APS Transformers
Located Outside Southwest Boundary of Section 16

Preliminary Geotechnical and Geological Engineering Exploration
Sun City West Expansion
Section 16, Township 4 North, Range 1 West
Maricopa County, Arizona
prepared for
Del E. Webb Development Company
Job No. 2120K206

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Del E. Webb Development Company
13950 Meeker Boulevard
Sun City West, Arizona 85375

January 17, 1991

Attn: Mr. Tim Goodrich

Re: **Preliminary Geotechnical and Geological Engineering Exploration**
Sun City West Expansion
Section 16, Township 4 North, Range 1 West
Maricopa County, Arizona

Job No. 2120K206
Inv. No. 21200434

Western Technologies Inc. has completed the preliminary geotechnical and geological engineering exploration for the proposed Sun City West Expansion encompassing Section 16, Township 4 North, Range 1 West in Maricopa County, Arizona. This study was requested and authorized by Mr. Dick Maston, and was performed in general accordance with our proposal number 21290A255 dated November 29, 1990.

The results of our study, including the boring location diagram, laboratory test results, test boring records, and the geotechnical recommendations needed to aid in the design and construction of foundations and other earth connected phases of this project are attached.

A supplementary geotechnical engineering exploration program should be performed at the site on an individual subdivision basis when final design plans become available and preliminary design studies are complete. Supplemental geotechnical explorations will be used to confirm or modify the recommendations contained in this preliminary report.

We have appreciated being of service to you in the subsurface exploration phase of this project and are prepared to assist you

during the construction phases as well. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us.

Sincerely,

WESTERN TECHNOLOGIES INC.
Geotechnical Engineering Services

Michael E. Anderson, E.I.T.
Project Engineer

Reviewed by: Donald R. Clark, P.E.
Director

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
DONALD R. CLARK
Date Signed 1-18-91
ARIZONA, U.S.A.

epm/9811G

Copies to: Addressee (10)

Del E. Webb Development Company
Job No. 2120K206

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Preliminary Geotechnical and
Geological Engineering Exploration
Sun City West Expansion
Section 16, Township 4 North, Range 1 West
Maricopa County, Arizona
January 17, 1991

INTRODUCTION

This report contains the results of our preliminary geotechnical and geological engineering exploration for the proposed Sun City West Expansion, encompassing Section 16, Township 4 North, Range 1 West in Maricopa County, Arizona. The purpose of these services is to provide information and general recommendations regarding:

- general surface and subsurface soil and groundwater conditions;
- regional and site geologic conditions;
- general site grading procedures and excavation of subsurface materials;
- drainage;
- preliminary pavement recommendations; and
- preliminary foundation design criteria;

PROPOSED CONSTRUCTION

Project information is preliminary at this time, however, we understand that the project will consist of the development of Section 16, Township 4 North, Range 1 West in Maricopa County, Arizona. We assume that the site will be a planned unit development, incorporating residential, commercial, and public land uses. The master plan will be developed in accordance with the subdivision regulations of Maricopa County.

Based upon our previous experience with development within Sun City West, we anticipate that the proposed residential structures will

be single-story structures, with wood framed superstructures supported on reinforced concrete foundation systems. The floors will be concrete slabs-on-grade. Wall and column loads are anticipated to be on the order of 1/2 to 1 kip per lineal foot (klf) and 1 to 2 kips, respectively.

The proposed commercial structures are anticipated to be one to two-story, slab-on-grade structures utilizing wood frame or masonry wall construction. Wall and column loads are assumed to be on the order of 3 to 6 klf and 20 to 40 kips, respectively.

Grading plans for the project have not been developed. However, because of limited site relief, we anticipate only slight modifications in existing grades during grading operations. Therefore, we anticipate that finished grade for both residential and commercial structures will be at or near existing grade.

SITE CONDITIONS

At the time of our exploration, the project site was located within an undeveloped section of land. The project site was bounded on the north, east, and west by undeveloped parcels of land. The McMicken Dam outlet channel is located directly adjacent to the project site at the northwest corner. High tension power lines and three abandoned structures were located adjacent to, and north of the project site. The abandoned structures consisted of a single-story structure, a steel framed structure utilized for storage, and a sun screened structure. An abandoned vehicle was located within the steel framed structure. In addition, a water storage tank and well were located east of the single-story structure. Deer Valley Drive borders the project site on the south.

The ground surface of the site is relatively flat with a maximum elevation difference of approximately 20 to 25 feet across the entire section. Site drainage was generally to the south and southeast. Five main natural drainage systems were observed on the project, including the drainage directly north of, and running parallel to Deer Valley Drive. In addition, a small retention basin was observed in the south central portion of the project site and a cistern was observed in the southeastern portion of the site. At the time of our observations, the retention basin contained water; however, all natural drainages were dry. In addition, various small washes existed across the project site.

Vegetation on the site consists of a sparse to moderate growth of native vegetation comprised of creosote bush, cacti, bursage and some scattered mesquite and Palo Verde trees. Vegetation was moderate to heavy along the drainages and retention basin.

Small uncontrolled piles of scattered domestic trash and construction debris were observed throughout the property. The majority of the domestic trash and construction debris were located on the southern boundary of the property and near drainages. The debris and trash consisted of old appliances, tires, bricks, automobile and truck parts, metal scraps, furniture, concrete and paper products. A large number of tires were stockpiled along the fence, south of the retention basin. Two abandoned vehicle bodies were observed on the project site. One vehicle was located directly northeast of the retention basin and the other was located southeast of the tire stockpile, north of the drainage along Deer Valley Drive.

SCOPE OF SERVICES

Twenty-five soil test borings were drilled to depths of approximately 15 to 20 feet below existing ground surface at the

locations shown on the site plan. The soil test borings were spaced approximately 1000 feet on center. During exploration, subsoils were examined visually and sampled at selected intervals. In addition, groundwater conditions were evaluated. Furthermore, local and regional geologic characteristics were evaluated and used to estimate seismic design criteria.

The following laboratory tests were performed on selected soil samples obtained during the field exploration:

- Water content
- Dry density
- Compression
- Expansion
- Gradation
- Plasticity

Laboratory test results were used in the development of foundation and earthwork recommendations contained in this report.

This report has been prepared for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. As we understand, a Phase I Environmental Audit for the subject property has been performed by Malcolm Pirnie, Inc., Project No. 1525-01-1, dated April 1990.

INTERPRETATION OF SUBSURFACE CONDITIONS

Regional Geology: Based on the review of geologic maps and literature, the project site is part of the Basin and Range physiographic province, which includes most of Arizona, south of the Mogollon Rim. Elongated basins and long, narrow mountain ranges characterize the terrain of this province. The elongated basins and long narrow mountain ranges are a result of normal block faulting (horst and graben structures) in a northwesterly-southeasterly direction. The upthrown blocks resulted in the formation of mountain ranges and the downthrown blocks resulted in the formation of basins. Faulting occurred about 18 million years ago during the late Tertiary Period. Volcanism was also active in the area from the late Tertiary Period to early Quaternary Period.

Site Geology: Based upon the review of Arizona Bureau of Mines Geologic Maps, alluvial deposits comprise the geology of the site. These deposits are primarily comprised of channel, flood plain, and alluvial fan. The alluvial deposits are quaternary in age and consist of sand, gravel, and conglomerate with mixtures of silt and clay. The source for these deposits are probably the Hieroglyphic Mountains located north of the project site. The Hieroglyphic Mountains are composed primarily of extrusive and intrusive igneous and metamorphic rocks. The thickness of these deposits are estimated to be greater than 1200 feet.

Geologic Hazards: Based upon our on-site observations and review of geologic maps, there are no geologic hazards that would preclude the development of the subject parcel. The project site is relatively flat which precludes the existence or potential of any rockfall or landslide hazards. In addition, no evidence of past or present faulting was observed during our field exploration and literature review.

Based on the review of U.S. Geologic Survey Maps, the project site is located approximately 1.5 miles northeast of a zone of earth fissuring created by groundwater depletion. However, the risk of future earth fissuring due to groundwater depletion for the project site is estimated to be very low. Furthermore, no evidence of earth fissuring was observed during our field exploration.

Based upon the review of U.S.D.A. Soil Conservation Survey Maps, the erosion potential of the soils on the project site are predominantly in the low category due to the existing topography. Erosion is expected to be higher along drainages and washes. Erosion potential is expected to increase temporarily during development. However, construction recommendations as presented in this report should decrease erosion potential to be pre-construction rates.

Exploration: As presented on Logs of Borings, surface soils to depths of approximately 2 to 14 feet below existing ground surface generally consist of sandy clays (CL) to clayey sands (SC). The sandy clays are very stiff to hard in consistency and are low to moderate in plasticity. The clayey sands are medium dense to dense in relative density and are low in plasticity.

The materials underlying the surface soils in the majority of the test borings and extending to the full depth of exploration, consisted of gravelly sands (SP-SC) to sandy gravels (GP-GC) with sandy clay and clayey sand strata encountered in some test borings. The gravelly sands (SP-SC) and sandy gravels (GP-GC) were not encountered underlying the surface soils in test borings 2, 5, 6, 8, 9, and 12 to the maximum depths of exploration. The gravelly sands to sandy gravels are medium dense to very dense in relative density and are low in plasticity. The sandy clays are very stiff to hard in consistency and are expected to be low to moderate in plasticity. The clayey sands are medium dense to dense in relative density and are expected to be low in plasticity.

Light to heavy calcite cementation was encountered in the subsurface soils at various depths during the exploration. However, all test borings were drilled to planned depths without refusal to auger drilling.

Groundwater: Groundwater was not encountered in any test borings at the time of exploration. These observations represent the groundwater conditions at the time of measurements and may not be indicative of other times. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

Based on the review of water well data by the Arizona Department of Water Resources and U.S. Geological Survey Maps, the depth to groundwater on the project site is expected to be on the order of 400 to 450 feet beneath the surface.

Testing: Laboratory classification testing of the near surface soils confirm that these soils generally consist of very sandy clays and clayey sands. These materials are either non-plastic or have only very low plasticity.

Compression testing of relatively undisturbed native soil samples at shallow foundation depth indicate that the majority of the soils are slightly compressible at existing water contents. For the majority of the samples tested, there is tendency for additional compression to occur when the water content is increased. However, most, if not all of the additional compression of the samples tested is believed to be attributable to sample disturbance since the field data indicated relatively high penetration resistance and laboratory testing indicates, for the most part, medium in-situ density. In one instance, very slight expansion occurred on a clay material when water content was increased.

Under remolded and recompacted conditions and saturation, the near surface soils exhibit slight to moderate tendency for expansion under light loading conditions. This expansion occurs on samples compacted to densities simulating compacted fill conditions at water contents below optimum moisture for compaction.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

General: It is anticipated that the tract will be developed into individual subdivisions or parcels for both residential and commercial construction. Major development activities which are anticipated in each subdivision or parcel will include:

- Overlot, or mass grading of each parcel
- Utility construction
- Roadway construction, including pavements
- Foundation and building construction

Accordingly, subsurface conditions have been analyzed to formulate recommendations for the major components of site development.

The preliminary recommendations presented in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the borings. A supplementary geotechnical engineering exploration should be performed at the site on an individual subdivision basis upon completion of initial design studies. Supplemental geotechnical explorations will be used to confirm or modify the recommendations contained in this preliminary report.

Earthwork:

- **Overlot Grading:** Construction of fill embankments across the site should consist of proper foundation preparation, constructing embankment benching when necessary, disposition of strippings, and proper fill placement and compaction.

  1. All organic, topsoil, soft surface soils, construction debris, and trash, beneath planned fill areas should be thoroughly stripped and removed prior to fill placement. All construction debris and trash should be removed from the project site and disposed of at a permitted landfill facility. Clean construction strippings can be stockpiled for future use in revegetating exposed slopes to minimize erosion potential. These materials are not to be used as structural fill material. However, these materials can be used in non-structural fill areas where the embankment fill sections do not exceed 5 feet in height.

  2. Cut slopes should be constructed no steeper than 2.5:1 to limit erosion, and to provide slope protection.

  3. After foundation areas have been cleared, the natural foundation soils should be scarified to a minimum depth of 6 inches, brought to the proper moisture content and then compacted to a minimum of 95 percent of Standard Proctor density as defined by ASTM D698. If soft or unstable soils are encountered, scarifying, drying and/or overexcavation and replacement with granular materials may be required.

  4. The compaction and moisture control of the soils will be dependent upon material types. Based on conditions encountered in the test borings, it appears that on-site

soils are generally suitable for use as fill. The specifications outlined in this report should also allow the use of shallow foundation systems placed on compacted structural fill material. Specifications for placement and compaction are outlined in the following sections of this report.

5. Particular attention should be paid to compaction of the exterior faces of slopes (i.e. slopes should be compacted to the minimum specification to the surface of the fill embankment.)

- **Embankment Erosion**: As previously outlined, the erosion potential of the site is expected to be low to moderate based on the site topography and the soils encountered. Based on available information and the subsurface materials, we recommend, as a minimum, that the exterior faces of all embankments adjacent to drainages be compacted to specifications outlined in the "Placement and Compaction" section of this report. When hydrologic studies have been completed, and information regarding flow rates and other hydrologic data have been determined, additional analyses may be required to provide recommendations for adequate protection of embankments. These recommendations may include the placement of rip-rap material along the embankment face, chemical treatment of embankment soils, placement of geotextile fabrics, and/or the placement of gabion structures. We are able to assist you in this matter if needed.

- **Subsurface Drainage**: Groundwater was not encountered in any boring to depths of approximately 15 to 20 feet below existing ground surface, at the time of our exploration. In addition, based upon review of geologic maps and water well

data, groundwater levels are expected to be at a depth greater than 400 feet beneath the site. Therefore, we do not believe that specialized subsurface drain systems will be required.

However, due to the proposed development and the nature of the clay subsurface materials, "perched" groundwater conditions may be created in localized areas due to the introduction of irrigation within the development. The primary concern regarding "perched" water development would be its effects, through seepage, on planned cuts and fill embankments. However, based on the minor cuts and fills anticipated, it is unlikely that subsurface drainage systems will be needed. We are able to discuss this matter with you upon the completion of final design plans.

- **Excavation**:

  1. We anticipate that excavations for the proposed development can be accomplished with conventional equipment. However, heavily cemented soils (if encountered) may require specialized excavation equipment.

  2. Where sloped excavations are used, we recommend that they conform to current OSHA Regulations.

- **Foundation Preparation**: Based upon available data, specialized treatment of existing soils within foundation areas is not required. However, any loose or disturbed soils encountered at foundation subgrade elevation should be removed or recompacted.

- **Interior Slab Preparation**:

  1. Interior slab preparation may include scarifying and compacting subgrade soils to a depth of approximately 8

inches. The subgrade preparation is to be accomplished in a manner which will result in uniform water contents and densities after compaction.

2. To minimize potential expansion of subgrade soils which will support interior slabs, the moisture content of recompacted materials should be maintained at a water content range of one percent below to three percent above optimum.

3. At least four inches of aggregate base course should be placed beneath interior slabs.

4. If moisture sensitive floor coverings are used on interior slabs, consideration should be given to the use of vapor barriers.

- **Pavement Preparation**: The subgrade should be scarified, moistened as required, and recompacted for a minimum depth of 12 inches prior to placement of fill and pavement materials.

- **Materials**:

1. Clean on-site soils placed at optimum moisture conditions or imported materials may be used as fill material for the following:

    - overlot grading
    - foundation areas
    - interior slab areas
    - pavement areas
    - backfill

2. If imported soils are used, they should conform to the following:

- Gradation (ASTM C136): percent finer by weight

6"	100
4"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	60 (max)

- Maximum expansive potential(%)* 1.5

- Maximum soluble sulfates(%) 0.10

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

3. Aggregate base should conform to Maricopa Association of Government (MAG) specifications.

- <u>Placement and Compaction</u>:

1. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

2. Uncompacted fill lifts should not exceed 10 inches.

3. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D698)
On-site soils, reworked and fill:	
Overlot grading	95
Below footings	95

Below slabs-on-grade	90
Below pavement	95
Imported fill:	
Overlot grading	95
Below footings	95
Below slabs-on-grade	90
Below pavement	95
Aggregate base	95
Miscellaneous backfill	90

4. On-site sand soils and imported soils should be compacted within a moisture range of 3 percent below to 3 percent above optimum. On-site clay soils should be compacted within a water content range of 1 percent below to 3 percent above optimum.

- **Compliance**: Recommendations for slabs-on-grade, foundations, pavement elements supported on compacted fills or prepared subgrade depend upon compliance with "Earthwork" recommendations. To assess compliance, observation and testing should be performed under the direction of the geotechnical engineer.

- **Ground Compaction and Shrinkage Factors**:

1. A change in the ground surface elevation of 1 to 2 inches can occur by compaction of the surface soils to a 12 inch depth and to an average density of 95 percent of the ASTM D698 maximum dry density. The following tabulation presents the relationship between depth of compacted on-site material, percent compaction, and approximate shrinkage of excavated on-site soils placed in compacted fills:

Excavated Depth Below Existing Grade (ft)	Percent Compaction in Fill (ASTM D698)	Estimated Shrinkage (%)
0 to 1	90	5-10
0 to 1	95	10-15
1 to 3	90	5
1 to 3	95	10

The estimated shrinkages consider only material densification and do not consider other effects such as transport, wind, overcompaction, or compaction of subsoils to greater depths.

- **Estimated Water Requirements**: Based upon laboratory tests, the on-site near surface soils exist at moisture contents generally below the estimated optimum moisture content for compaction. Consequently, moisture conditioning will be required to achieve compaction requirements. Preliminary moisture content testing of the subgrade soils indicates the following ranges and averages:

Soil Type	Moisture Content Range % Low	Moisture Content Range % High	Average Moisture Content%	Estimated Proctor Optimum Moisture Content %	Estimated Required Water Per Cubic Yard of fill (gal)*
Sandy clay (CL)	2.9	9.0	5.7	12.0	20
Clayey sand (SC)	1.9	4.9	3.4	10.0	23
Gravelly sand (SP-SC)	1.4	2.6	2.0	8.0	24

*Gallons of water per cubic yard of compacted fill required to achieve optimum moisture content from the average in-situ moisture content.

- **Grading and Slopes**: The following statements represent our opinion regarding specified grading and slopes:

- Maximum Slope: Cut or fill slopes should not be steeper than 2.5:1 (horizontal to vertical). This assumes proper slope protection and planting to limit erosion.

- Future Movement of Fill Areas: Fill areas constructed as specified should not experience movements that will produce any significant structural distress or impair the usefulness of the structures.

- Bearing Capacity of Fill Areas: The bearing capacity of fill areas constructed as specified will be adequate to support footings.

Drainage:

- Surface Drainage:

1. Positive drainage should be provided during construction and maintained throughout the life of the proposed development. Infiltration of water into utility or foundation excavations must be prevented during construction. Planters and other surface features which could retain water in areas adjacent to structures should be eliminated.

2. In areas where sidewalks or paving do not immediately adjoin the structures, we recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration.

- **Drainage Behind Walls**:

  1. If basements or retaining walls are constructed within the development, free-draining, granular soils containing less than five percent fines (by weight) passing a No. 200 sieve should be placed adjacent to the walls. A drainage system consisting of either weep holes or perforated drain lines (placed near the base of the wall) should be used to intercept and discharge water which would tend to saturate the backfill. Where used, drain lines should be embedded in a uniformly graded filter material and provided with adequate clean-outs for periodic maintenance. An impervious soil should be used in the upper layer of backfill to reduce the potential for water infiltration.

Pavement: Based on existing subgrade conditions, the following preliminary pavement sections are recommended:

		Pavement Section (inches)		
	Alternate	Asphaltic Concrete Pavement (inches)	Base Course (inches)	TOTAL
Residential streets (low traffic frequency)	1	3.0		3.0
	2	2.0	4.0	6.0
Collector streets (medium traffic frequency)	1	5.0		
	2	3.0	6.0	9.0

When overlot grading has been completed at the site, we should be contacted to conduct a final pavement evaluation in order to verify initial assumptions used in preparation of the preliminary pavement recommendations and to provide final pavement thicknesses and construction recommendations.

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphaltic concrete. Base course and asphaltic concrete should conform with MAG specifications.

Material and compaction requirements should conform to recommendations presented under "Earthwork." The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections. The native clayey subgrade soils will soften and lose stability if subjected to conditions which result in an increase in water content.

Foundations:

- **Residential Structures:** We recommend spread foundations bearing upon undisturbed subsoils, and/or engineered fill for the anticipated loading conditions. The footings may be designed for an allowable bearing pressure of 1500 pounds per square foot (psf). It is our understanding that anticipated typical foundation wall loads are less than 1000 pounds per lineal foot. Based upon these loads and typical shallow foundation construction within the Sun City West Development, the wall footings should be founded a minimum of 12 inches below finished exterior grade, and should be a minimum of 14 inches in width.

  Total or differential settlements resulting from the assumed loads are estimated to be less than 1/2 inch provided that:

  - foundations are constructed as we recommend, and
  - essentially no changes occur in water contents of foundation soils.

Additional foundation movements up to one inch could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction.

Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings. The design bearing capacities apply to dead loads plus design live load conditions. The design bearing capacity may be increased by one-third when considering total loads that include wind or seismic.

Thickened slab sections can be used to support interior partitions, provided that:

- loads do not exceed 900 plf,
- thickened sections have a minimum width of 12 inches, and
- thickness and reinforcement are consistent with structural requirements.

All footings and stem walls should be reinforced to reduce the potential for distress caused by differential foundation movements.

- <u>Commercial Structures</u> We recommend spread foundations bearing upon undisturbed subsoils, recompacted native soils, and/or engineered fill for the anticipated loading conditions. The following tabulation presents estimated depth intervals and respective allowable soil bearing capacities for preliminary foundation design analyses:

Estimated Depth Interval (ft)*	Bearing** Capacity (psf)	Bearing Material	Settlement Potential
0-2	1500-2000	Undisturbed Subsoils	low to moderate
0-2	2500-3000	Compacted Fill	low
2-4	2000-2500	Undisturbed Subsoils	low

*Below existing grade and at least 1.5 feet below finished grade.
**Design bearing capacities assume fulfillment of "Earthwork" Recommendations.

Seismic Considerations: The project site is located within Seismic Risk Zone 1 of the Seismic Zone Map of the United States as specified by the Uniform Building Code. Based upon the nature of the subsurface materials, we recommend using a seismic site coefficient, "s", of 1.2 for the design of structures within the development (Uniform Building Code, table no. 23-J).

Ancillary Features:

- **Exterior**:

  1. Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in backfill may experience some movement due to the volume change of the backfill. Potential movement could be reduced by:

     - minimizing moisture increases in the backfill
     - controlling moisture-density during placement of backfill
     - using designs which allow vertical movement between the exterior features and adjoining structural elements

- placing effective control joints on relatively close centers
- allowing vertical movements in utility connections

- **Corrosion**:

  1. We recommend Type II portland cement be used for all project concrete on, and below grade. The concrete should be designed in accordance with the ACI Design Manual (Section 318, Chapter 4.5).

  2. The soluble salts concentration of subsoils indicates low corrosive potential for underground metallic conduits, and only minor additional corrosion of buried conduits would be expected in areas where soils become moist. Special protection does not appear necessary for copper piping except where dissimilar metals are joined or placed in close proximity. Wrappings or protective coatings could be used to extend the life expectancy of galvanized or black steel piping.

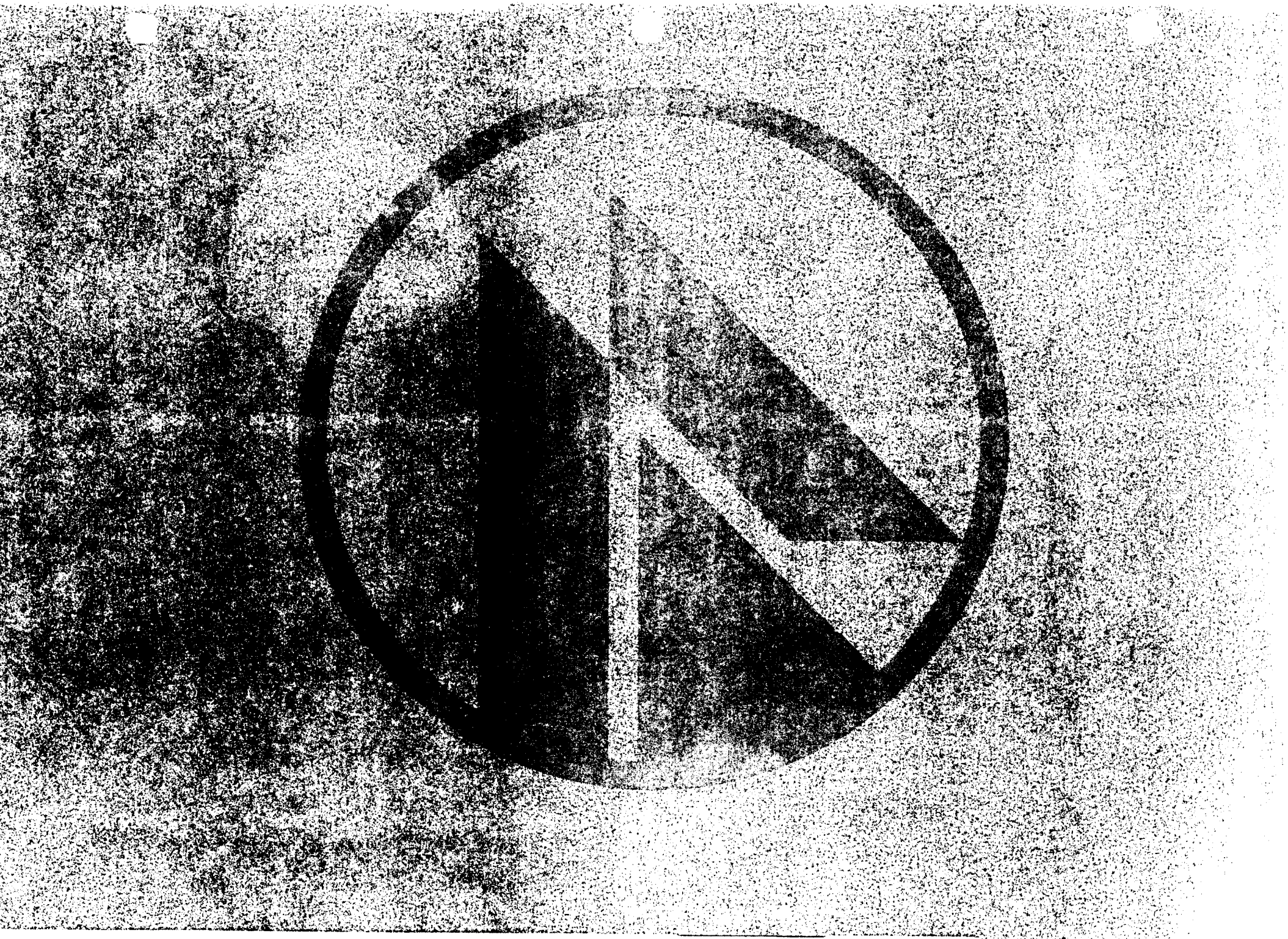
- **Underground Utility Systems**: All underground piping within or near the proposed structures should be designed with flexible couplings, so minor deviations in alignment do not result in breakage or distress. Utility knockouts in stem walls should be oversized to accommodate differential movements.

CLOSURE

Supplementary geotechnical engineering explorations should be conducted on an individual subdivision basis as final design plans become available. Our conclusions and recommendations are based on observation and testing of the earthwork and foundation preparation directed by a geotechnical engineer. Because of our familiarity

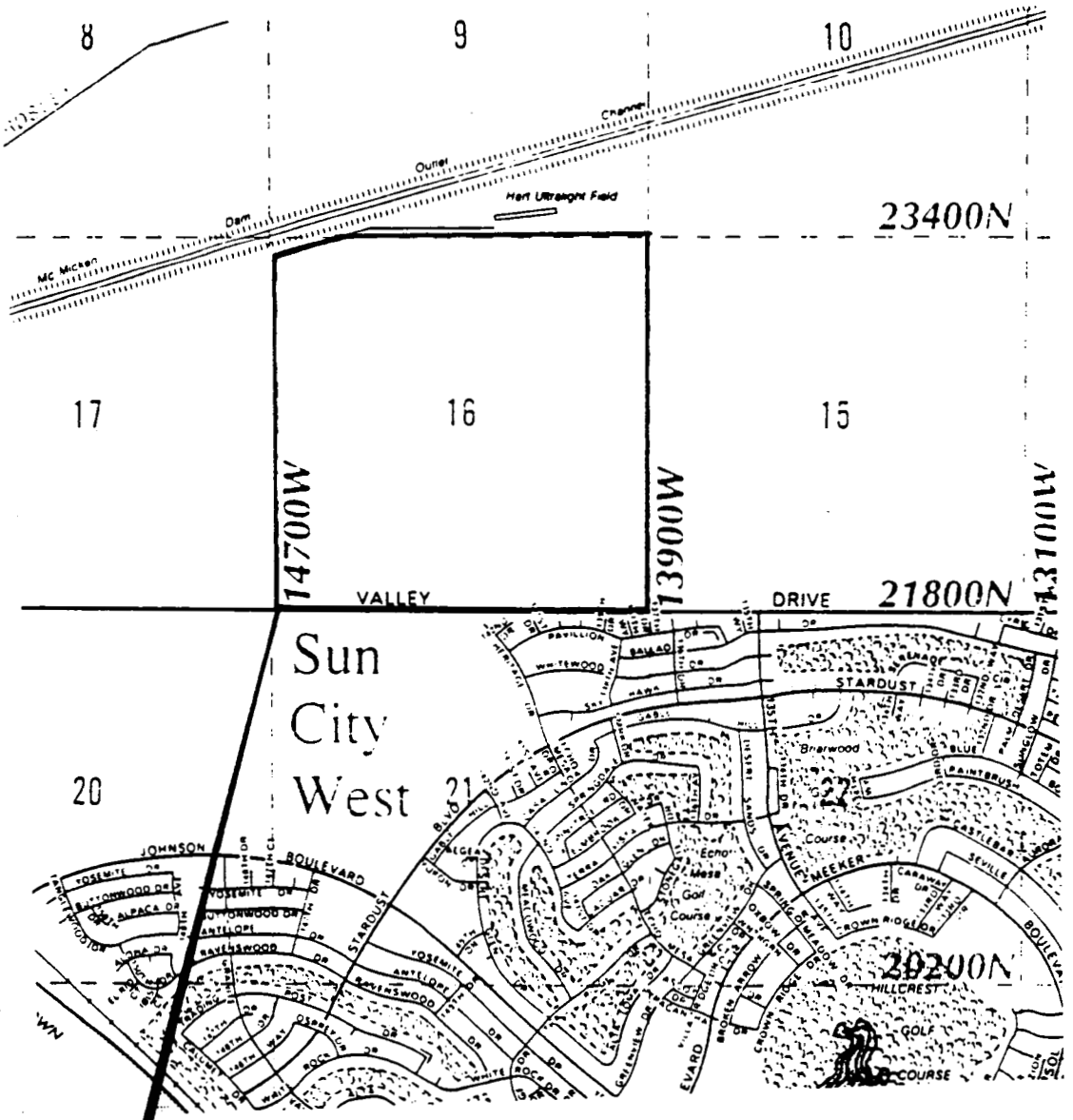
with the site, Western Technologies Inc. could provide these services efficiently and effectively.

If plans, specifications, or field applications deviate from our recommendations, we shall be relieved of responsibility unless our written concurrence has been obtained.



APPENDIX A

SUN CITY WEST EXPANSION
Section 16, Township 4 North, Range 1 West
Maricopa County, Arizona
Vicinity Map



Project Location

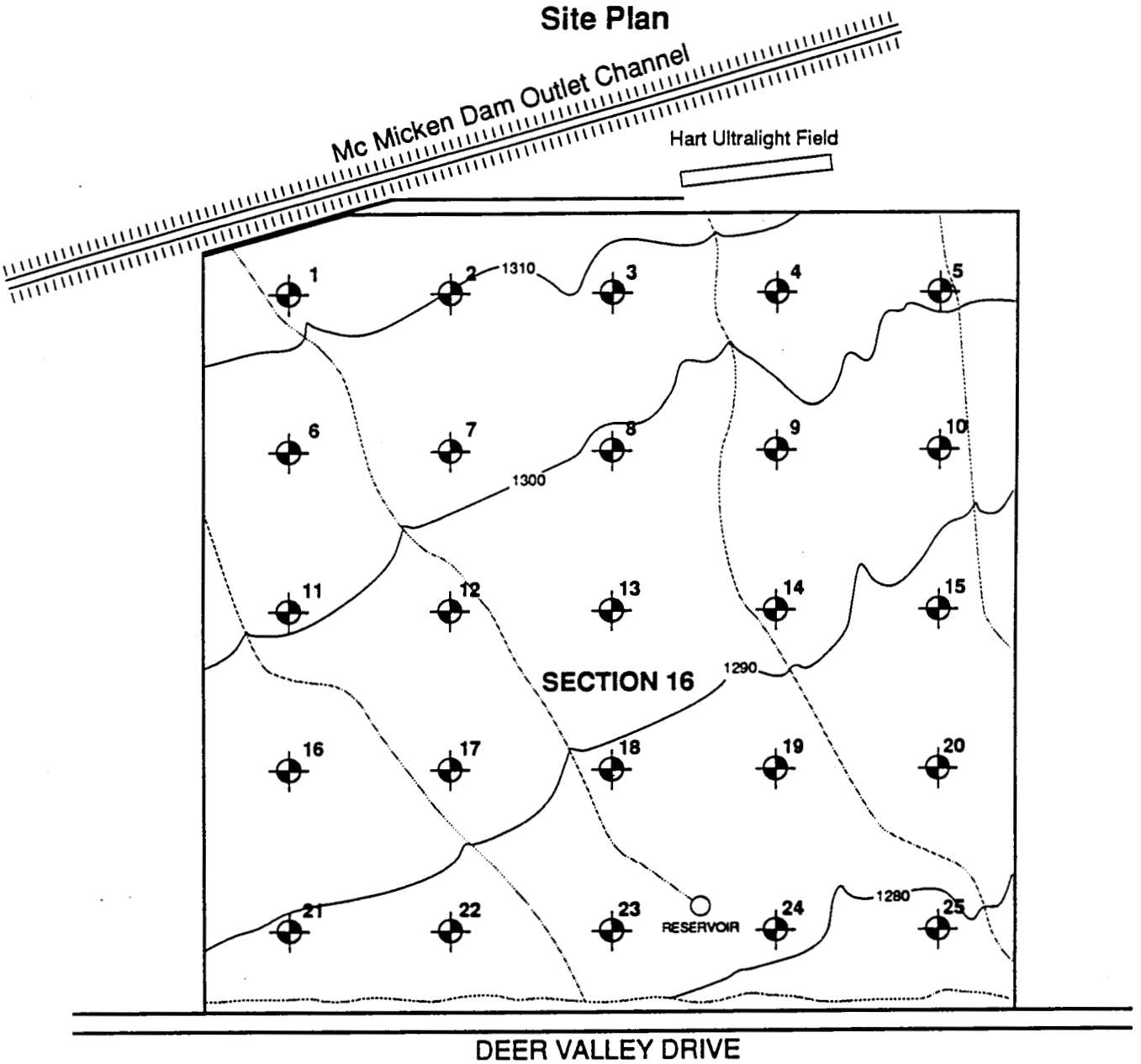
NOT TO SCALE

JOB NO. 2120K206

REVIEWED	S. NEELY, E.I.T.
PREPARED	R. Bowers

WESTERN TECHNOLOGIES INC.
The *Quality* People

SUN CITY WEST EXPANSION
Section 16, Township 4 North, Range 1 West
Maricopa County, Arizona
Site Plan



LEGEND

Location of Test Boring

Existing Drainage

Source: Calderwood Butte Quadrangle, 1974
U.S.G.S. Topographic Map

N

NOT TO SCALE

JOB NO. 2120K206

REVIEWED S. NEELY, E.I.T.	**WESTERN TECHNOLOGIES INC.**
PREPARED R. Bowers	**The *Quality* People**

DEFINITION OF TERMINOLOGY

Allowable Soil Bearing Capacity **Allowable Foundation Pressure**	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
Concrete Slabs-on-Grade	A concrete surface layer cast directly upon a base, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement.
Native Grade	The naturally occuring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand & Gravel Base	A base course of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.

METHOD OF SOIL CLASSIFICATION
(ASTM D 2487)

COARSE-GRAINED SOILS

LESS THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	
SM	SILTY SANDS, SAND-SILT MIXTURES, MORE THAN 12% FINES	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	

NOTE:
Coarse-grained soils receive dual symbols if they contain 5 to 12% fines (e.g. SW-SM, GP-GC, etc.)

FINE-GRAINED SOILS

MORE THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS Liquid limit less than 50
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
OL	ORGANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY	
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit more than 50
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
PT	PEAT, MUCK, AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

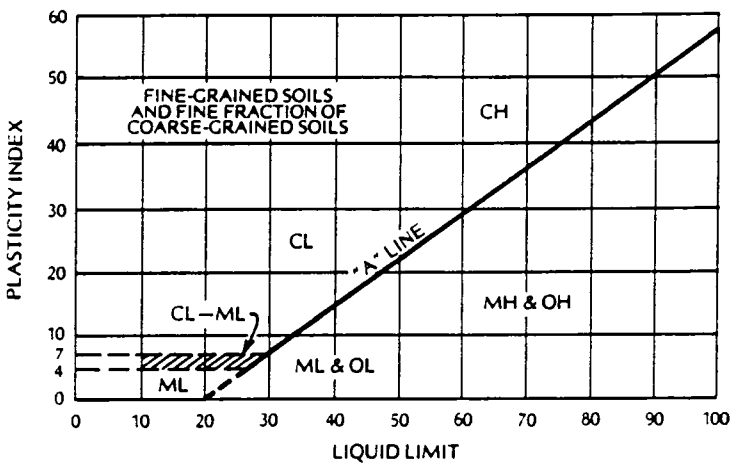
NOTE:
Fine-grained soils receive dual symbols if their limits plot in the hatched zone on the Plasticity Chart (CL—ML)

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 in.
COBBLES	3 in. to 12 in.
GRAVEL	No. 4 to 3 in.
Coarse	¾ in. to 3 in.
Fine	No. 4 to ¾ in.
SAND	No. 200 to No 4
Coarse	No. 10 to No. 4
Medium	No. 40 to No. 10
Fine	No. 200 to No. 40
*FINES (Silt or Clay)	BELOW No. 200

NOTE:
Only sizes smaller than three inches are used to classify soils.

PLASTICITY CHART



BORING LOG NOTES

The number shown in **"LOG OF BORING NO."** refers to the approximate location of the same number indicated on the "Site Plan" as positioned in the field by pacing from property lines and/or existing features.

"TYPE/SIZE BORING" refers to the exploratory equipment used in the boring wherein **HSA = hollow-stem auger**

"N" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a two-inch-outside-diameter split-barrel sampler a distance of 1 foot, Standard Penetration Test (ASTM D1586). Refusal to penetration is defined as more than 100 blows per foot.

"R" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a 2.42-inch-inside-diameter ring sampler a distance of 1 foot. Refusal to penetration is considered more than 50 blows per foot.

"Sample Type" refers to the form of sample recovery, in which **N = Split-barrel sample, R = Ring sample, G = Grab sample.**

"Dry Density, pcf" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol **"NR"** indicates that no sample was recovered. The symbol **"DU"** indicates that dry density was undetermined due to a disturbed sample.

"Water Content, %" refers to the laboratory-determined moisture content in percent (ASTM D2216).

"Unified Classification" refers to the soil type as defined by "Method of Soil Classification". The soils were classified visually in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

In general, terms and symbols on the boring logs conform with "Standard Definitions of Terms and Symbols Relating to Soil and Rock Mechanics" (ASTM D653).

Log of Boring Number 1

Project **Sun City West Expansion** | Job No. **2120K206**

Elevation **Not Determined** | Datum

Type/Size Boring **HSA/7"** | Rig Type **CME 45**

Groundwater Conditions **Not encountered** | Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
			G				CL	SANDY CLAY; with silt, light brown
1							SC	CLAYEY SAND; with gravel, brown
		50/9" DU	R					
		100/10"	N					
		50/4"	N					
10							SP	GRAVELLY SAND; light to moderate cementation, light brown
		50/5"	N					
20								**Boring Stopped**
30								

Log of Boring Number 2

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; some silt, light brown
		21	R		107	3.8		
		39	R		93	7.1		light to moderate cementation trace gravel
							SC	CLAYEY SAND; with gravel, light cementation, light brown
10		50/8" DU	R					
		50/3" NR	R					
								Boring Stopped
20								
30								

Log of Boring Number 3

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-17-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; trace gravel, reddish brown
		50/8"	R		123	3.3	GP	SANDY GRAVEL; orange brown
		78	N				CL	SANDY CLAY; trace gravel, moderate to heavy cementation,brown
10		62	N				CL-SC	SANDY CLAY/CLAYEY SAND;light cementation, brown
		50/7" NR	R				SC	CLAYEY SAND; with gravel, light brown
20								**Boring Stopped**
30								

Log of Boring Number 4

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-17-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL	SANDY CLAY; reddish brown
		50/8.5"	R					moderate cementation
		50/6" DU	R					
							GC	SANDY GRAVEL; with clay, orange brown
10		71	N				CL-SC	SANDY CLAY/CLAYEY SAND; light cementation, brown
		71	N					
								Boring Stopped
20								
30								

Log of Boring Number 5

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-26-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1		50/8" DU	G R				CL- SC	SANDY CLAY/CLAYEY SAND; with silt, reddish brown light to moderate cementation
		50/4"	N				SC	CLAYEY SAND; with gravel, light brown
10		90 89/9"	N N				CL- SC	SANDY CLAY/CLAYEY SAND; some gravel, moderate cementation, light brown
20								**Boring Stopped**
30								

Log of Boring Number 6

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; some silt, light brown
		22	R		124	1.9	SC	CLAYEY SAND; with gravel, some cobbles, light cementation, light brown
		22 NR	R					
								moderate cementation
		95/3"	N					
10								
		74	N					
								Boring Stopped
20								
30								

Log of Boring Number 7

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
			G				CL	SANDY CLAY; some silt, trace gravel, light brown
1								1
		50/11" DU	R				SC	CLAYEY SAND; with gravel, light cementation, light brown
		50/9" NR	R				GC	SANDY GRAVEL; with clay, some cobbles, light to moderate cementation, light brown
		88 NR	N					
10								10
		25/1"	N					
20								20
								Boring Stopped
30								30

Log of Boring Number 8

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-17-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1		50/8" DU	G, R				CL	SANDY CLAY; trace gravel, reddish brown
		50/8.5" DU	R				SC	CLAYEY SAND; some gravel, brown
10		55	N					light cementation
								2' lense of gravel
		86	N					
								Boring Stopped
20								
30								

Log of Boring Number 9

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-17-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL	SANDY CLAY; with silt, brown
		50/11"	R		104	6.1		some gravel, light cementation
		50/9"	R		99	5.8		moderate cementation
								no gravel, light to moderate cementation
		50/6"	R					
10								
		50/5"	R					
20								**Boring Stopped**
30								

Log of Boring Number 10

Project Sun City West Expansion

Job No. 2120K206

Elevation Not Determined

Datum

Type/Size Boring HSA/7"

Rig Type CME 45

Groundwater Conditions Not encountered

Date 12-26-90

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1		50/4" NR	G				SC	CLAYEY SAND; some silt, light brown with gravel, moderate cementation
			R					
		83	N					
							GC	SANDY GRAVEL; with clay, light brown
		49	N				SP	SAND; trace clay, light brown
10							CL	SANDY CLAY; moderate cementation, light brown
		82	N					
20								**Boring Stopped**
30								

Log of Boring Number 11

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1		31 DU	G / R			1.4	SC	CLAYEY SAND; with silt, light brown with gravel, light cementation
		50/10" NR	R				GC	SANDY GRAVEL; with clay, light brown
		50/4" NR	R					light to moderate cementation
10		104/10"	N					
20								**Boring Stopped**
30								

Log of Boring Number 12

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
			G				CL-SC	SANDY CLAY/CLAYEY SAND; some silt, lt brn
1							SC	CLAYEY SAND; with gravel, light cementation, light brown
		100/10"	N					
		50/1.5"	N					increasing gravels, some cobbles
		100	N					
10								
								Boring Stopped
20								
30								

Log of Boring Number 13

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-17-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				SC	CLAYEY SAND; some gravel, orange brown
		50/8"	R		92	7.2	CL	SANDY CLAY; moderate cementation, tan
		50/1" NR	R					
							SC	CLAYEY SAND; with gravel, light brown
10		50/5"	N					
		58	N				SP	GRAVELLY SAND; light brown
20								**Boring Stopped**
30								

Log of Boring Number 14

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-17-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL	SANDY CLAY; brown
		50/8.5"	R		102	9.0	SC	CLAYEY SAND; trace gravel, brown
		50/8" DU	R			2.6		
							GP	SANDY GRAVEL; orange brown
							SC	GRAVELLY SAND; with clay, brown
		50/6.5"	R					
10								light cementation
		50/11"	R					
							CL	SANDY CLAY; some silt, trace gravel, brown
20								**Boring Stopped**
30								

Log of Boring Number 15

Project Sun City West Expansion | Job No. 2120K206

Elevation Not Determined | Datum

Type/Size Boring HSA/7" | Rig Type CME 45

Groundwater Conditions Not encountered | Date 12-26-90

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				SC	CLAYEY SAND; some silt, trace gravel, brown
		49 DU	R					with gravel
		36	N					
								trace to some gravel
10		60	N					
		26	N					
								Boring Stopped
20								
30								

Log of Boring Number 16

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; some silt, light brown
		21	R		105	2.5		
								trace to some gravel
		42	R		103	4.6		
							SC	CLAYEY SAND; with gravel, light cementation, light brown
		50/5" NR	R					
10								
							GC	SANDY GRAVEL; with clay, light cementation, light brown
		50/6"	R					
								Boring Stopped
20								
30								

Log of Boring Number **17**

Project	**Sun City West Expansion**	Job No.	**2120K206**
Elevation	**Not Determined**	Datum	
Type/Size Boring	**HSA/7"**	Rig Type	**CME 45**
Groundwater Conditions	**Not encountered**	Date	**12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
			G				CL-SC	SANDY CLAY/CLAYEY SAND; some silt, lt brn
1								1
		13 NR	R				SC	CLAYEY SAND; with gravel, light cementation, light brown
		11	N				GC	SANDY GRAVEL; with clay, light brown
		35	N					
10								10
							SC	CLAYEY SAND; with gravel, light to moderate cementation, light brown
		92/9"	N					
								Boring Stopped
20								20
30								30

Log of Boring Number 18

Project Sun City West Expansion

Job No. 2120K206

Elevation Not Determined

Datum

Type/Size Boring HSA/7"

Rig Type CME 45

Groundwater Conditions Not encountered

Date 12-14-90

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; some silt, light brown
		22	R		94	5.7		
		50/9"	R		106	6.3		moderate cementation, trace to some gravel
10		50/4.5"	R					
		38	N				SP	GRAVELLY SAND; light cementation, light brown
20								**Boring Stopped**
30								

Log of Boring Number 19

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-26-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				SC	CLAYEY SAND; some silt, light brown
		50/8"	R				CL	SANDY CLAY; trace gravel, reddish brown
		50/7.5"	R				SC	CLAYEY SAND; trace to some gravel, light cementation, light brown
								with gravel
		50/5"	N					
10							GC	SANDY GRAVEL; with clay, light brown
		42	N				CL	SANDY CLAY; with silt, light brown
								Boring Stopped
20								
30								

Log of Boring Number **20**

Project **Sun City West Expansion** | Job No. **2120K206**

Elevation **Not Determined** | Datum

Type/Size Boring **HSA/7"** | Rig Type **CME 45**

Groundwater Conditions **Not encountered** | Date **12-26-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
			G				CL-SC	SANDY CLAY/CLAYEY SAND; light brown
1							SC	GRAVELLY SAND; with clay, light to moderate cementation, light brown
		50/5"	R					
		50/5"	N					
							GC	SANDY GRAVEL; with clay, light brown
		79	N				SC	CLAYEY SAND; trace to some gravel, moderate cementation, light brown
10								
		90/9"	N					
20								**Boring Stopped**
30								

Log of Boring Number 21

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL	SANDY CLAY; some silt, light brown
		23	R		109	2.9		trace to some gravel
								light cementation
		26	R		104	4.9		
							SC	GRAVELLY SAND; with clay, some cobbles, light cementation, brown
		30 NR	R					
10								
								more gravel
		50/4"	R					
20								
								Boring Stopped
30								

Log of Boring Number **22**

Project **Sun City West Expansion** | Job No. **2120K206**

Elevation **Not Determined** | Datum

Type/Size Boring **HSA/7"** | Rig Type **CME 45**

Groundwater Conditions **Not encountered** | Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL	SANDY CLAY; some gravel, some silt, light brown
		22 DU	R				SC	GRAVELLY SAND; with clay, light cementation, light brown
		32 DU	R				GC	SANDY GRAVEL; with clay, light cementation, light brown
								moderate cementation
		50/5"	N					
10								
		50/3.5" NR	N					
								some cobble
								Boring Stopped
20								
30								

Log of Boring Number 23

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-14-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; trace gravel, some silt, light brown
		50/9"	R		99	4.5	SC	GRAVELLY SAND; with clay, light cementation, light brown
		50/10"	R		99	4.9		
10		84	N					light to moderate cementation
		50/4"	N					
								Boring Stopped
20								
30								

Log of Boring Number 24

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-26-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL	SANDY CLAY; trace gravel, some silt, light brown
		50/8"	R				SC	CLAYEY SAND; trace to some gravel, light to moderate cementation, light brown
		50/8"	R					
							GC	SANDY GRAVEL; with clay, some silt, light brown
10		50/5"	N					
							SC	GRAVELLY SAND; with clay, light brown
		54	N					more gravel
20								**Boring Stopped**
30								

Log of Boring Number **25**

Project **Sun City West Expansion** Job No. **2120K206**

Elevation **Not Determined** Datum

Type/Size Boring **HSA/7"** Rig Type **CME 45**

Groundwater Conditions **Not encountered** Date **12-26-90**

WESTERN TECHNOLOGIES INC. - Phoenix Division

Depth (ft)	Blows / Foot C	Blows / Foot N/R	Sample Type	Graphic	Dry Density (pcf)	Moisture Content (%)	Unified Soil Class	Soil Description
1			G				CL-SC	SANDY CLAY/CLAYEY SAND; trace gravel, light cementation, light brown
		50/9"	R		102	6.1		
		48	R		100	4.2		
							SC	GRAVELLY SAND; with clay, light brown
10		27	N				CL	SANDY CLAY; light brown
		50/8"	R				SP	SAND; trace clay, light brown
								Boring Stopped
20								
30								

SOIL PROPERTIES

Job No. 2120K206

Boring No.	Depth, ft	Soil Class.	Soil Property: Initial Dry Density pcf	Soil Property: Initial Water Content, %	Compression/Consolidation: Surcharge KSF	Compression/Consolidation: Total Comp. %	Compression/Consolidation: Void Ratio	Expansion: Surcharge KSF	Expansion: Expansion %	Expansion: Max. Swell Pressure KSF	Shear Strength: Test Method	Shear Strength: C KSF	Shear Strength: ø Deg.	Water Soluble Matter: Salts MMHOS/CM	Water Soluble Matter: Sulfates PPM	Remarks
2	0-2	CL												1.3	13	5
2	0-2	CL	104	9.5				0.1	3.4							1,3,5
2	4-5	CL	106	7.1	0.56	0.2										4,5
					0.56	1.1										3
					1.10	1.5										3
					2.22	3.1										3
6	2-3	SC	124	1.9	0.56	0.1										4,5
					1.10	0.4										
					2.22	0.7										
					2.22	2.6										3
9	0-2	CL	103	8.5				0.1	1.4							1,3,5
9	4-5	CL	101	5.8	0.56	0.4										4,5
					1.10	0.7										
					2.22	1.3										
					2.22	6.6										3
					4.42	9.5										3

Boring No.	Depth, ft	Comments

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press.
- CU Consolidated Undrained
- CD Consolidated Drained

REMARKS
1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum).
2. Compacted density (approx. 95% of ASTM D1557 max. density at moisture content slightly below optimum).
3. Submerged to approximate saturation.
4. Dry density determined from one ring of a multiring sample.
5. Visual Classification

SOIL PROPERTIES

Job No. 2120K206

Boring No.	Depth, ft	Soil Class.	Soil Property: Initial Dry Density pcf	Soil Property: Initial Water Content, %	Compression/Consolidation: Surcharge KSF	Compression/Consolidation: Total Comp. %	Compression/Consolidation: Void Ratio	Expansion: Surcharge KSF	Expansion: Expansion %	Expansion: Max. Swell Pressure KSF	Shear Strength: Test Method	Shear Strength: C KSF	Shear Strength: ø Deg.	Water Soluble Matter: Salts MMHOS/CM	Water Soluble Matter: Sulfates PPM	Remarks
13	2-3	CL	92	7.2	0.56	0.6										4,5
					1.10	1.3										
					2.22	1.5										
					2.22	6.7										3
14	0-2	CL												3	83	5
16	0-2	CL-SC	104	8.7				0.1	2.8							1,3,5
	4-5	CL-SC	106	4.6	0.56	0.3										4,5
					1.10	1.0										
					2.22	1.5										
					2.22	5.1										3
18	2-3	CL-SC	102	5.7	0.56	0.4										4,5
					1.10	1.0										
					2.22	1.8										
					2.22	9.7										3

Boring No.	Depth, ft	Comments

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press
- CU Consolidated Undrained
- CD Consolidated Drained

REMARKS
1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum).
2. Compacted density (approx. 95% of ASTM D1557 max. density at moisture content slightly below optimum)
3. Submerged to approximate saturation.
4. Dry density determined from one ring of a multiring sample.
5. Visual Classification

SOIL PROPERTIES

Job No. 2120K206

Boring No.	Depth, ft	Soil Class.	Soil Property		Compression/Consolidation			Expansion			Shear Strength			Water Soluble Matter		Remarks
			Initial Dry Density pcf	Initial Water Content, %	Surcharge KSF	Total Comp. %	Void Ratio	Surcharge KSF	Expansion %	Max Swell Pressure KSF	Test Method	C KSF	ø Deg.	Salts MMHOS/CM	Sulfates PPM	
21	2-3	CL	111	2.9	0.56	0.6										4,5
					1.10	1.2										
					2.22	2.1										
					2.22	5.2										3
					4.42	6.6										3
22	0-2	CL												1.3	18	5
24	0-2	CL	102	9.2				0.1	1.1							1,3,5
25	4-5	CL-SC	105	4.2	0.56	0.5										4,5
					0.56	+0.7										3
					1.10	0										3
					2.22	1.9										3

Boring No.	Depth, ft	Comments

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press.
- CU Consolidated Undrained
- CD Consolidated Drained

REMARKS
1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum).
2. Compacted density (approx. 95% of ASTM D1557 max. density at moisture content slightly below optimum).
3. Submerged to approximate saturation.
4. Dry density determined from one ring of a multiring sample.
5. Visual Classification

PHYSICAL PROPERTIES

Job No. 2120K206

Boring No.	Depth, ft.	Soil Classification	Particle Size Distribution, % Passing By Weight					Atterberg Limits		Moisture-Density Relationship			Specific Gravity	Permeability		Corrected 'R' Value	REMARKS
			3"	#4	#10	#40	#200	LL	PI	Dry Density pcf	Optimum Moisture %	Method		Dry Density pcf	K Cm/Sec		
1	0-2	SM-SC	100	67	52	40	26	26	5								2
3	0-2	CL-SC	100	93	86	76	49	24	9								2
5	0-2	SC	100	85	81	67	35	21	5								2
11	0-2	SC	100	65	55	45	26	--	NP								2
13	0-2	SC	100	77	60	44	23	33	14								2
15	0-2	SC	100	75	65	52	27	--	NP								2
21	0-2	CL	100	99	98	94	64	20	NP								2
23	0-2	CL-SC	100	99	98	89	52	27	12								2
25	0-2	CL-SC	100	100	97	87	54	26	8								2

Boring No.	Depth, ft.	COMMENTS

REMARKS

Classification/Partical Size
1. Visual
2. Laboratory Tested
3. Minus #200 Only

Mositure-Density Relationship
4. Tested ASTM D689/AASHTO 199
5. Tested ASTM D1557/AASHTO T180
6. Other

Specific Gravity
7. Minus #4
8. Plus #4

Permeability
9. Constant Head
10. Falling Head

'R' Value
11. Expansion Pressure psi
12. Exudation Pressure psi

NOTE: NP = nonplastic

CONCEPTUAL MASTER DRAINAGE REPORT

FOR

SUN CITY WEST EXPANSION AREA

Prepared For

DEL E. WEBB DEVELOPMENT CO. L.P.,
a Delaware limited partnership,
Developer

DEL WEBB HOME CONSTRUCTION, INC.
an Arizona Corporation,
Owner

Prepared By

STANLEY CONSULTANTS INC.
3117 North 16th Street
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Prepared: January, 1992

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INTRODUCTION

This report has been prepared at the direction of Del E. Webb Development Co., L.P., a Delaware limited partnership (hereinafter, Del Webb) for the purpose of providing to the Flood Control District of Maricopa County the proposed Conceptual Master Drainage Report for the Sun City West Expansion Area and other information relevant thereto in connection with the District's review and processing of Del Webb's Development Master Plan application.

The Development Master Plan titled "Sun City West Expansion" is to govern 884.7 acres situated immediately north of Sun City West and is planned as an expansion of the existing Sun City West active-adult community. Development plans consist primarily of single family lots, casitas, an 18-hole regulation golf course, a multi-purpose community recreation center and a small commercial parcel. See Figure 1 for Vicinity Map.

Residential portions of the Expansion Area consist primarily of single family units on lots averaging 6,000 to 8,000 square feet. Multi-family casitas are planned on three parcels near the center of the master plan. The golf course is a "target" type with about half being turf and the remainder being decomposed granite or similar ground cover with low water use landscaping. Open space parcels are located throughout the master plan incorporating portions of the golf course with entry features which will include 3-5 permanent lakes.

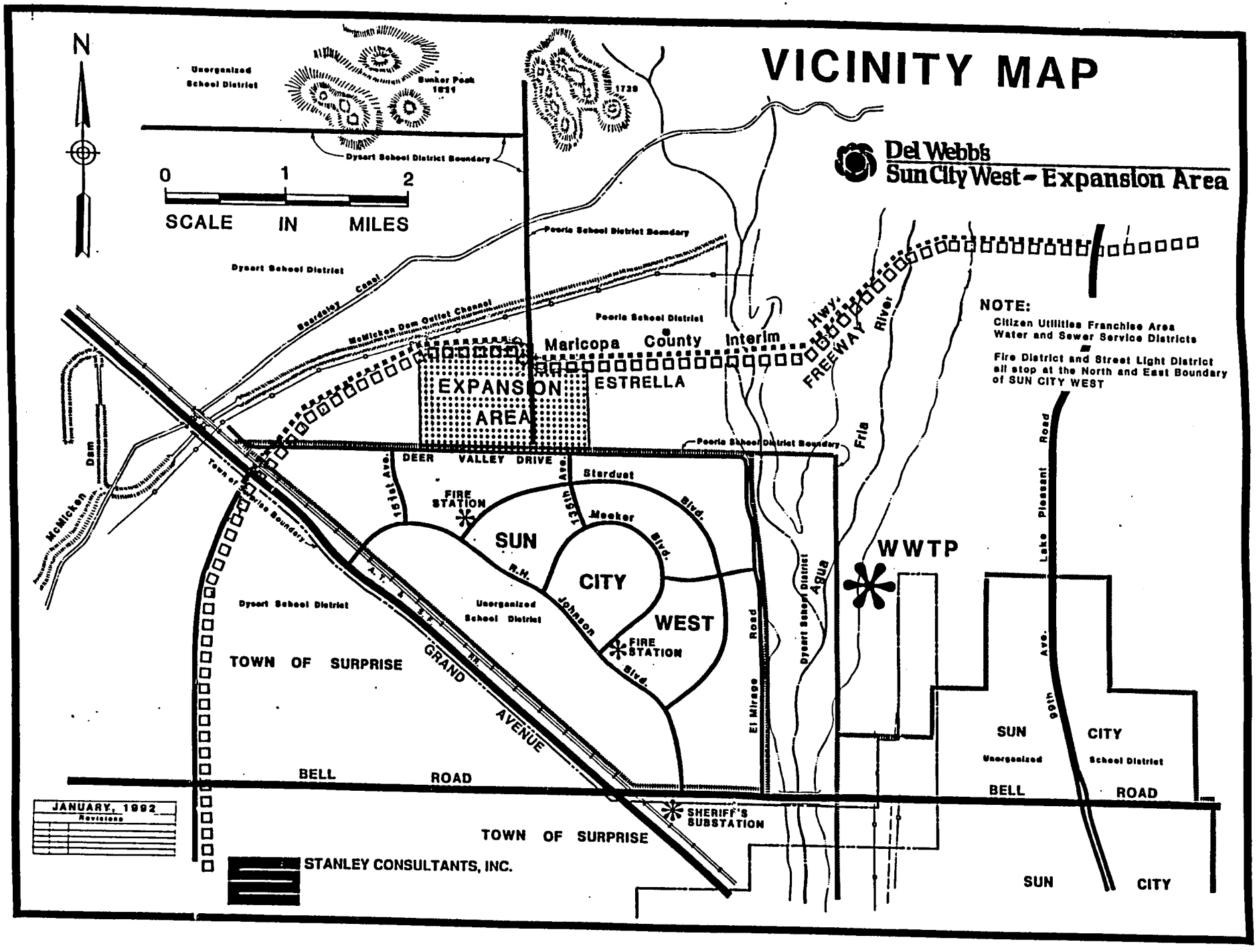
VICINITY MAP
Del Webb's
Sun City West - Expansion Area
N
SCALE IN MILES
0 1 2
Unorganized School District
Bunker Peak 1821
1729
Dysart School District Boundary
Peoria School District Boundary
Dysart School District
Beardsley Canal
McMicken Dam Outlet Channel
Peoria School District
Maricopa County Interim Hwy.
FREEWAY
River
Fria
EXPANSION AREA
ESTRELLA
DEER VALLEY DRIVE
Peoria School District Boundary
Stardust
Blvd.
151st Ave.
136th Ave.
FIRE STATION
Meeker
Blvd.
SUN CITY WEST
R.H. Johnson
Blvd.
FIRE STATION
Unorganized School District
Dysart School District
TOWN OF SURPRISE
A.T.&S.F.
GRAND AVENUE
Town of Surprise Boundary
McMicken Dam
El Mirage Road
Dysart School District
Agua
WWTP
Lake Pleasant Road
99th Ave.
SUN CITY
Unorganized School District
BELL ROAD
BELL ROAD
SHERIFF'S SUBSTATION
TOWN OF SURPRISE
SUN CITY
NOTE:
Citizen Utilities Franchise Area
Water and Sewer Service Districts
Fire District and Street Light District
all stop at the North and East Boundary
of SUN CITY WEST
JANUARY, 1992
Revisions
STANLEY CONSULTANTS, INC.

FIGURE 1

The existing property is undeveloped desert with a light to moderate cover of brush, trees and some cacti and a seasonal cover of grass. Soils are primarily fine textured alluviums ranging from sandy loam to clay loam with surface gravels present in some areas. There is an existing livestock water tank in the south-central portion of the property. The overall slope is from northwest to southeast at about 2/3 percent and the terrain is relatively flat and uniform. There are a number of existing washes that cross the parcel.

To the south is Deer Valley Drive which is an existing 2-lane paved roadway. South of Deer Valley Drive is the existing Sun City West development. To the west and north is existing undeveloped desert similar to the onsite area. The proposed Estrella Freeway will pass across the northern edge of the property. It is not due for construction for several years but right-of-way will be set aside for it at this time. Maricopa County proposes an interim highway along the freeway's north right-of-way limit. To the east of the site is an existing citrus orchard.

Drainage in the area is generally from northwest to southeast. The upper limit of offsite contributing area is the existing McMicken Dam Outlet Channel which passes just north of the property. This is a combination open channel and levee that conveys the discharge from McMicken Dam, which is located west of Sun City, east toward the Agua Fria River. The outlet Channel discharges to an existing wash near the alignment of 123rd Avenue, which, in turn, conveys the flow south to the Agua Fria River. The Outlet Channel has sufficient capacity to carry both the 100-year McMicken discharge and the concurrent local 100-year flows that it intercepts along its path.

Drainage from the area south of the McMicken Dam Outlet Channel, including the Expansion Area property, moves southeasterly as both shallow overland flow and shallow concentrated flow in existing washes. Typically, washes are on the order of 1 to 3 feet in depth and 5 to 25 feet in width. This drainage collects along the north side of Deer Valley Drive in an existing drainageway which extends from Grand Avenue east to about 123rd Avenue where it joins the same wash that receives the McMicken Dam Outlet Channel discharge.

This drainageway, from Grand Avenue to the eastern boundary of the subject property, is shallow and overgrown with trees and brush. To the east of the property, this drainageway becomes a formal channel with a clean uniform trapezoidal cross section. This channel was constructed by Del Webb. The drainage system along Deer Valley Drive protects the existing Sun City West from offsite flows. The Deer Valley drainageway is classed as a major drain under the Uniform Drainage Policies and Standards for Maricopa County because of the size of its contributing area.

A second drainageway exists running north to south along the west side of the existing citrus orchard. This is a shallow, more or less continuous channel that is overgrown with trees and brush. It provides a degree of drainage protection for the citrus orchard by directing shallow flows south to the drainageway along Deer Valley Drive. All the area, then, north of Deer Valley Drive, east of Grand Avenue, south of the McMicken Dam Outlet Channel and west of the citrus orchard drains toward the southeast corner of the proposed expansion property where it enters the improved Deer Valley Drive channel.

PLATE 1 TYPICAL ONSITE EXISTING DESERT. PHOTOGRAPH TAKEN NEAR CENTER OF PROPERTY LOOKING SOUTHEAST.

PLATE 2 TYPICAL WASH ONSITE. BOTTOM WIDTH IS ABOUT 2 TO 3 FEET. PHOTOGRAPH TAKEN LOOKING SOUTHEAST NEAR CENTER OF PROPERTY.

PLATE 3 TYPICAL REACH OF McMICKEN DAM OUTLET CHANNEL LOOKING EAST (DOWNSTREAM) NEAR NORTHWEST CORNER OF PROPERTY.

PLATE 4 DRAINAGEWAY ALONG EAST SIDE OF PROPERTY LOOKING SOUTH (DOWNSTREAM). EXISTING CITRUS ORCHARD TO EAST.

PLATE 5 EXISTING DRAINAGE CHANNEL ALONG DEER VALLEY DRIVE LOOKING EAST (DOWNSTREAM) FROM ABOUT 135TH AVENUE.

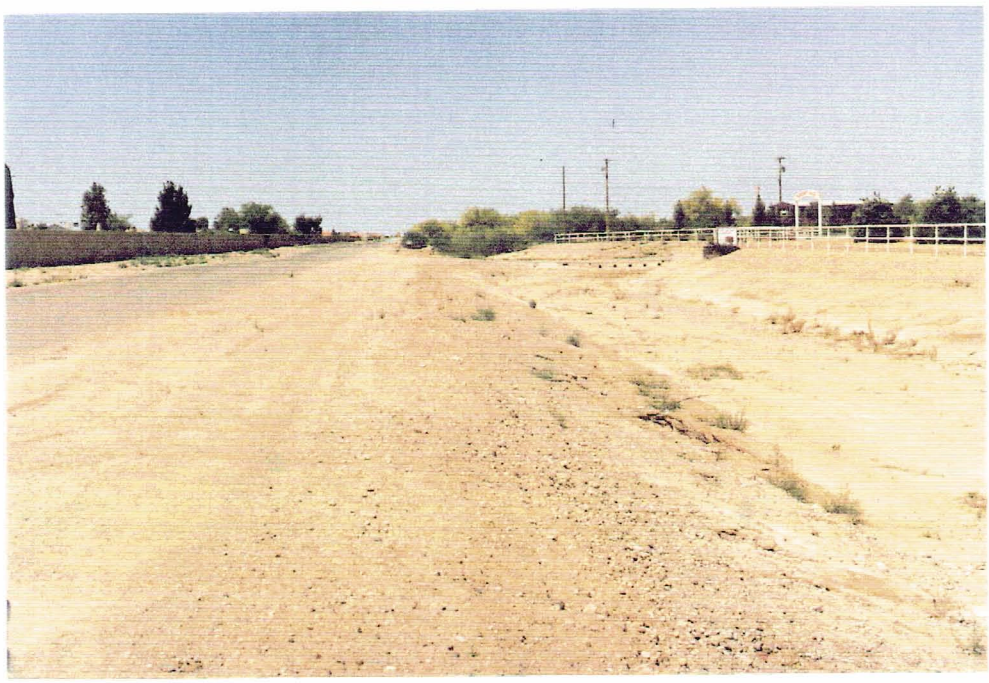

PLATE 6 EXISTING CHANNEL ALONG DEER VALLEY DRIVE LOOKING WEST (UPSTREAM) NEAR 135TH AVENUE.

According to the Flood Insurance Rate Map for Maricopa County, Arizona and Incorporated Area, the proposed expansion property falls on map panel numbers 04013C1135E, 1145E, 1155E and 1165F (See Figure 2). These four map panels all carry the revision date of September 4, 1991. The property is designated on these maps as being within flood insurance Zone X. This zone is defined as follows:

> Zone X-Areas of 500-year flood; areas of 100 year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

This appears to be a fairly accurate assessment of the general flood potential of the property and surrounding area for insurance purposes. There is no federal mandatory requirement for flood insurance on structures in Zone X.

The proposed expansion property is not located within any formal basin-wide master drainage plan or Area Drainage Master Study (ADMS). The property was included as offsite contributing area to Sun City West in a previous master drainage report prepared by HDR Engineers in 1977. That report estimated peak flows contributing at various points to the drainageway along Deer Valley Drive. Hydrology was based on the Soil Conservation Service TR-20 computer watershed model.

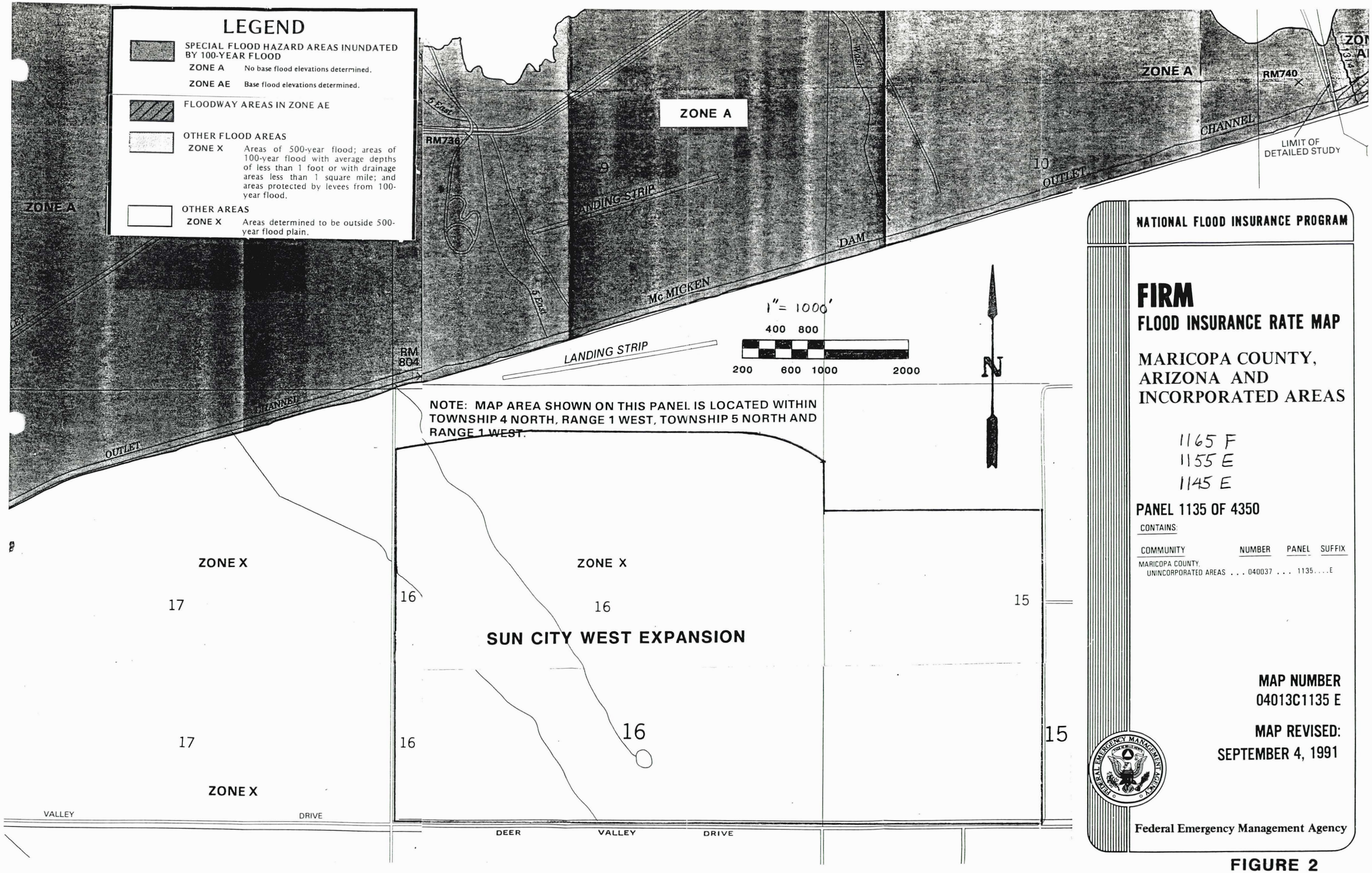
LEGEND
SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD
ZONE A No base flood elevations determined.
ZONE AE Base flood elevations determined.
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.
OTHER AREAS
ZONE X Areas determined to be outside 500-year flood plain.
ZONE A
ZONE A
ZONE A
RM736
RM740
RM 804
9
10
LANDING STRIP
LANDING STRIP
DAM
Mc MICKEN
CHANNEL
OUTLET
CHANNEL
OUTLET
LIMIT OF DETAILED STUDY
1" = 1000'
400 800
200 600 1000 2000
N
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 4 NORTH, RANGE 1 WEST, TOWNSHIP 5 NORTH AND RANGE 1 WEST.
ZONE X
ZONE X
ZONE X
17
17
16
16
16
16
15
15
SUN CITY WEST EXPANSION
VALLEY DRIVE
DEER VALLEY DRIVE
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS
1165 F
1155 E
1145 E
PANEL 1135 OF 4350
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS . . . 040037 . . . 1135. . . . E
MAP NUMBER
04013C1135 E
MAP REVISED:
SEPTEMBER 4, 1991
Federal Emergency Management Agency

FIGURE 2

SCOPE AND OBJECTIVES

The purpose of this report is to:

1. Establish drainage background, describe existing and proposed drainage and review any previous studies;

2. Establish basic design criteria for proposed primary and secondary drainage facilities including drainage channels, culverts, storm drains, detention basins, and street drainage;

3. Present methods of study and assumptions for initial and future drainage improvements;

4. Present a conceptual design of the primary drainage facilities;

This report is the first step in a series of drainage submittals that will be made for the Expansion Area. It is intended to lay the foundation for drainage design and present concepts for dealing with drainage. It will be refined and updated as the master plan evolves and such things as golf course design, earthwork and mass grading, phasing and land use become more finalized. Future submittals will include mass grading plans, golf course plans, grading and paving plans for subdivision units and the recreation center.

BASIC DESIGN CRITERIA

The basic design criteria for this report can be found in three primary documents from the Flood Control District of Maricopa County. The first is the Uniform Drainage Policies and Standards for Maricopa County, Arizona dated February 25, 1987. It is intended to standardize drainage requirements for Maricopa County including incorporated areas.

The second document is the Drainage Regulation for the Unincorporated Area of Maricopa County, Arizona, published October 5, 1988. It's purpose is to implement and enforce drainage standards in unincorporated areas through the requirement for drainage clearances and submittal of plans and reports.

The third document is the Hydrologic Design Manual for Maricopa County dated September 1, 1990. This manual outlines methods to be used in the study of hydrology in Maricopa County. Its development was the direct result and one of the primary objectives of the Uniform Drainage Policies and Standards. The Manual is currently under revision. In addition to these documents, standards and criteria will be employed from the County Highway Department.

The basic design storm for this project will be the 100-year, 2-hour storm. This applies to the design of both stormwater conveyance systems and detention basins. Discharges from the property under developed conditions will be as close as possible in location to existing conditions with depth and velocity no greater than existing conditions. The peak discharge after development will not exceed existing conditions.

The hydrologic model in this report will use the Clark unit hydrograph method with Green-Ampt rainfall losses based on the Hydrologic Design Manual. The Clark unitgraph method will also be used for any future updates, master plan revisions or drainage design where hydrograph routing is involved. The rational method will be used for subsequent design of individual subdivision units, and commercial and recreation center parcels where hydrographs and hydrograph routing are not required.

Stormwater detention basins will be designed to contain the peak 100-year 2-hour volume for the overall developed site. Detention basins will be designed to discharge their entire volume within a 36-hour period. Drainageways will be designed to convey 100-year peak discharges with freeboard. For this report, hydraulics will be based on normal depth Manning analysis. Streets will be designed to carry flows in accordance with both Maricopa County and Del Webb criteria. Storm drains or channels will be provided where necessary to limit the amount of flow carried in the streets. Culverts will be designed so that there is no more than 8" of flow going over the roadway in a 100-year event. Finished floors will be above the maximum 100-year high water elevation.

Hydraulics Manual 6 11

PROPOSED DRAINAGE SYSTEM

Drainage from offsite areas will be intercepted by a perimeter channel system and conveyed to locations where it can enter the proposed development. Along the west boundary, there will be a concrete lined trapezoidal channel. Along the north side, a channel with earth sides and bottom is proposed in conjunction with the landscaped buffer area adjacent to the proposed Estrella Freeway. This north channel does not currently fall entirely within the expansion property boundary (See Figure 3, Appendix A). This discontinuity will be corrected through proposed land trades involving the acquisition of right-of-away for the Estrella Freeway. Or, the proposed drainage system will be modified to accommodate the situation. This report assumes a continuous channel along the north boundary.

Offsite flows will enter the property at two locations along the west boundary and one location along the north boundary (See Figures 3, 4 and 5 in Appendices A and B). This drainage will be conveyed from the point of entry to the proposed golf course/open space area via concrete lined trapezoidal channel. Trapezoidal channels, where used, will generally have a bottom width ranging from 10 to 20 feet and side slopes of 0.5 horizontal to 1.0 vertical. Offsite flows will then be conveyed through the development via the golf/open space areas to the southeast corner of the property.

Conveyance within the golf/open space areas is primarily by means of open channels. These channels will have a non-uniform cross-section and a combination of turf, stone or bare soil ground surface. Vegetation, from a hydraulic standpoint, will generally be designed to minimize obstruction. The golf/open space conveyance system may incorporate a series of

localized depressed areas in order to increase minimum design slopes in turfed areas. It may also incorporate a low flow channel or storm drain system in final design. Flow velocities will be kept to non-erosive values.

Onsite developed areas will be designed to surface drain via streets to localized outfalls within the golf/open space area. Streets will range in size from residential 32 feet wide and 4 inch roll curb to major arterial 68 feet wide and 6 inch vertical curb. No inverted crown streets are proposed at this time. Contributing sub-basins will be kept as small as reasonably possible in final design to minimize the amount of flow carried in the streets. Storm drain and catch basin systems or open channels will be provided where street capacities exceed allowable criteria. Culverts will be provided under roadways at various locations in conjunction with the golf course/open space channels. Tentatively, sizes range from single 36-inch diameter pipe to multiple barrel box culverts. Golf cart crossings may be incorporated into some of the larger box culvert systems.

Detention basins for onsite development will be provided in the golf/open space area. There are a total of 12 basins proposed throughout the development. Seven of these 12 basins will receive drainage from onsite sub-basins only. The remainder will receive both onsite and offsite drainage. Collectively, their maximum stage volumes for the design storm will equal the total excess rainfall generated by onsite sub-basins for that same storm.

These basins will be incorporated into the golf course/open space grading and landscaping. They generally have a maximum depth of 6 feet and side slopes of 6 horizontal to 1 vertical. At least three of the twelve basins will be incorporated into permanent lake features. Their

maximum stages will be in addition to the normal lake water surface. Detention basin outlets will generally consist of a pipe principal discharge and a weir overflow spillway. Pipe sizes range from a single 18 inch to multiple 48 inch pipe. Weirs are generally assumed to be 100 feet in length. Discharge from the detention basin system is conveyed within the golf course/open space channels mentioned previously. A transition reach will be provided from the lower-most detention basin at the southeast corner of the Expansion Area to the existing channel along Deer Valley Drive.

Onsite grading of future subdivision units in the proposed expansion will be similar in nature to the existing Sun City West. Residential lots will be mass graded and will share common rear yard drainage swales. At regular intervals, it will be discharged to an adjacent street through side yard swales or at the end of blocks. All on-lot drainage swales will be included within drainage easements recorded on final plats.

HYDROLOGY-BASIC ASSUMPTIONS AND METHODS

The Corps of Engineers HEC-1 computer hydrograph program, version 4.0 dated September 1990 was used in this report to generate and route synthetic hydrographs. This version contains Green-Ampt loss rate functions, which, along with the Clark unitgraph hydrograph option are required by the Flood Control District's Hydrologic Design Manual. Clark unitgraph hydrology will be used as the basis of design for storm water detention, offsite and major onsite drainage channels, golf course conveyance, storm drain trunklines and other major drainage features on an overall master plan basis.

The rational method from the District's Hydrology Manual will also be used. It will be the basis for drainage design of future individual parcels in the Master Plan area. Generally, it will be used where peak flows only are needed and not hydrographs or hydrograph routing. It will be used as the basis for checking residential street capacity, design of minor drainage channels and swales, catch basins inlets and minor storm drain laterals.

Because both methods will be used, it is desireable that they yield reasonably similar peak flows and volumes. This report will establish basic input data for both methods that are intended to be consistent with the Hydrology Manual and produce reasonable results and agreement. These basic data and comparison results will be presented throughout this and later sections of the report.

Rainfall data is taken directly from the Hydrology Manual. The 100-year 2-hour rainfall amount for use with the Clark unitgraph method is estimated at 2.77 inches. This storm total was used in conjunction with the 2-hour distribution from table 2.2 of the Hydrology Manual.

No aerial reduction was assumed for the HEC-1 model. Future rational method calculations will use the rainfall intensity duration-frequency relation of Figure 3.2 of the Hydrology Manual. No location adjustment was made for rational intensity in the comparisons to the Clark unit graph contained in this report.

Drainage sub-basins for the HEC-1 models are shown on Figures 3, 4, and 5 in Appendices A and B. Their areas were estimated through the use of a digital planimeter. Right-of-way for the proposed Estrella Freeway was considered as offsite area, existing desert. Areas are presented in HEC-1 carried to the nearest 0.001 square mile although the program rounds to the nearest 0.01 square mile. Rational method will use area in acres. Rounding off of areas in HEC-1 will potentially produce discrepancies with the rational method.

Times of concentration are estimated using essentially the same methodology for both the Clark unit graph and rational method. Both methods use the same basic equation (equation 3.2/5.5 of the Hydrology Manual) to estimate floodwave travel time as a function of length, watershed resistance, slope and intensity. This equation is:

$$Tc = 11.4L^{0.5}\, Kb^{0.52}\, S^{-0.31}\, i^{-0.38}$$

The only difference is that Clark unitgraph uses the intensity of rainfall excess and the rational method uses direct rainfall intensity. Slopes and lengths have been estimated for the HEC-1 model based on preliminary street layout and mass grading plans. Watershed resistance coefficients, Kb, are taken from Table/Figure 3.1 of the Hydrology Manual. Table 1 which follows is a summary of selected m and b parameters used in estimating Kb.

TABLE 1 RESISTANCE COEFFICIENT PARAMETERS

	m	b
Residential	-0.00625	0.04
Commercial, Recreation Center	-0.00625	0.04
Existing Desert	-0.025	0.15
Golf Course/Open Space	-0.025	0.15

Watershed resistance coefficient, R, is a function of time of concentration, area and length based on equation 5.6 of the Hydrology Manual. This equation is:

$$R = 0.37\ Tc^{1.11}\ A^{-0.57}\ L^{0.80}$$

The time-area relationship for urban watersheds from Table 5.2 of the Hydrology Manual was used for all onsite developed sub-basins. All offsite sub-basins and the existing condition onsite area use the natural watershed time-area relationship from Table 5.2. The HEC-1 computation time interval was chosen at 5 minutes.

Green Ampt rainfall loss rates for all offsite sub-basins and the onsite existing condition sub-basin are area weighted values based on soil texture classifications and the parameters in Table 4.2 of the Hydrology Manual. DTHETA is based on the normal value and XKSAT is adjusted assuming a vegetation cover of 25%. Initial surface retention loss, IA, for existing conditions was assumed to be 0.25 inches and impervious area was assumed to be 1 percent. The existing surface cover of gravel which occurs in parts of the study area was assumed to not affect rainfall losses.

Green Ampt loss rates and percent impervious for urbanized areas are not presented in the Hydrology Manual. Loss rates, initial retention loss and percent impervious for proposed conditions were selected to produce the same rainfall excess that rational runoff coefficients would produce for corresponding land uses. Percent impervious ranges from 1 percent for golf/open space areas to 80 percent for commercial and recreation center areas. Initial surface retention loss, IA, ranges from 0.10 inches for commercial and recreation center areas to 0.25 inches for golf/open space areas. DTHETA, XKSAT and PSIF would correspond to a sandy loam/loamy sand soil texture. No adjustment is made to developed condition XKSAT for vegetative cover. Table 2 presents a summary of proposed loss rates and runoff coefficients to be used for onsite developed conditions. The 100-year frequency factor of 1.25 in Table 2 is being applied in anticipation of the next revision of the Hydrology Manual.

Hydrograph routing in HEC-1 for this report is performed using kinematic wave and modified Puls options. Kinematic wave routing applies only to concrete lined trapezoidal channels. Modified Puls routing applies to both channel and detention basin routing in the golf/open space areas. Assumed cross sections for routing purposes are presented in Appendix B. Golf/open space channels are either 50 feet or 100 feet in total width and include a hypothetical low flow channel. No infiltration/percolation losses are assumed for any modified Puls routing. Longitudinal channel slopes are estimated based on preliminary grading plans. The number of routing steps is one (1) for reservoir routing. For channel routing, it is estimated based on reach length divided by an assumed average flow velocity of 5 feet/second divided by the computation time interval of 5 minutes (or 300 seconds).

Detention basin volumes are estimated based on an assumed typical basin cross section having a level, flat bottom ranging from 50 to 250 feet in width and side slopes of 6 horizontal to 1 vertical. Lengths of these basins ranged from 200 feet to 1,000 feet. Maximum assumed effective depth is 6 feet, not including any permanent lake water. Basin outlets consist of a combination pipe and weir represented in HEC-1 by SL and SS records. Pipes assume inlet control and their capacities are estimated based on Bureau of Public Roads standard curves. The corresponding orifice coefficient of discharge is estimated at 0.37. Weirs have crest lengths of 100 feet and crest elevations ranging from 3.0 feet to 5.9 feet above basin bottom. A weir coefficient of 2.60 was assumed for all weirs. It is assumed for this report that proposed culverts have no effect on hydrograph routing. It was also assumed for existing condition models that the existing livestock water tank located on the proposed expansion property has no affect on hydrographs.

TABLE 2

PROPOSED RAINFALL LOSSES

RATIONAL METHOD RUNOFF COEFFICIENTS

LAND USE	RUNOFF COEFF C	FREQUENCY FACTOR	ADJUSTED RUNOFF COEFF C	100-YR 2-HR RAINFALL (INCHES)	RAINFALL EXCESS (INCHES)
SINGLE FAM RES	0.50	1.25	0.63	2.77	1.75
RES CASITA	0.50	1.25	0.63	2.77	1.75
GOLF/OPEN SPACE	0.28*	1.25	0.35	2.77	0.97
COMM, REC CENTER	0.70	1.25	0.88	2.77	2.43

*Composite C based on half turf @ C=0.20 and the other half desert @ C=0.35

GREEN-AMPT LOSS RATES

LAND USE	INITIAL LOSS (INCHES)	DTHETA	PSIF (INCHES)	XKSAT* (IN/HR)	RTIMP (PERCENT)	100-YR 2-HR RAINFALL (INCHES)	RAINFALL EXCESS (INCHES)
SINGLE FAM RES	0.15	0.28	3.4	0.80	37	2.77	1.75
RES CASITA	0.15	0.28	3.4	0.80	37	2.77	1.75
GOLF/OPEN SPACE	0.25	0.30	2.4	1.20	1	2.77	0.97
COMM, REC CENTER	0.10	0.28	3.4	.80	80	2.77	2.45

*XKSAT assumes no Ck adjustment for vegetation cover

HYDROLOGIC MODELS

There are four HEC-1 models presented in this report. Model 11028H considers the entire contributing area to the southeast corner of the proposed expansion as one basin, existing conditions. Model 11028I takes the same existing condition basin in 11028H and breaks it into sub-basins according to onsite and offsite areas. Model 11028M takes the onsite sub-basin in 11028I and breaks it into developed condition sub-basins with channel and detention basin routing. Model 11028N is identical to Model 11028M except it eliminates the offsite contributing drainage and only considers the onsite developed area. In addition to these HEC-1 models, this report will present a comparison of peak flows and volumes from the rational method to those from Clark unitgraph for three selected onsite developed sub-basins.

HEC-1 models 11028H and 11028I are intended to provide an existing condition peak discharge for comparison to the previous estimate by HDR and to the proposed developed condition. These two models also compare, between each other, the effects of breaking the total area into smaller sub-basins. Offsite flows in model 11028I are routing through the onsite area in hypothetical channels. Model 11028N is intended to compare onsite only developed condition discharge to existing condition onsite sub-basin E in Model 11028I.

CONCLUSIONS

The existing condition peak discharge at the southeast corner of the expansion property is estimated at 2,550 cfs for the 100-year 2-hour storm using the Flood Control District's Hydrology Manual. The 1977 report by HDR does not identify that same location as a concentration point. Based on HDR concentration point 59 which is just downstream from the expansion property's southeast corner, the estimated peak discharge is about 1800 cfs. HDR used a 100-year 24-hour storm and the SCS TR-20 watershed model.

The estimated capacity of the existing improved channel along Deer Valley Drive downstream from the expansion property is 1300 cfs at the top of the south bank. The south bank is about 5.5 feet above the channel bottom based on field measurement. At an assumed depth of 7.0 feet, the capacity is about 2300 cfs. Flow velocities in the channel are on the order of 6 feet per second at bank full depths.

Hydraulics of the Deer Valley Road channel are based on normal depth calculations using a single representative cross section. Based on field inspection and measurement, it appears that the channel has been constructed substantially close to original design and has functioned adequately since constructed in about 1983. Using the estimated existing condition 100-year peak flow of 2550 cfs from this report, there is a potential for overflow indicated on both sides of the channel. This overflow has been considered hydraulically on the south side of the channel where the Deer Valley roadway exists but not on the north side.

With the proposed expansion of Sun City West, there will be a significant amount of stormwater detention provided on a significant portion of the overall contributing area. Using

current drainage criteria the estimated peak discharge after development will be about 1750 cfs. This would be a net reduction of 800 cfs and would correspond to a depth of about 6 feet in the channel along Deer Valley Drive.

The proposed expansion area comprises almost half of the total area contributing to the channel along Deer Valley Drive at 135th Avenue. Runoff from slightly more than half of the onsite area is detained in basins that are separate from offsite flow. Detention basins for the remaining area handle both onsite and offsite flows. Collectively, onsite detention basins provide enough volume at their peak stages to equal the total 100-year 2-hour detention requirement. Table 3 contains a summary of the onsite areas, their peak flows and their volumes. Table 4 contains a summary of basic detention basin data, peak stages and corresponding volumes. The maximum drawdown time on any of the proposed detention basins is about 15 hours. The average is less than 10 hours and the maximum allowable is 36 hours under County criteria.

On the basis of the entire area contributing to the southeast corner of the proposed expansion area, the existing condition peak discharge of 2550 cfs will be reduced to about 1750 cfs with the detention system in the proposed development. On the basis of onsite area only, the existing discharge of about 1300 cfs will be reduced to less than 400 cfs, a significant reduction either way.

Three sub-basins were selected for comparison between the rational method and Clark unitgraph. Sub-basin 290 represents one of the smaller, primarily golf course sub-basins. Sub-basins 300 and 410 represent typical smaller and larger (respectively) primarily residential

sub-basins. Peak flows and volumes were developed from the same basic area, length, slope, resistance coefficient and rainfall data.

DOES IT USE Roundoff number when computing in program

Considering the roundoff of drainage area in HEC-1, there is reasonably good comparison in volumes between the two methods. Actually, without area roundoff, volumes would theoretically be identical because Green Ampt loss rates for developed areas have been selected on the basis of rational runoff coefficients. Peak flows however, from the rational method are consistently higher than the Clark unitgraph peaks by approximately 20 percent on a discharge per unit area basis. This is fairly good agreement in a hydrologic sense, but from a drainage design standpoint, better agreement would be desireable.

A number of assumptions have been made in this report regarding land use, phasing, hydraulic conveyance, grading, etc. As plans and design are developed, these assumptions will be refined. This report is intended to present primary concepts and methods commensurate in detail with the Master Land Use Plan. As golf course plans are developed, for example, the current stormwater detention scheme will evolve to a more final configuration. This applies to golf course channels as well. This design evolution will be reflected hydrologically in future updates and revisions. Future drainage submittals will also include greater hydraulic detail regarding storm drains and channels.

STORM RUNOFF FLOWS AND VOLUMES FOR INDIVIDUAL ONSITE SUB-BASINS 1-9-92

TABLE 3

SUB-BASIN NUMBER	PEAK DISCHARGE (cfs)	RUNOFF VOLUME (ac-ft)
10	43	2
20	12	1
30	31	2
40	30	1
50	17	1
60	59	4
70	60	3
75	37	2
76	23	3
80	66	3
90	82	5
100	11	2
110	52	2
130	43	2
140	42	1
150	37	2
160	83	4
170	98	5
175	34	4
180	8	1
190	102	5
200	80	5
210	62	2
220	63	4
225	34	1
230	50	3
250	38	2
260	29	1
270	12	2
280	50	2
290	21	1
300	45	2
310	18	2
320	24	1
330	9	1
340	8	1
350	17	1
360	30	1
370	48	3
380	93	6
390	38	3
400	48	3
410	108	5
425	27	3
440	25	2

TOTAL DETENTION REQUIRED = 112 (ac-ft)

TABLE 4

DETENTION BASIN CHARACTERISTICS HEC-1 MODEL 11028M 1-9-92

BASIN NUMBER	BOTTOM WIDTH (ft)	LENGTH (ft)	NUMBER PIPES	SIZE PIPES (in)	WIER ELEV (ft)	WIER L (ft)	Qin (cfs)	Qout (cfs)	VOLUME AT MAX STAGE (ac-ft)	MAX STAGE (ft)
21	100	500	2	48	105.9	100	274	133	8	105.19
91	100	400	2	18	105.9	100	147	20	7	105.64
131	100	200	2	18	105.9	100	93	19	3	105.23
141	50	200	1	18	105.9	100	42	3	1	102.52
161	100	200	1	36	105.9	100	120	39	3	105.35
181	100	300	2	48	105.9	100	151	124	4	104.76
231	250	800	1	48	105.9	100	421	69	28	105.39
281	100	800	4	48	103.5	100	1298	1275	15	105.92
301	100	200	1	18	105.9	100	61	8	3	104.40
349	100	600	4	48	105.0	100	535	470	11	105.78
401	150	400	1	36	105.9	100	131	35	6	104.70
441	150	1000	6	48	103.0	100	1789	1737	25	105.91

TOTAL DETAINED VOLUME 114 (ac-ft)

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1. Uniform Drainage Policies and Standards for Maricopa County, Arizona; February 25, 1987.

2. Drainage Regulations for the Unincorporated Area of Maricopa County, Arizona; October 5, 1988.

3. Hydrological Design Manual for Maricopa County; September 1, 1990.

4. Corps of Engineers HEC-1 Computer Hydrograph Package, Version 4.0, September 1990.

5. Sun City West Drainage Master Plan, HDR Engineers, 1977.

6. Flood Insurance Rate Map for Maricopa County, Panels 04013C1135E, 1145E, 1155E, 1165F, September 4, 1991.

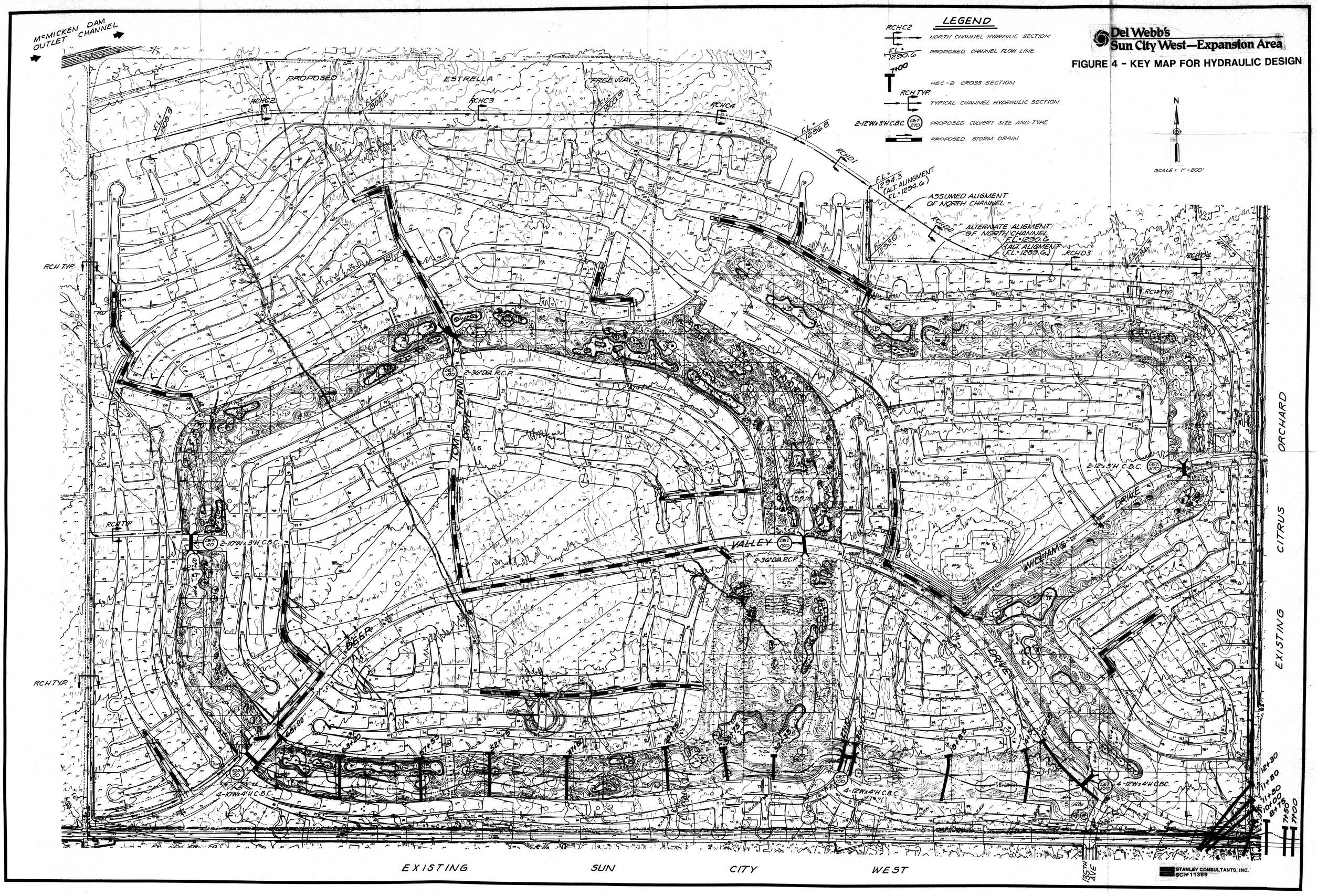
7. United States Geological Survey 7.5 Minute Quadrangles Calderwood Butte and McMicken Dam.

8. Onsite Topography, 1 ft. Contour Interval, Prepared by Kenney Aerial, Dated December 1990.

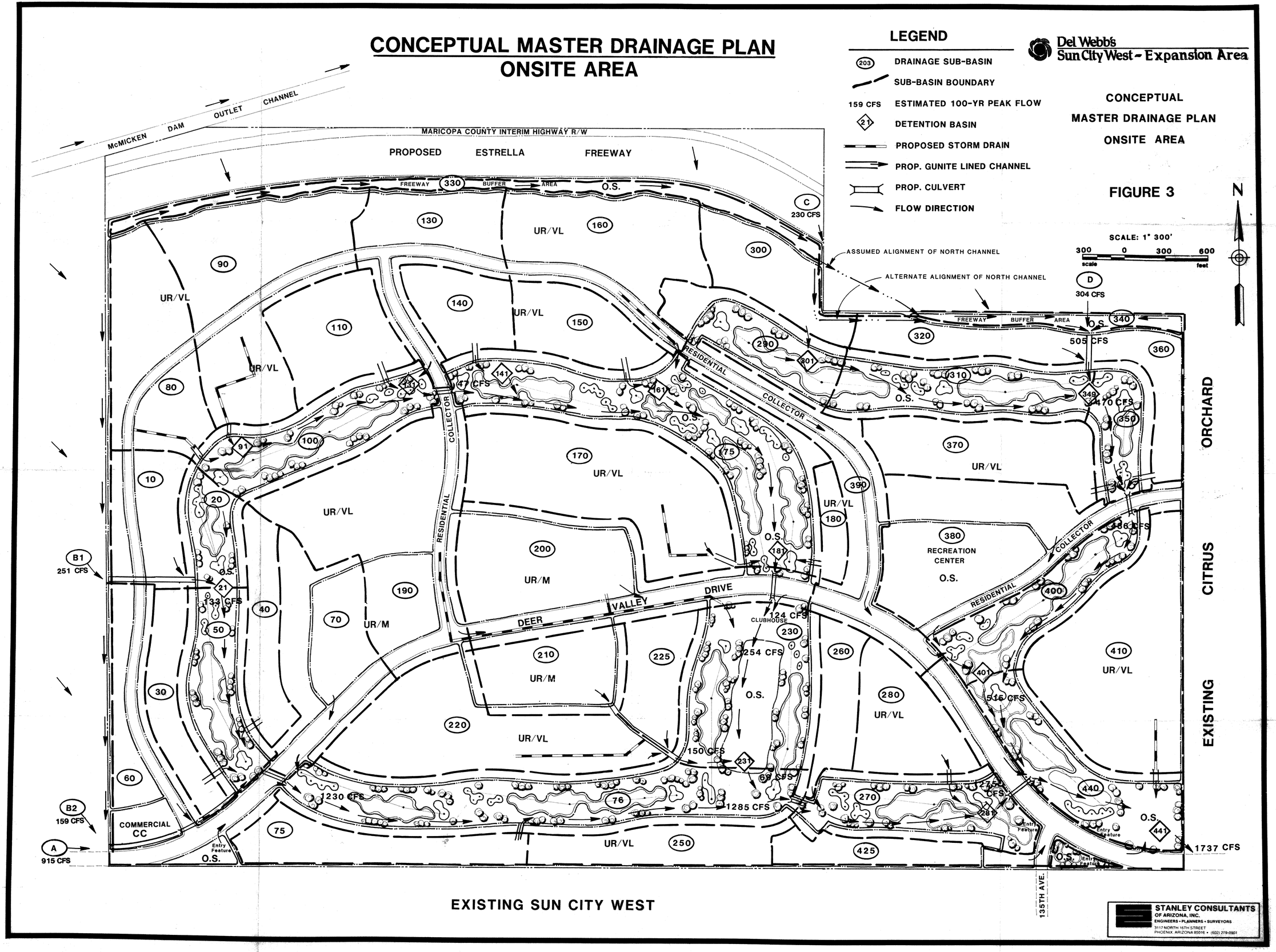
9. Soil Survey of Maricopa County, Central Part, Soil Conservation Service, September 1977.

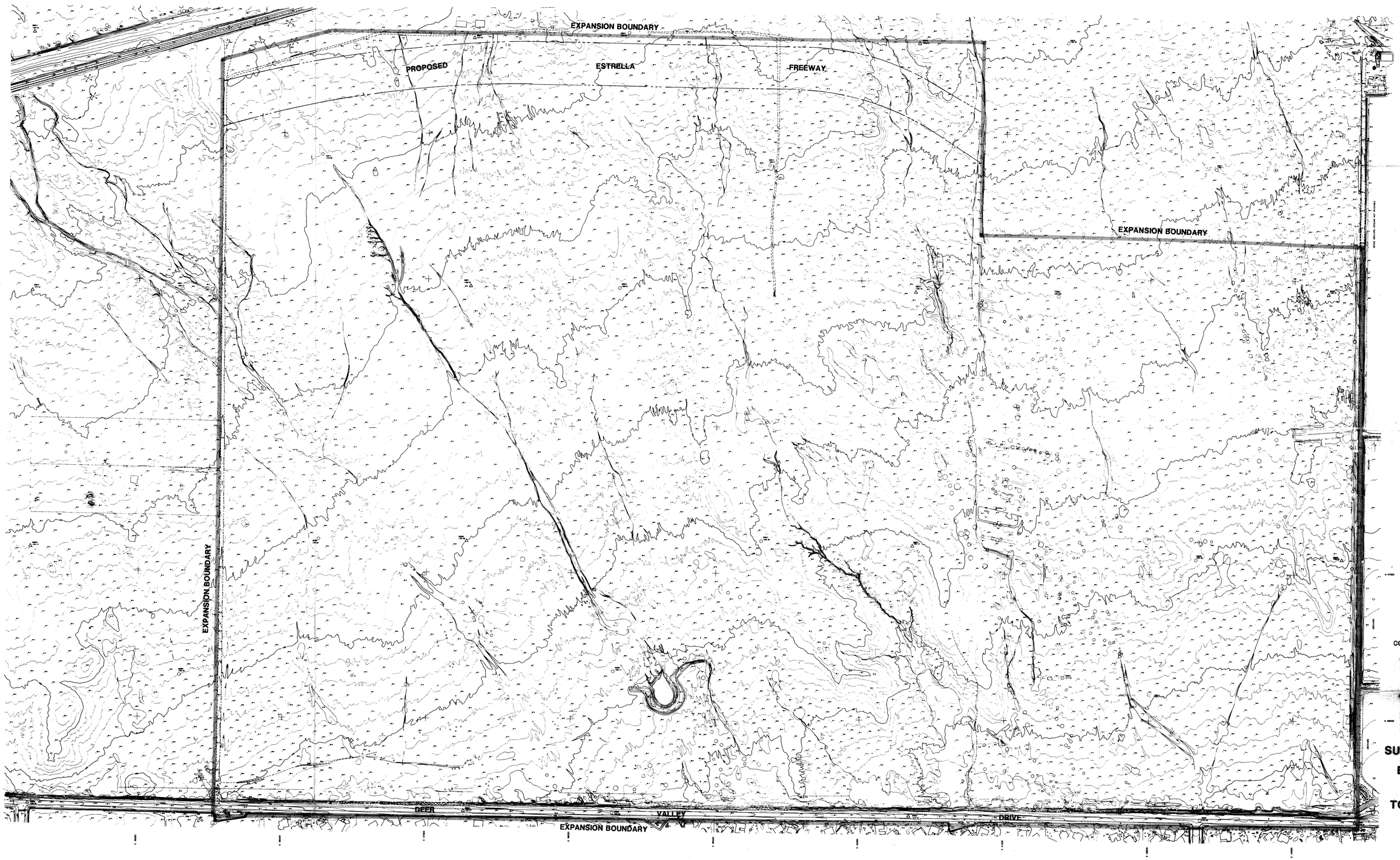
Del Webb's Sun City West—Expansion Area

FIGURE 4 - KEY MAP FOR HYDRAULIC DESIGN



CONCEPTUAL MASTER DRAINAGE PLAN
ONSITE AREA





CONTOUR INTERVAL: 1 FT.

N

SCALE 1"=300'

SUN CITY WEST
EXPANSION
ONSITE
TOPOGRAPHY

FIGURE 5

KENNY AERIAL MAPPING DECEMBER 1990

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APPENDIX B
HEC-1 INPUT AND SUPPORT CALCULATIONS

STANLEY

JOB SUN CITY WEST EXPANSION

SHEET NO. 1 OF 4

CALCULATED BY GSB DATE

CHECKED BY DATE

SCALE

PRECIPITATION: (REFER TO HYDROLOGY MANUAL, CHAPTER 2)

FREQUENCY	DURATION 6-HOUR	DURATION 24-HOUR	
2 YEAR	1.2"	1.5"	FIGURES 2.2 THRU 2.13
5 YEAR	1.7"	2.1"	
10 YEAR	2.1"	2.6"	
25 YEAR	2.6"	3.2"	
50 YEAR	2.9"	3.6"	
100 YEAR	3.3"	4.1"	

FOR 1-HOUR DURATION:

2 YEAR = $-0.011 + 0.942(1.2)(1.2/1.5) = 0.89$

100 YEAR = $0.494 + 0.755(3.3)(3.3/4.1) = 2.50$

5 " = 1.25"

10 " = 1.55"

25 " = 1.9"

50 " = 2.2"

FIGURE 2.14

FOR 2-HOUR DURATION

2 YEAR = $0.341(1.2) + 0.659(0.89) = 1.00$

100 YEAR = $0.341(3.3) + 0.659(2.5) = 2.77$

FOR 3-HOUR DURATION:

2 YEAR = $0.569(1.2) + 0.431(0.89) = 1.07$

100 YEAR = $0.569(3.3) + 0.431(2.5) = 2.96$

FOR 12 HOUR DURATION REFER TO FIG. 2.15

FOR LESS THAN 1 HR DURATION:

	2YR	5YR	10YR	25YR	50YR	100YR
5MIN	0.30	0.43	0.53	0.65	0.75	0.85
10MIN	0.45	0.64	0.79	0.97	1.12	1.28
15MIN	0.55	0.78	0.96	1.18	1.36	1.55
30MIN	0.60	1.03	1.27	1.56	1.80	2.05

PRODUCT 205-1 NEBS Inc., Groton, Mass. 01471. To Order PHONE TOLL FREE 1-800-225-6380

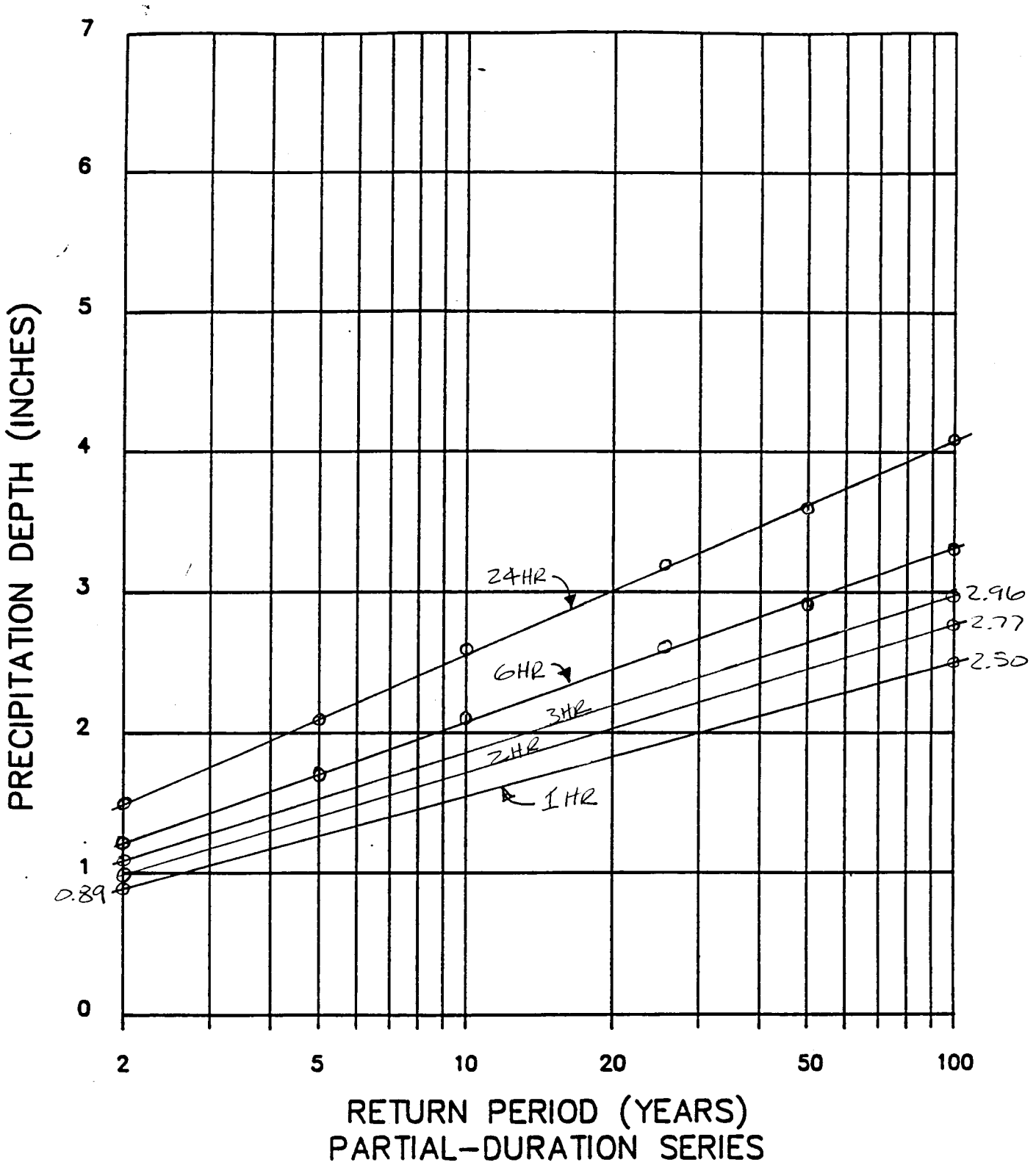


Figure 2.14
Precipitation Depth versus Return Period for Partial-Duration Series

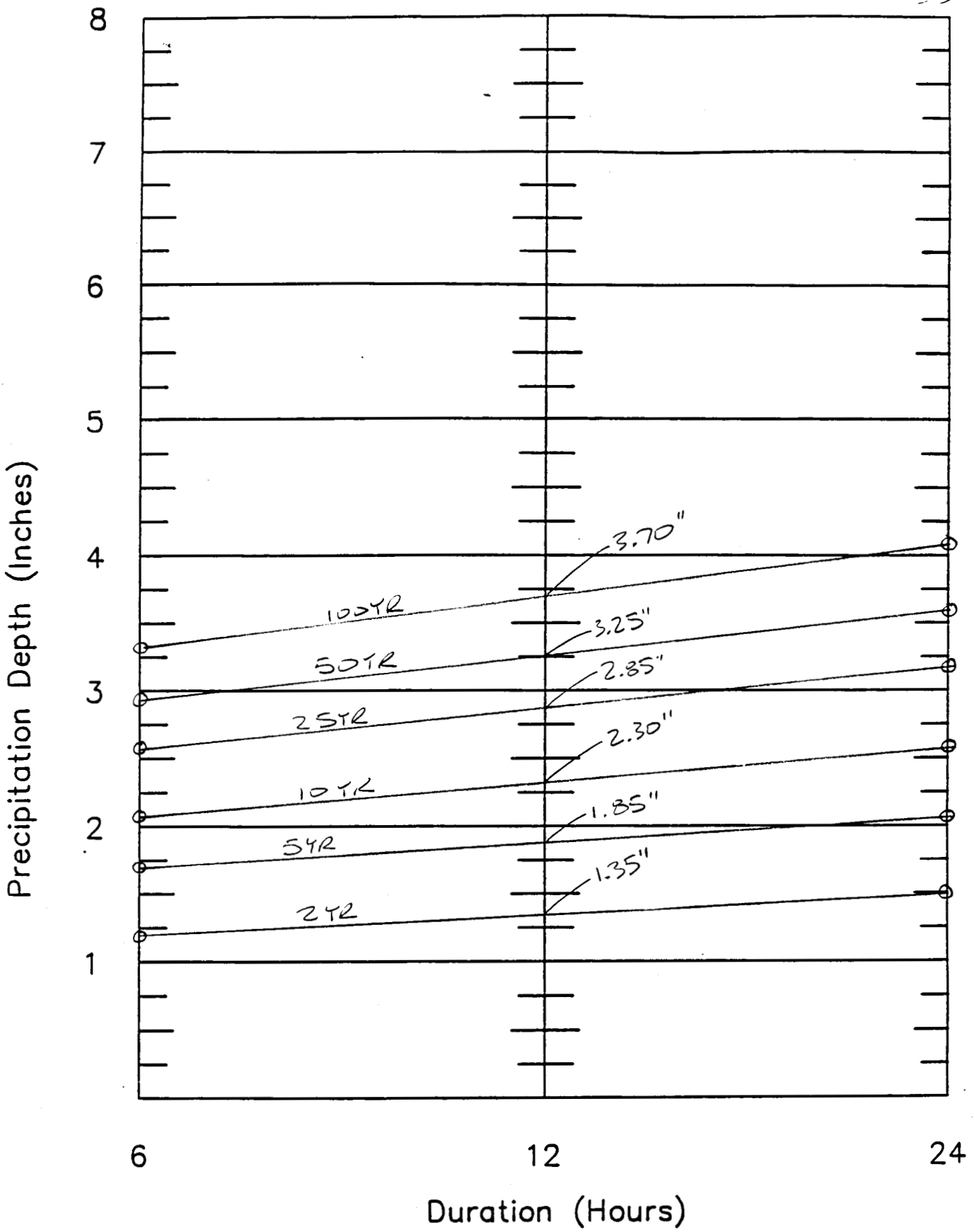


Figure 2.15
Precipitation Depth-Duration Diagram (6 to 24 hour)

STANLEY

JOB SUN CITY WEST EXPANSION

SHEET NO. 4 OF 4

CALCULATED BY GJC DATE

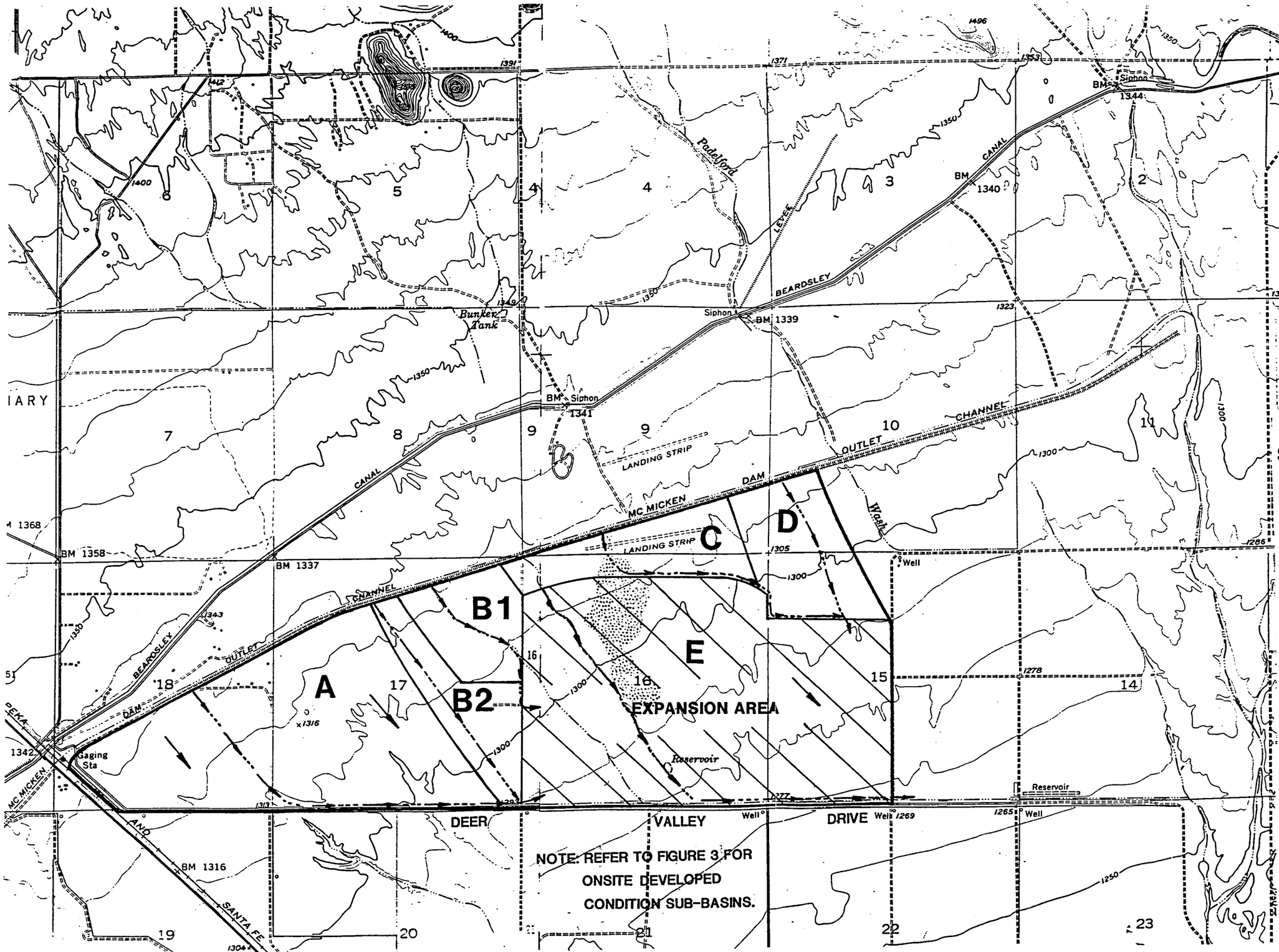
CHECKED BY DATE

SCALE

DEPTH DURATION FREQUENCY TABLE
FOR SUN CITY WEST EXPANSION :

DURATION	FREQUENCY 2YR	5YR	10YR	25YR	50YR	100YR
5 MIN	0.30	0.43	0.53	0.65	0.75	0.85
10 MIN	0.45	0.64	0.79	0.97	1.12	1.28
15 MIN	0.55	0.78	0.96	1.18	1.36	1.55
30 MIN	0.60	1.03	1.27	1.56	1.80	2.05
1 HR	0.89	1.25	1.55	1.90	2.20	2.50
2 HR	1.00	1.40	1.70	2.15	2.45	2.77
3 HR	1.07	1.50	1.85	2.30	2.65	2.96
6 HR	1.20	1.70	2.10	2.60	2.90	3.30
12 HR	1.35	1.85	2.30	2.85	3.25	3.70
24 HR	1.50	2.10	2.60	3.20	3.60	4.10

PRODUCT 205-1 NEBS Inc., Groton, Mass. 01471. To Order PHONE TOLL FREE 1-800-225-6380



SUN CITY WEST EXPANSION WATERSHED MAP FOR HEC-1 MODEL 11028 I

N

FIGURE 5

SCALE: 1"-2000'

LEGEND

WATERSHED BOUNDARY

FLOW PATH

DIRECTION OF FLOW

E SUB-BASIN DESIGNATION

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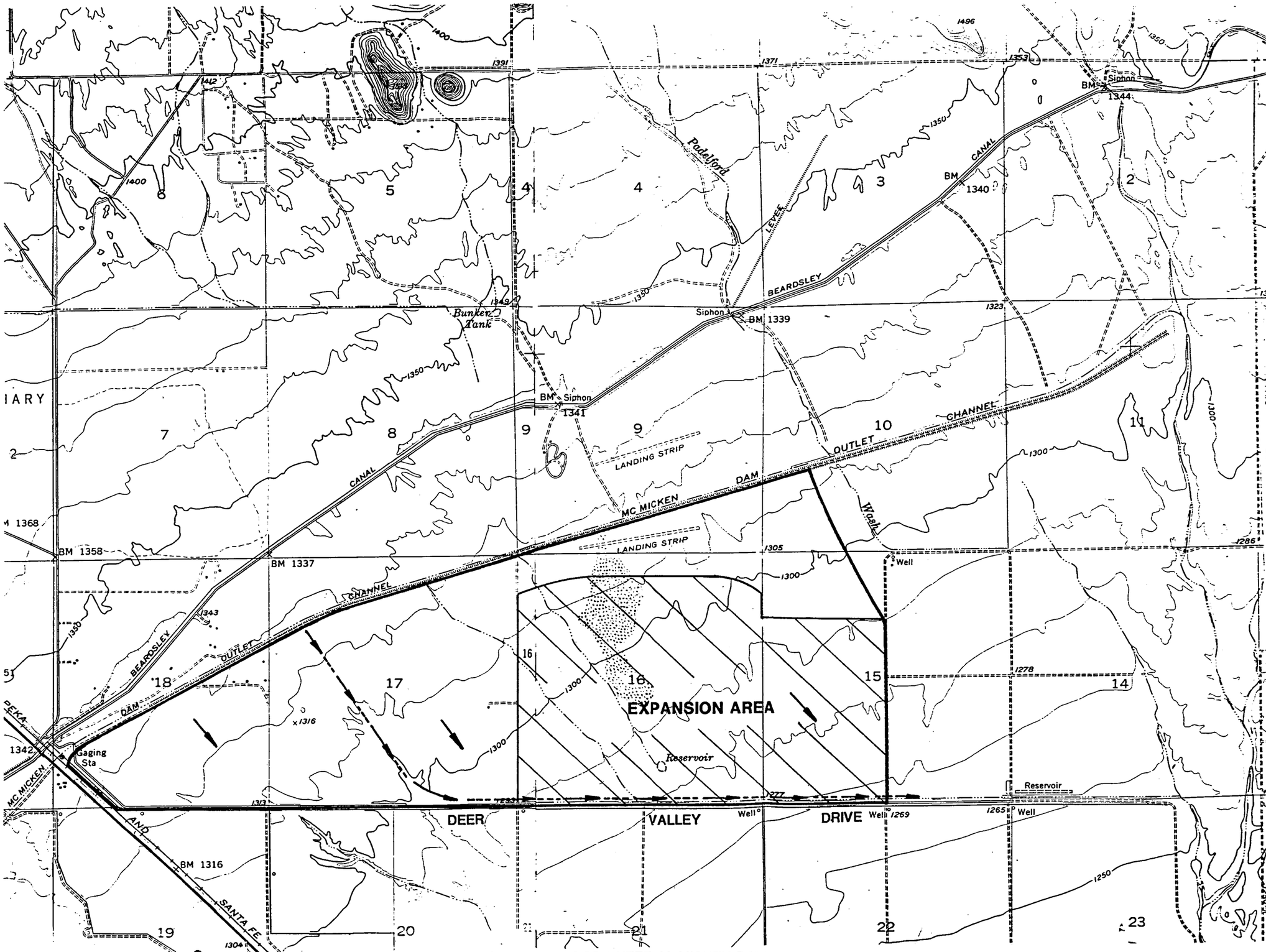

USGS 7.5 MIN. QUADRANGLES CALDERWOOD BUTTE, McMICKEN DAM

SUN CITY WEST EXPANSION WATERSHED MAP FOR HEC-1 MODEL 11028H

N

FIGURE 6

SCALE: 1"-2000'

LEGEND

- WATERSHED BOUNDARY
- FLOW PATH
- DIRECTION OF FLOW

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NOTE: THIS MAP REPRODUCED FROM SOIL SURVEY OF MARICOPA COUNTY, ARIZONA - CENTRAL PART, SOIL CONSERVATION SERVICE, SEPTEMBER 1977, SHEETS 2 & 3. REFER TO THAT SURVEY FOR DESCRIPTION OF SOILS.

GREEN AND AMPT RAINFALL LOSS PARAMETERS BY SCS SOIL TYPE

SCS SOIL TYPE	IA (dry)	IA (norm)	DTHETA (dry)	DTHETA (norm)	PSIF	XKSAT
SANDY LOAM AbA, AdA, AdB AGB, AHC, GYD GWD, RaA, Vc, Va	0.7	0.6	0.35	0.25	4.3	0.4
LOAM Es, GgA, GM, LcA	0.6	0.5	0.35	0.25	3.5	0.25
SANDY CLAY LOAM TfA, Tg, Th, TrA TrB, TSC	0.6	0.5	0.25	0.15	8.6	0.06
CLAY LOAM Mp, MTB, Mv	0.5	0.4	0.25	0.15	8.2	0.04

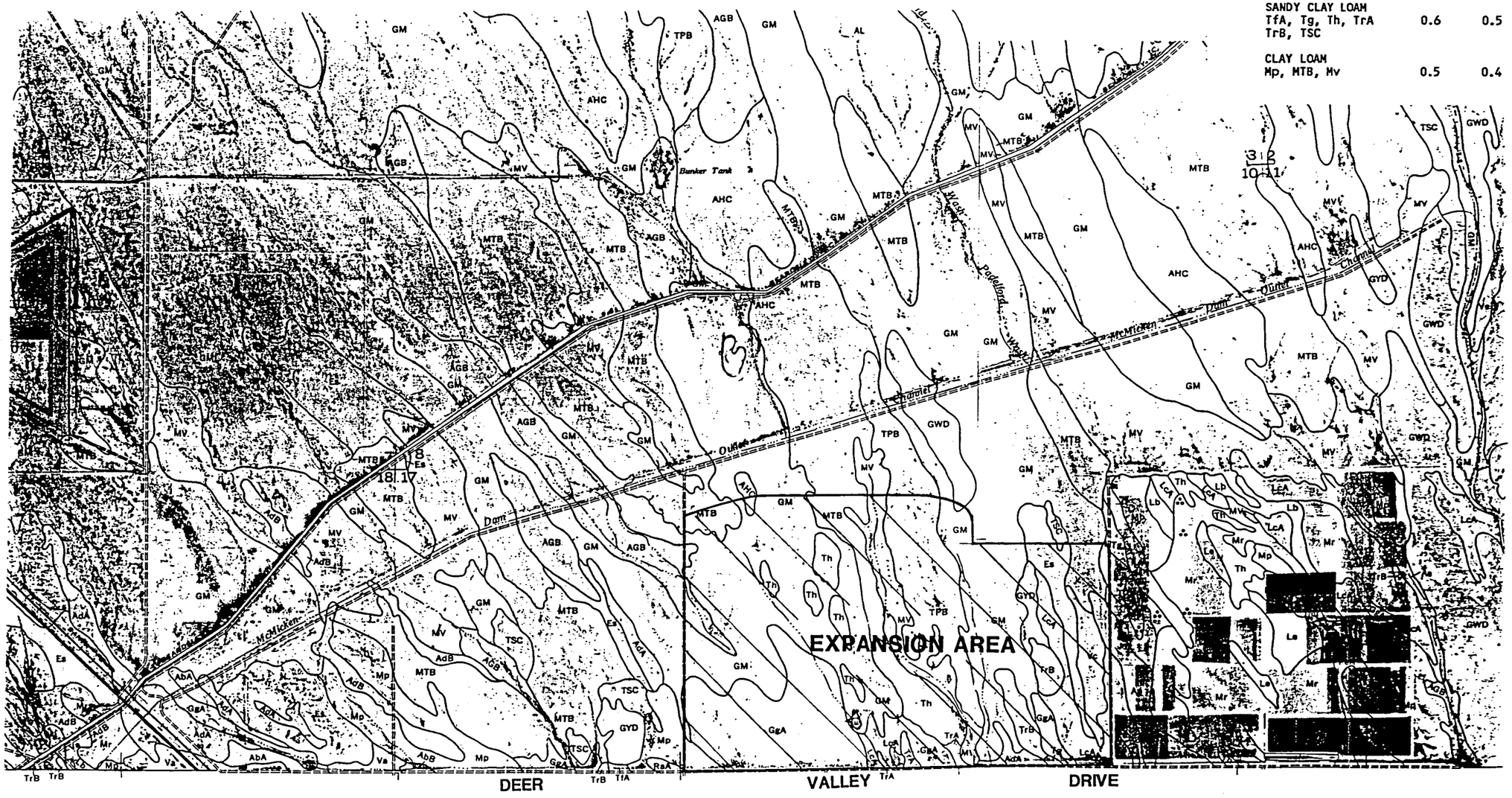

FIGURE 7

N

SCALE: 1"-2000'

SUN CITY WEST

EXPANSION

SOILS MAP-

EXISTING CONDITIONS

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BASIC SUB-BASIN HEC-1 DATA 1-9-92

RESIST. COEFF. PARAMETERS

m(residential) =	-0.00625
m(desert) =	-0.025
b(residential) =	0.04
b(desert) =	0.15

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.15	0.28	3.4	0.8	37
Res CAS	0.15	0.28	3.4	0.8	37
Golf/O.S.	0.25	0.3	2.4	1.2	1
Comm	0.1	0.28	3.4	0.8	80
Exst des	0.25	**	**	**	1

SPECIFIC SUB-BASIN DATA

Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff Kb	Slope (ft/mi)	WEIGHTED GREEN / AMPT PARAMETERS IA	DTHETA	PSIF	XKSAT	RTIMP (%)	MCUHP1 Tc (hr)	Resist. (hr)
OFFSITE											
A	0.867	1.515	0.081	26.4	0.25	0.25	6.15	0.21	1	0.967	0.539
B1	0.169	0.568	0.099	29.9	0.25	0.32	5.09	0.28	1	0.533	0.323
B2	0.180	1.000	0.098	38.0	0.25	0.32	5.09	0.28	1	0.733	0.697
C	0.195	0.76	0.098	23.7	0.25	0.25	6.05	0.20	1	0.700	0.508
D	0.227	0.78	0.096	32.1	0.25	0.28	4.34	0.26	1	0.617	0.413
E	1.297	1.84	0.077	26.1	0.25	0.27	5.05	0.23	1	1.083	0.568
TOT	2.930	2.65	0.068	23.0	0.25	0.26	5.55	0.22	1	1.383	0.627
ONSITE											
10	0.020	0.316	0.033	19.0	0.15	0.28	3.40	0.80	37	0.183	0.208
20	0.012	0.180	0.128	16.7	0.23	0.30	2.65	1.10	10	0.400	0.422
30	0.017	0.371	0.034	20.2	0.15	0.28	3.40	0.80	37	0.200	0.286
40	0.016	0.378	0.034	23.8	0.15	0.28	3.40	0.80	37	0.183	0.273
50	0.022	0.303	0.121	19.8	0.23	0.30	2.65	1.10	10	0.517	0.602
60	0.036	0.568	0.032	19.4	0.14	0.28	3.40	0.80	43	0.267	0.361
70	0.030	0.384	0.032	15.6	0.15	0.28	3.40	0.80	37	0.217	0.233
75	0.024	0.500	0.033	20.0	0.15	0.28	3.40	0.80	37	0.250	0.382
76	0.056	0.667	0.111	18.0	0.23	0.30	2.65	1.10	10	0.917	1.256
80	0.037	0.492	0.031	21.1	0.15	0.28	3.40	0.80	37	0.233	0.277
90	0.058	0.544	0.030	8.1	0.15	0.28	3.40	0.80	37	0.383	0.397
100	0.027	0.345	0.119	5.6	0.23	0.30	2.65	1.10	10	1.033	1.283
110	0.022	0.275	0.033	20.0	0.15	0.28	3.40	0.80	37	0.167	0.168
130	0.026	0.441	0.032	15.9	0.15	0.28	3.40	0.80	37	0.250	0.330
140	0.016	0.227	0.034	33.0	0.15	0.28	3.40	0.80	37	0.133	0.127
150	0.017	0.312	0.033	22.4	0.15	0.28	3.40	0.80	37	0.167	0.203
160	0.039	0.447	0.031	24.6	0.15	0.28	3.40	0.80	37	0.200	0.207
170	0.053	0.540	0.030	20.7	0.15	0.28	3.40	0.80	37	0.250	0.259
175	0.063	0.620	0.110	24.8	0.23	0.30	2.60	1.12	8	0.750	0.887
180	0.006	0.242	0.036	8.3	0.15	0.28	3.40	0.80	37	0.267	0.506
190	0.056	0.549	0.030	19.3	0.15	0.28	3.40	0.80	37	0.267	0.273
200	0.050	0.568	0.031	15.1	0.15	0.28	3.40	0.80	37	0.300	0.341
210	0.025	0.265	0.032	22.6	0.15	0.28	3.40	0.80	37	0.167	0.143
220	0.046	0.629	0.031	15.1	0.15	0.28	3.40	0.80	37	0.333	0.436
225	0.014	0.227	0.034	19.8	0.15	0.28	3.40	0.80	37	0.150	0.157
230	0.041	0.256	0.115	17.6	0.22	0.30	2.65	1.10	16	0.450	0.317

Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	Tc (hr)	Resist. (hr)
250	0.023	0.450	0.033	17.3	0.15	0.28	3.40	0.80	37	0.233	0.333
260	0.013	0.288	0.034	31.3	0.15	0.28	3.40	0.80	37	0.150	0.198
270	0.024	0.265	0.120	4.9	0.23	0.30	2.65	1.10	10	0.900	0.953
280	0.024	0.390	0.033	25.6	0.15	0.28	3.40	0.80	37	0.183	0.222
290	0.021	0.280	0.122	30.4	0.23	0.30	2.65	1.10	10	0.400	0.437
300	0.021	0.379	0.033	30.3	0.15	0.28	3.40	0.80	37	0.167	0.211
310	0.027	0.360	0.119	19.4	0.23	0.30	2.65	1.10	10	0.600	0.726
320	0.015	0.379	0.034	15.8	0.15	0.28	3.40	0.80	37	0.217	0.342
330	0.027	1.023	0.032	13.7	0.25	0.30	2.40	1.20	1	0.533	1.470
340	0.008	0.242	0.035	12.4	0.25	0.30	2.40	1.20	1	0.233	0.371
350	0.013	0.178	0.127	28.1	0.23	0.30	2.65	1.10	10	0.317	0.309
360	0.015	0.312	0.034	17.6	0.15	0.28	3.40	0.80	37	0.183	0.243
370	0.028	0.420	0.032	14.3	0.15	0.28	3.40	0.80	37	0.250	0.305
380	0.052	0.602	0.030	17.4	0.13	0.28	3.40	0.80	59	0.300	0.349
390	0.028	0.662	0.032	27.6	0.15	0.28	3.40	0.80	37	0.267	0.471
400	0.058	0.337	0.111	13.4	0.24	0.30	2.55	1.14	6	0.633	0.473
410	0.056	0.568	0.030	25.5	0.15	0.28	3.40	0.80	37	0.233	0.242
425	0.029	0.597	0.032	10.1	0.15	0.28	3.40	0.80	37	0.450	0.759
440	0.035	0.386	0.116	24.1	0.24	0.30	2.55	1.14	6	0.567	0.622

TOTAL ONSITE AREA 1.35 SQ.MI.

SHEET 2 OF 2

** GREEN AND AMPT RAINFALL LOSS PARAMETERS FOR EXISTING OFFSITE AREAS AND EXISTING ONSITE AREA ARE WEIGHTED BY AREA OF INDIVIDUAL SOIL TYPES WITHIN EACH SUB-BASIN.

SUN CITY WEST EXPANSION
DRAINAGE ROUTING SCHEMATIC FOR MODEL 11028M

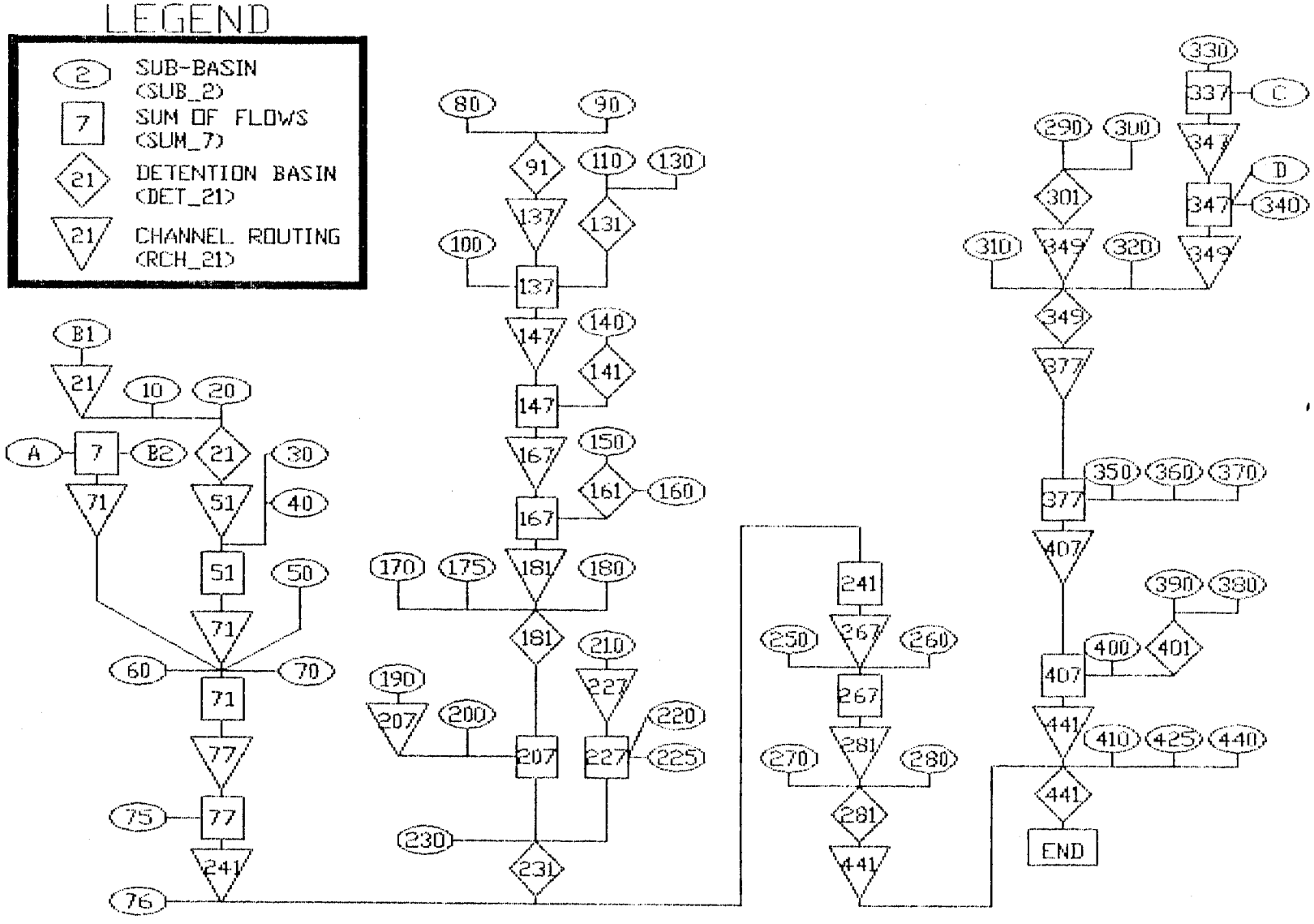

FIGURE 8

RATMETH 1-7-92

RATIONAL METHOD FOLLOWS THE PROCEDURE OUTLINED IN THE FCDMC HYDROLOGIC DESIGN MANUAL.

TIME OF CONCENTRATION

The following equation is used in conjunction with Fig. 3.2 in Hydro Manual.

Tc = 11.4*L^(.5)*Kb^(.52)*S^(-.31)*i^(-.38)

Tc is the Time of Concentration (hours)
L is the length of the longest flow path in the sub-basin (miles)
Kb is the watershed resistance coefficient (weighted by land use)
S is the slope of the watercourse (feet/mile)
i is the rainfall intensity (inches/hour)

RESISTANCE COEFFICIENT PARAMETERS

m(residential) = -0.00625 Kb = m * logA + b
m(golf/open sp) = -0.025
b(residential) = 0.04
b(golf/open sp) = 0.15

SPECIFIC SUB-BASIN DATA

Sub-Basin #	Area (acres)	Length (ft)	Length (mi)	Slope (ft/mi)	Resist. Coeff Kb	Land Use (percent)	
290	13.66	1480	0.280	30.4	0.099	SF/25	GOL/75
300	13.46	2000	0.379	30.3	0.033	SF/100	
410	35.83	3000	0.568	25.5	0.030	SF/100	

CALCULATION OF Tc

SUB-BASIN 290		assume initial value for i:	4.90 in/hr		
Tc =	0.34 hours	so the new i is:	5.00 in/hr	recalc Tc	
Tc =	0.34 hours	so ..... i is:	5.00 in/hr	<< USE THIS	
SUB-BASIN 300		assume initial value for i:	6.30 in/hr		
Tc =	0.21 hours	so the new i is:	6.50 in/hr	recalc Tc	
Tc =	0.20 hours	so ..... i is:	6.50 in/hr	<< USE THIS	
SUB-BASIN 410		assume initial value for i:	5.50 in/hr		
Tc =	0.27 hours	so the new i is:	5.60 in/hr	recalc Tc	
Tc =	0.27 hours	so ..... i is:	5.60 in/hr	<< USE THIS	

COEFFICIENTS OF RUNOFF
C-factors are weighted by area of different land uses within the sub-basin.

	Raw C-value	Frequency Factor	Adjusted C-value
SFR	0.5	1.25	0.63
CAS	0.5	1.25	0.63
GOLF	0.28	1.25	0.35
COMM	0.7	1.25	0.88

SUB-BASIN 290	SFR =	25 %	GOLF =	75 %
Weighted C =	0.42			
SUB-BASIN 300	SFR =	100 %		
Weighted C =	0.63			
SUB-BASIN 410	SFR =	100 %		
Weighted C =	0.63			

CALCULATION OF RUNOFF

SUB-BASIN #	C	i (in/hr)	A (acres)	Q (cfs)
SUB290	0.42	5.00	13.66	28.60
SUB300	0.63	6.50	13.46	54.68
SUB410	0.63	5.60	35.83	125.40

COMPARISON OF RATIONAL METHOD TO CLARK UNIT HYDROGRAPH

USING SUB-BASINS 290, 300 & 410

PARAMETER	FCDMC RATIONAL METHOD SUB290	SUB300	SUB410	CLARK UNIT HYDROGRAPH METHOD SUB290	SUB300	SUB410	
AREA	13.66	13.46	35.83 acres	0.021	0.021	0.056 sq mi	*
AREA	----	----	----	0.02	0.02	0.06 sq mi	**
AREA	----	----	----	12.8	12.8	38.4 acres	***
LENGTH	1480	2000	3000 feet	0.28	0.38	0.57 miles	
SLOPE	30.4	30.3	25.5 ft/mi	30.4	30.3	25.5 ft/mi	
Kb	0.10	0.03	0.03	0.120	0.030	0.030	
C	0.42	0.63	0.63	NA	NA	NA	
IA	NA	NA	NA	0.23	0.15	0.15	
DTHETA	NA	NA	NA	0.30	0.28	0.28	
PSIF	NA	NA	NA	2.65	3.40	3.40	
XKSAT	NA	NA	NA	1.10	0.80	0.80	
RTIMP	NA	NA	NA	10	37	37	
Tc	0.34	0.20	0.27 hrs	0.40	0.17	0.23 hrs	
R	NA	NA	NA	0.44	0.21	0.24	
i	5.00	6.50	5.60	NA	NA	NA	
P	2.77	2.77	2.77	2.77	2.77	2.77	
Q	28.60	54.68	125.40 cfs	21	45	108 cfs	
Q	2.09	4.06	3.50	1.64	3.50	2.81 cfs/ac	
VOL	1.32	1.94	5.17 ac-ft	1	2	5 ac-ft	

* HEC-1 input areas
** HEC-1 rounded off areas
*** acres corresponding to HEC-1 roundoff

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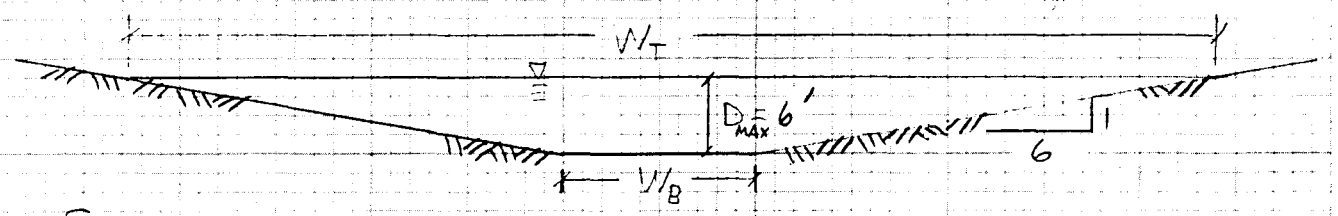
APPROVED BY	DATE	[illegible]	

TYPICAL DETENTION BASIN CROSS-SECTION

ASSUMPTIONS:

1) FLAT BOTTOM
2) CONSTANT SIDE SLOPE
3) DEPTH IS 4 FEET
4) ENDS ARE SQUARE

LENGTH = L (ft)



$$S_{BASIN} = A \cdot D$$

$$= \left(\frac{W_T + W_B}{2}\right) \cdot L \cdot D$$

$$= \left(\frac{W_B + SS \cdot D \cdot 2 + W_B}{2}\right) \cdot L \cdot D$$

$$S_{BASIN} = \frac{(W_B \cdot D + SS \cdot D^2) \cdot L}{43560} \quad [AC \cdot FT]$$

$$W_T = W_B + 2 \cdot SS \cdot D$$

SEE ALSO "STORAGE CAPACITY TABLES FOR 6:1 SIDE SLOPES

STORAGE CAPACITY TABLES
FOR
PRELIMINARY DETENTION BASINS

STORAGE CAPACITY TABLES

DEPTH = 1.00 FEET
SIDE SLOPE = 6.00 :1

L>>>> Wb	200	400	500	600	700	800	900	1000	Wtop
0	0.03	0.06	0.07	0.08	0.10	0.11	0.12	0.14	12
50	0.26	0.51	0.64	0.77	0.90	1.03	1.16	1.29	62
100	0.49	0.97	1.22	1.46	1.70	1.95	2.19	2.43	112
150	0.72	1.43	1.79	2.15	2.51	2.87	3.22	3.58	162
200	0.95	1.89	2.36	2.84	3.31	3.78	4.26	4.73	212
250	1.18	2.35	2.94	3.53	4.11	4.70	5.29	5.88	262

DEPTH = 2.00 FEET
SIDE SLOPE = 6.00 :1

L>>>> Wb	200	400	500	600	700	800	900	1000	Wtop
0	0.11	0.22	0.28	0.33	0.39	0.44	0.50	0.55	24
50	0.57	1.14	1.42	1.71	1.99	2.28	2.56	2.85	74
100	1.03	2.06	2.57	3.09	3.60	4.11	4.63	5.14	124
150	1.49	2.98	3.72	4.46	5.21	5.95	6.69	7.44	174
200	1.95	3.89	4.87	5.84	6.81	7.79	8.76	9.73	224
250	2.41	4.81	6.01	7.22	8.42	9.62	10.83	12.03	274

DEPTH = 3.00 FEET
SIDE SLOPE = 6.00 :1

L>>>> Wb	200	400	500	600	700	800	900	1000	Wtop
0	0.25	0.50	0.62	0.74	0.87	0.99	1.12	1.24	36
50	0.94	1.87	2.34	2.81	3.28	3.75	4.21	4.68	86
100	1.63	3.25	4.06	4.88	5.69	6.50	7.31	8.13	136
150	2.31	4.63	5.79	6.94	8.10	9.26	10.41	11.57	186
200	3.00	6.01	7.51	9.01	10.51	12.01	13.51	15.01	236
250	3.69	7.38	9.23	11.07	12.92	14.77	16.61	18.46	286

DEPTH = 4.00 FEET
SIDE SLOPE = 6.00 :1

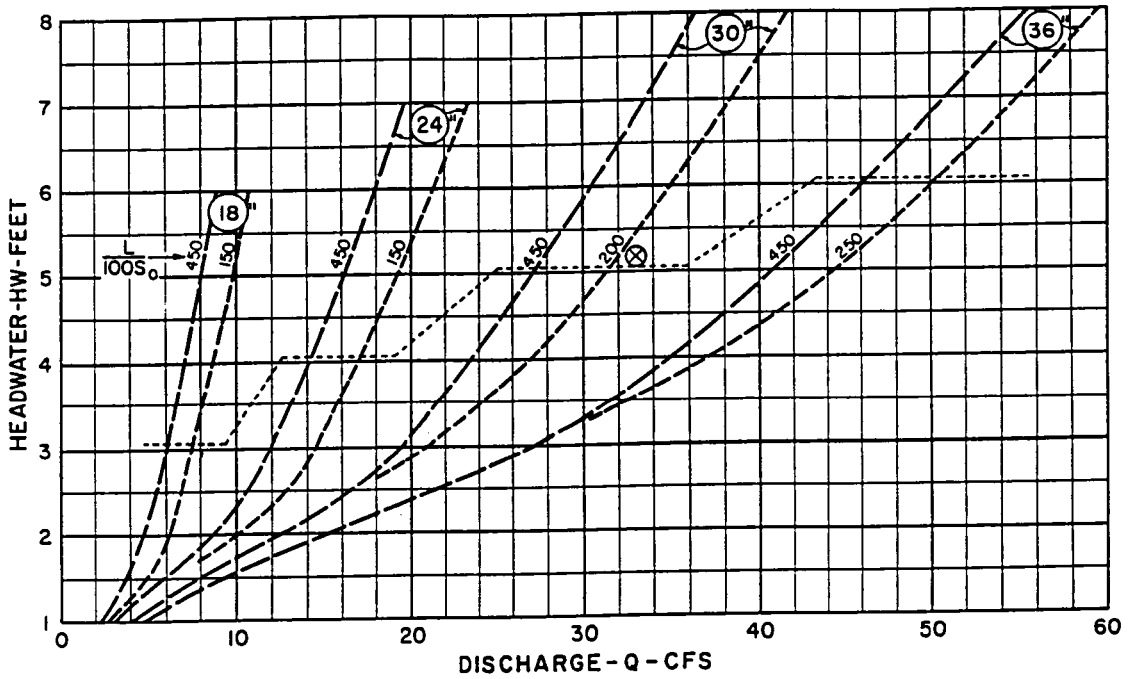
L>>>> Wb	200	400	500	600	700	800	900	1000	Wtop
0	0.44	0.88	1.10	1.32	1.54	1.76	1.98	2.20	48
50	1.36	2.72	3.40	4.08	4.76	5.44	6.12	6.80	98
100	2.28	4.55	5.69	6.83	7.97	9.11	10.25	11.39	148
150	3.20	6.39	7.99	9.59	11.18	12.78	14.38	15.98	198
200	4.11	8.23	10.28	12.34	14.40	16.46	18.51	20.57	248
250	5.03	10.06	12.58	15.10	17.61	20.13	22.64	25.16	298

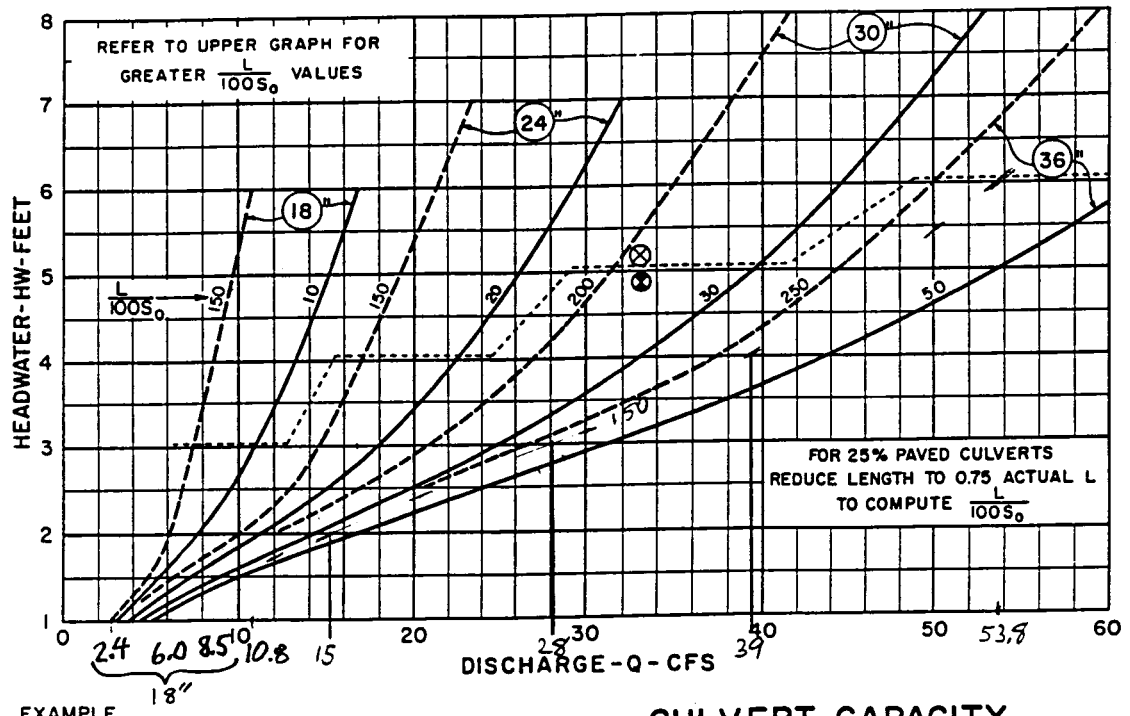
DEPTH = 6.00 FEET
SIDE SLOPE = 6.00 :1

L>>>> Wb	200	400	500	600	700	800	900	1000	Wtop
0	0.99	1.98	2.48	2.98	3.47	3.97	4.46	4.96	72
50	2.37	4.74	5.92	7.11	8.29	9.48	10.66	11.85	122
100	3.75	7.49	9.37	11.24	13.11	14.99	16.86	18.73	172
150	5.12	10.25	12.81	15.37	17.93	20.50	23.06	25.62	222
200	6.50	13.00	16.25	19.50	22.75	26.01	29.26	32.51	272
250	7.88	15.76	19.70	23.64	27.58	31.52	35.45	39.39	322

ASSUME $L = 75'$
$S_0 = .005'/FT$

CHART 19





EXAMPLE

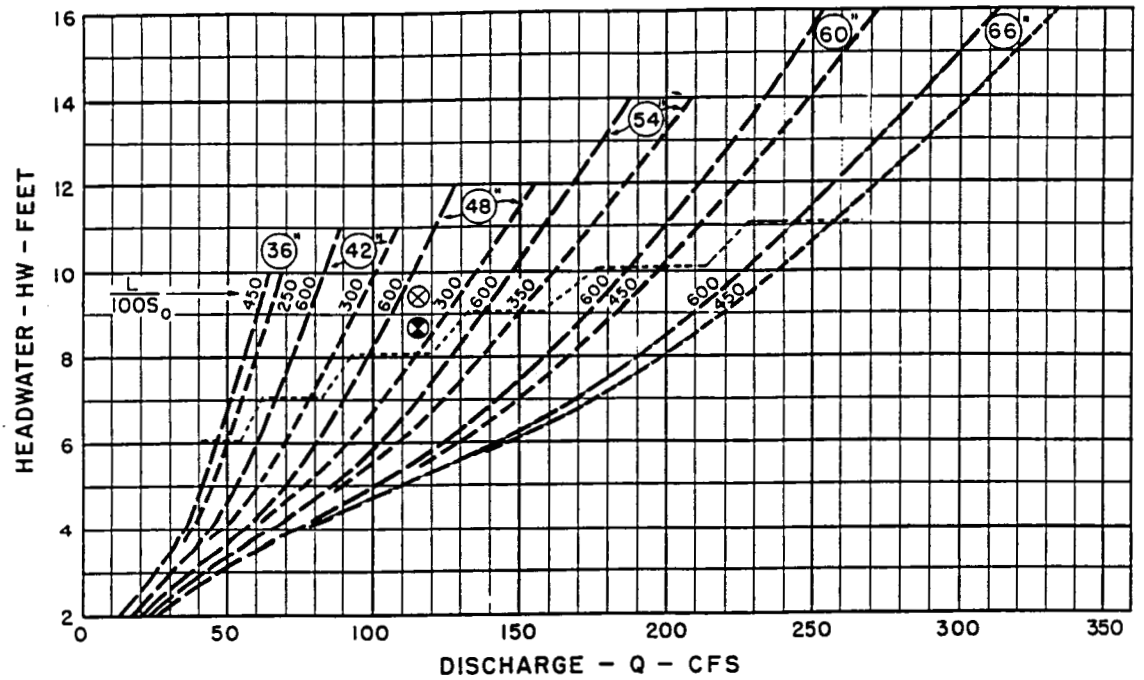
⊗ GIVEN:
33 CFS; AHW = 5.2 FT.
L = 70 FT.; S_0 = 0.005

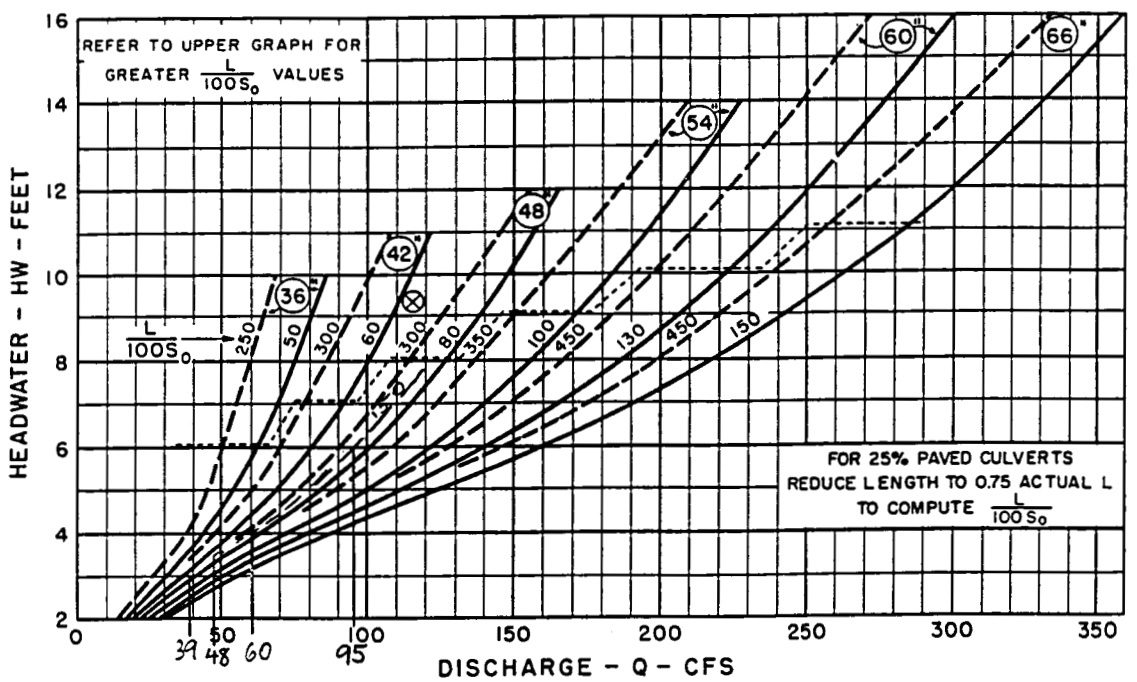
⊗ SELECT 30" UNPAVED
HW = 4.9 FT.

CULVERT CAPACITY
STANDARD
CIRCULAR CORR. METAL PIPE
PROJECTING ENTRANCE
18" TO 36" ○

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 20





EXAMPLE

⊗ GIVEN:
115 CFS; AHW = 9.4 FT.
L = 135 FT.; S_0 = 0.0034

⊗ SELECT 48" UNPAVED
HW = 8.6 FT.

CULVERT CAPACITY STANDARD

CIRCULAR CORR. METAL PIPE PROJECTING ENTRANCE 36" TO 66" ○

BUREAU OF PUBLIC ROADS JAN. 1963

ASSUME $L = 75'$
$S_0 = .005'/FT$

DESIGNED BY D. STOUGH DATE 12-27-91 SHEET NO. 1 PAGE NO.
CHECKED BY DATE OF 2 JOB NO.
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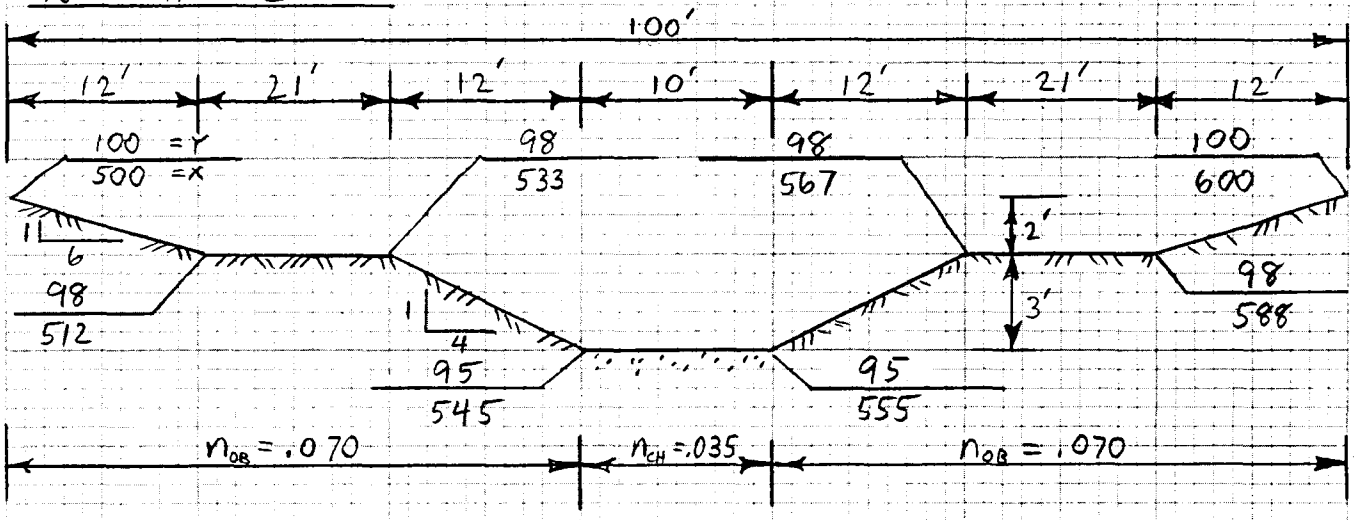
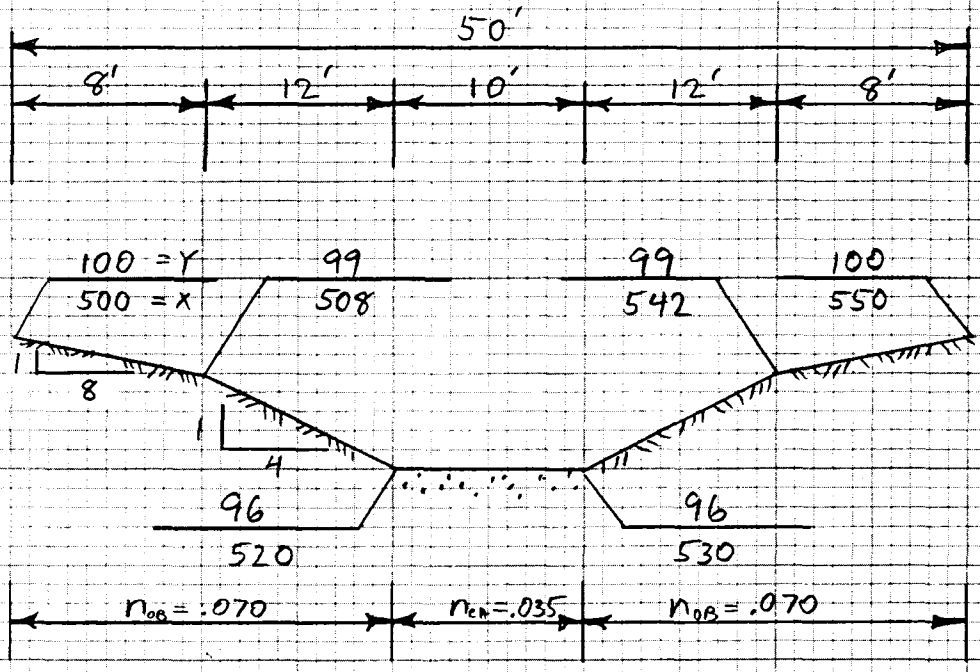
APPROVED BY DATE ROUTING CHANNEL X-SECTIONS.

TYPICAL CHANNEL CROSS-SECTIONS IN GOLF COURSE

100' CHANNEL



50' CHANNEL



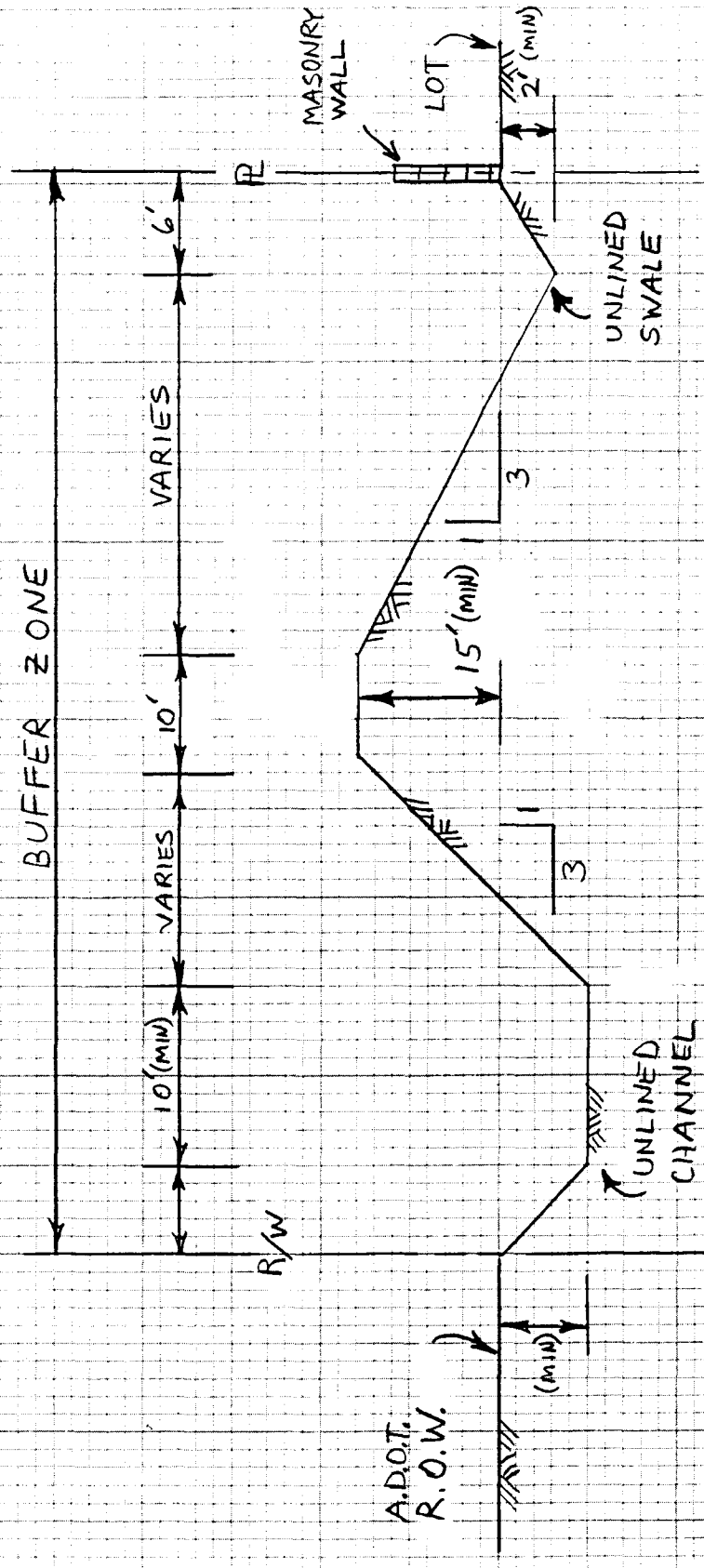
SC 3020

DESIGNED BY D.STOUGH DATE 1-6-91 SHEET NO. PAGE NO.
CHECKED BY DATE OF JOB NO.
REVIEWED BY DATE SUBJECT: TYPICAL CROSS-SECTION FOR FREEWAY BUFFER ZONE
APPROVED BY DATE

FREEWAY BUFFER ZONE

TYPICAL CROSS-SECTION

(NTS)



SC 3020

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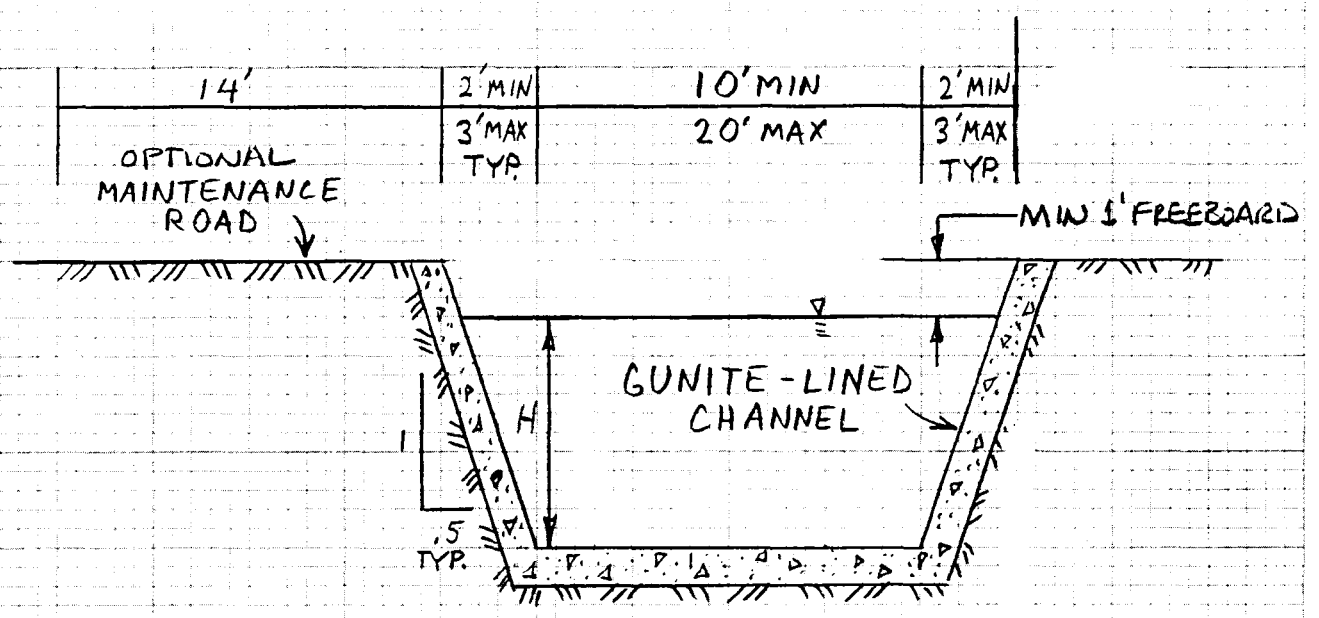
APPROVED BY DATE X-SECTION

TYPICAL GUNITE LINED CHANNEL



CAPACITY DETERMINED USING MANNINGS EQUATION

ASSUME NORMAL DEPTH; NO BACKWATER EFFECT

$$\text{CAPACITY} = \frac{1.486}{n} * \left(\frac{A}{WP}\right)^{2/3} * S^{1/2} * A$$

S IS THE AVERAGE SLOPE OF THE CHANNEL BED

ASSUME S = .003'/FT MIN.

n FOR GUNITE-LINED CHANNEL IS ASSUMED TO BE

n = 0.016 (MANNINGS n-VALUE)

A AND WP VARY WITH H

	10' BOTTOM WIDTH			20' BOTTOM WIDTH		
H(FT)	A (SQ.FT)	V(FPS)	Q(CFS)	A (SQ.FT.)	V(FPS)	Q(CFS)
1	10.5	4.9	51.4	20.5	5.0	102.2
2	22.0	7.5	165.5	42.0	7.8	326.5
3	34.5	9.6	330.4	64.5	10.0	645.9
4	48.0	11.3	543.0	88.0	11.9	1050.7
5	62.5	12.8	802.3	112.5	13.7	1535.8
6	78.0	14.2	1108.3	138.0	15.2	2098.1

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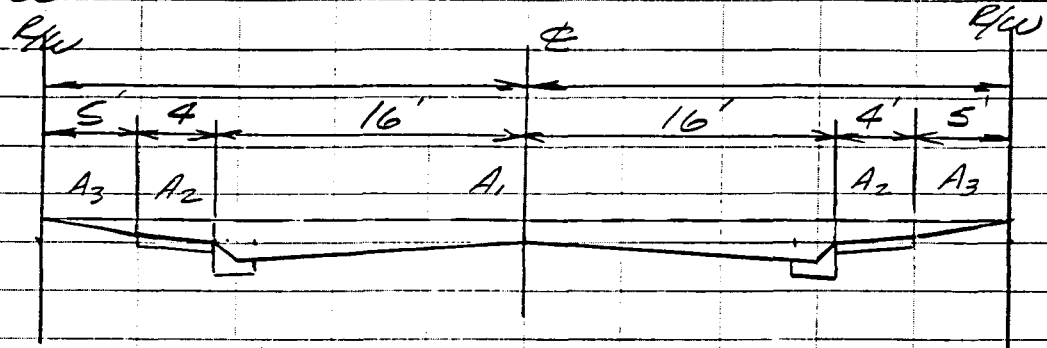
Job No. Page No.
Subject SUN CITY WEST EXP.

Sheet No. 1 of 4

STREET FLOW CAPACITIES

$Q = V \times A$): $V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$): $n = 0.015$



FLOW TO TOP OF CURB

$A = 16 \times 0.33 = 5.28$, $w.p. = 32.1$ $R^{2/3} = 0.30$

FLOW 0.1 FT ABOVE CURB

$A_1 = 5.28 + 32 \times 0.1 = 8.48$, $wp = 32.3$ $R^{2/3} = 0.41$

$A_2 = (0.04 + 0.1)\frac{1}{2} \times 4 = 0.28$, $wp = 4.14$ $R^{2/3} = 0.166$

FLOW 0.2 FT ABOVE CURB

$A_1 = 8.48 + 32 \times 0.1 = 11.68$, $w.p = 32.5$, $R^{2/3} = 0.505$

$A_2 = (0.14 + 0.2)\frac{1}{2} \times 4 = 0.68$, $wp = 4.34$, $R^{2/3} = 0.291$

$A_3 = 0.14 \times 5 \times \frac{1}{2} = 0.35$, $wp = 5.14$, $R^{2/3} = 0.167$

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Subject SUN CITY WEST EXT

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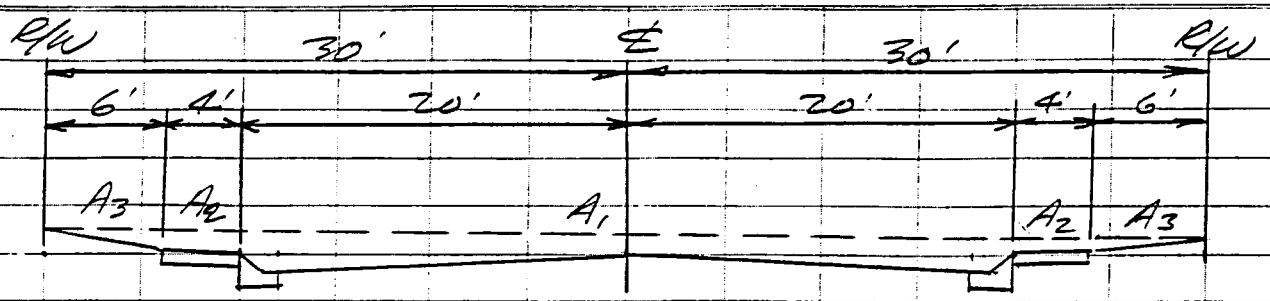
Sheet No. 2 of 4



ROLL CURB

TOP OF CURB

$A = 16 \times 0.33 = 5.28$, $w.p. = 32.1$, $R^{2/3} = 0.30$

FLOW 0.1' ABOVE CURB

$A_1 = 0.41 \times 20 + 0.02 \times 40 = 9.00$, $WP = 40.3$ $R^{2/3} = 0.368$

$A_2 = (0.04 + 0.1)\frac{1}{2} \times 4 = 0.28$, $wp = 4.14$ $R^{2/3} = 0.166$

FLOW 0.2' ABOVE CURB

$A_1 = 9.00 + 0.1 \times 40 = 13.0$, $WP = 40.5$ $R^{2/3} = 0.469$

$A_2 = (0.14 + 0.2)\frac{1}{2} \times 4 = 0.68$, $wp = 4.34$, $R^{2/3} = 0.291$

$A_3 = 0.14 \times 6 \times \frac{1}{2} = 0.42$, $wp = 6.14$, $R^{2/3} = 0.167$

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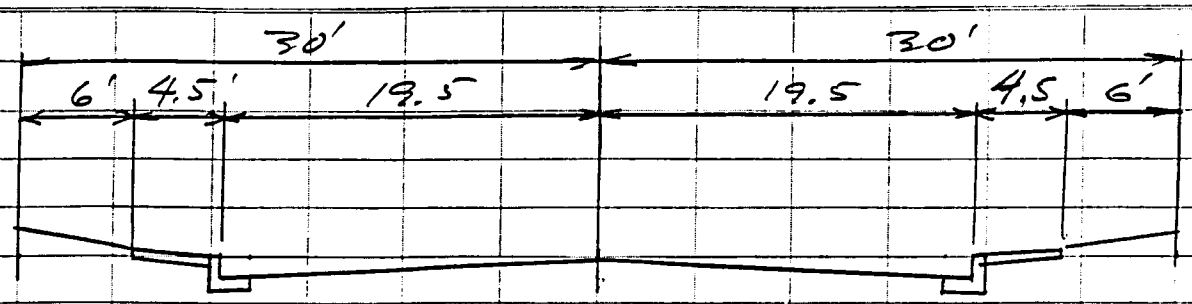
Job No. Page No.
Subject SUN CITY WEST EXIT

Sheet No. 3 of 4



6" VERT. CURB

TOP OF CURB

$A = (0.5+0.08)\frac{1}{2} \times 19.5 \times 2 = 11.31 \quad W.P. = 41.0, \; R^{2/3} = 0.424$

FLOW 0.1' ABOVE CURB

$A_1 = 11.31 + 0.1 \times 39 = 15.21 \quad WP = 41.2, \; R^{2/3} = 0.515$

$A_2 = (0.04+0.1)\frac{1}{2} \times 4.5 = 0.32 \quad WP = 4.64, \; R^{2/3} = 0.166$

FLOW 0.2' ABOVE CURB

$A_1 = 15.21 + 0.1 \times 39 = 19.11 \quad WP = 41.4, \; R^{2/3} = 0.597$

$A_2 = (0.14+0.2)\frac{1}{2} \times 4.5 = 0.77, \; WP = 4.84, \; R^{2/3} = 0.292$

$A_3 = 0.14 \times 6 \times \frac{1}{2} = 0.42, \; WP = 6.14, \; R^{2/3} = 0.167$

Job No. 1 Page No.

Computed by AL Date 11-19-1991 Subject SUN CITY WEST EXT.

Checked by Date

Reviewed by Date

Approved by Date Sheet No. 4 of 4

50' STREET - STORM DRAINAGE CAPACITY
ROLL CURB & GUTTER - 2% CROSS SLOPES -

DEPTH OF FLOW	STREET SLOPE 0.25%	0.30%	0.40%	0.50%	0.60%	0.70%
T.C.	7.9	8.6	9.9	11.1	12.2	13.1
T.C.+0.1	17.7	19.4	22.4	25.0	27.4	29.5
TC+0.2	31.0	34.0	39.3	43.9	48.1	51.9

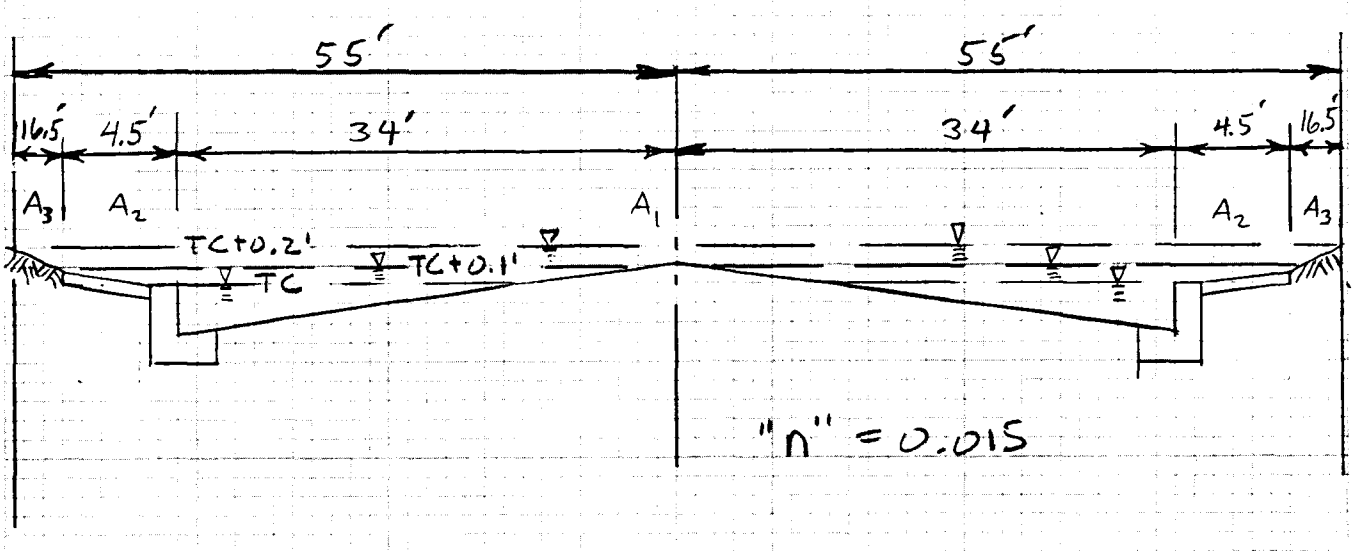
60' STREET - STORM DRAINAGE CAPACITY
ROLL CURB & GUTTER - 2% CROSS SLOPE

DEPTH OF FLOW	STREET SLOPE 0.25%	0.3%	0.4%	0.5%	0.6%	0.7%
T.C.	7.9	8.6	9.9	11.1	12.2	13.1
T.C.+0.1'	16.9	18.5	21.3	23.9	26.1	28.3
T.C.+0.2'	32.5	35.6	41.2	46.0	50.3	54.4

60' STREET - STORM DRAINAGE CAPACITY
6" VERT. CURB & GUTTER - 2% CROSS SLOPE

DEPTH OF FLOW	STREET SLOPE 0.25%	0.30%	0.40%	0.50%	0.60%	0.70%
T.C.	23.8	26.0	30.1	33.6	36.8	39.8
T.C.+0.1'	39.4	43.1	49.7	55.6	60.9	65.8
T.C.+0.2'	59.1	64.7	74.8	83.6	91.5	98.9

DESIGNED BY D. STRICH DATE 1-3-12 SHEET NO. ..... PAGE NO. .....
CHECKED BY ..... DATE ..... OF ..... JOB NO. .....
REVIEWED BY ..... DATE ..... SUBJECT: SUNCITY WEST EXTENSION
APPROVED BY ..... DATE .....



68' STREET (FACE CURB) - STORM DRAINAGE CAPACITY
VERTICAL CURB & GUTTER - 2 % CROSS-SLOPES - FULL STREET

DEPTH OF FLOW	0.002	0.004	0.006	0.008	0.010	0.012
T.C.*	16.8 CFS	23.0 CFS	29.0 CFS	32.0 CFS	37.0 CFS	40.0 CFS
T.C. + 0.1'	34.2	48.4	59.2	68.4	76.4	85.8
T.C. + 0.2'	50.5	71.4	87.4	100.9	112.9	123.6

FLOW @ T.C. USE GUTTER FLOW CAPACITY CHART * (A_1 = 6.25 SQ.FT.) HALF STREET

FLOW @ T.C. + 0.1'

$A_1 = (0.6 * 30')/2 = 9.0$ $A_2 = (.04 + .10)/2 * 4.5 = 0.32$

$A_{1/2\,STR} = 9.32$ S.F. $WP_{1/2\,STR} = 30' + 0.5 + 4.5 = 35.0'$

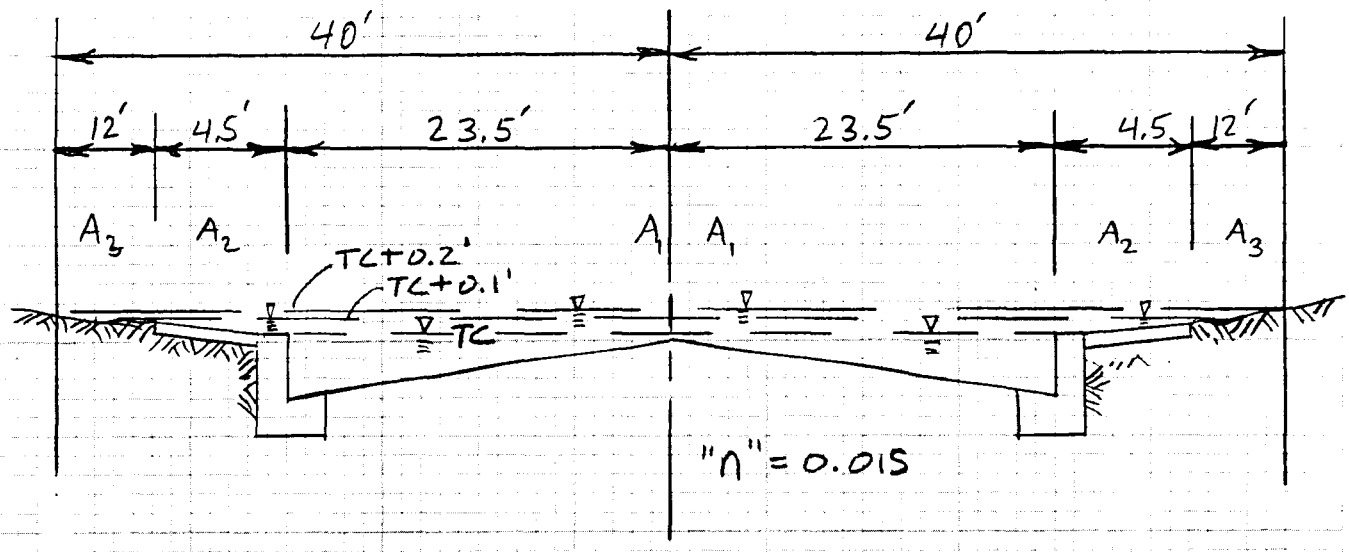
FLOW @ T.C. + 0.2'

$A_1 = (0.68 * 34)/2 + 34' * .02 = 12.24$ $A_2 = (.14 + .20)/2 * 4.5 = .76$

$A_3 = (0 + .14)/2 * 16.5 = 1.16$

$A_{1/2\,STR} = 14.16$ S.F. $WP_{1/2\,STR} = 34 + 5.0 + 16.5 = 55.5$

DESIGNED BY L. STOUGH DATE 1-3-92 SHEET NO. PAGE NO.
CHECKED BY DATE OF JOB NO.
REVIEWED BY DATE SUBJECT: SUN CITY WEST EXTENSION
APPROVED BY DATE



47' STREET (FACE CURB) - STORM DRAINAGE CAPACITY
VERTICAL CURB & GUTTER - 2% CROSS-SLOPES

DEPTH OF FLOW	0.002'/FT	0.004	0.006	0.008	0.010	0.012
T.C.*	16.8 CFS	23.0 CFS	29.0 CFS	32.0 CFS	37.0 CFS	40.0 CFS
T.C. + 0.1'	35.4	50.2	61.4	71.0	79.4	87.0
T.C. + 0.2'	50.0	70.7	86.6	100.0	111.8	122.4

FLOW @ T.C. +0.1'

$A_1 = 6.11 + 0.1 * 23.5 = 8.46$ $A_2 = (.04+.10)/2 * 4.5 = .32$

$A_{1/2 STR} = 8.46 + 0.32 = 8.78$ $WP_{1/2 STR} = 23.5 + .5 + 4.5 = 28.5$

FLOW @ T.C. +0.2'

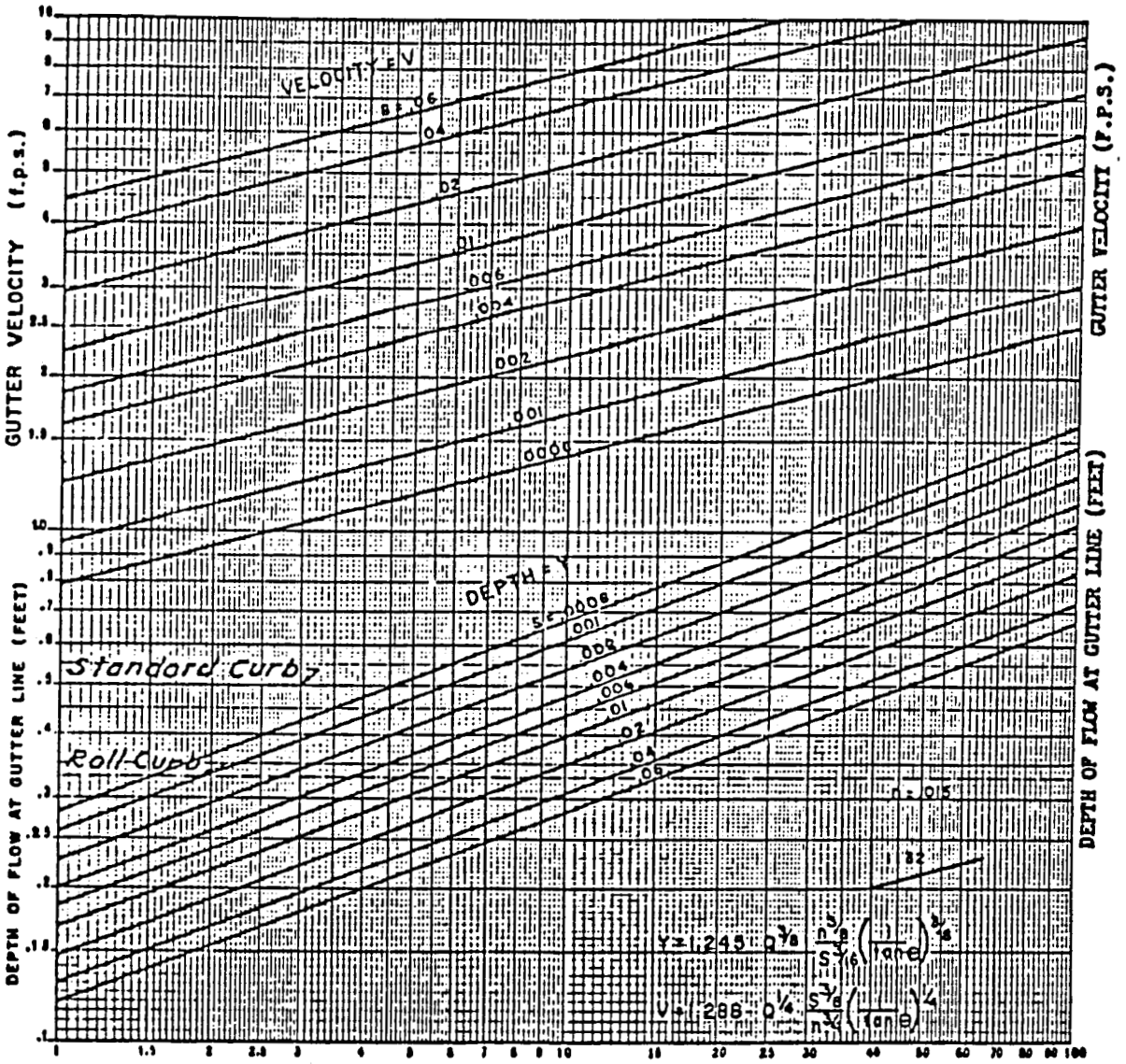
$A_1 = 6.11 + 0.2 * 23.5 = 10.81$ $A_2 = (.14+.20)/2 * 4.5 = .76$

$A_3 = (0+.14)/2 * 12.0 = 0.84$

$A_{1/2 STR} = 10.81 + 0.76 + 0.84 = 12.41$ S.F. $WP = 23.5 + 5.0 + 12.0 = 40.5'$

* NOTE: FOR FLOW @ T.C. USE GUTTER FLOW CAPACITY CHART
$A_{1/2 STR} = 6.11$ S.F.

GUTTER FLOW CAPACITY CHART
CITY OF PHOENIX
STORM DRAIN DESIGN MANUAL

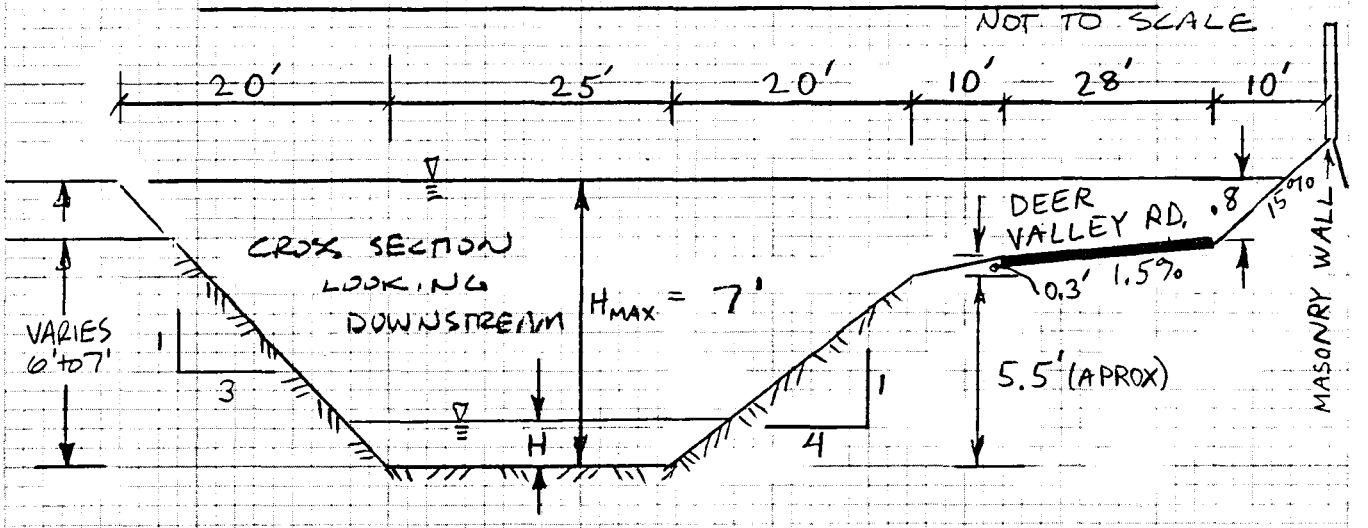


GUTTER FLOW = Q (C.F.S.)

DESIGNED BY D. STOWOH DATE 1-6-92 SHEET NO. PAGE NO.
CHECKED BY DATE OF JOB NO.
REVIEWED BY DATE SUBJECT: SUN CITY WEST EXPANSION
APPROVED BY DATE

TYPICAL CHANNEL ALONG DEER VALLEY RD. FROM 135th AVENUE TO 123rd AVENUE

NOT TO SCALE



CAPACITY DETERMINED USING MANNINGS EQUATION

ASSUME NORMAL DEPTH; NO BACKWATER EFFECT

$$\text{CAPACITY} = \frac{1.486}{n} * \left(\frac{A}{WP}\right)^{2/3} * S^{1/2} * A$$

S IS THE AVERAGE SLOPE OF THE CHANNEL BED

$S = (1263 - 1255)/4100' = 0.002'/FT$

"n" FOR AN UNLINED CHANNEL IN FAIR CONDITION IS ASSUMED TO BE 0.025 "n" FOR OVERBANK = 0.020

A (AREA) AND WP (WETTED PERIMETER) VARY WITH H.

H (FT)	TOTAL A (SQ. FT.)	CHANNEL V (FPS)	Q (CFS)
1	29.2	2.0	58.3
2	63.3	3.1	196.1
3	107.8	3.8	409.5
4	156.1	4.5	702.5
5	211.9	5.1	1081.0
5.5	241.5	5.4	1304.2
5.8	264.1	5.6	1467.
6.2	299.4	5.9	1718
7.0	383.2	6.4	2305

APPENDIX C
HEC-1 PRINTOUT

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
  RUN DATE  01/10/1992  TIME  11:06:53 *
*                                       *
*****************************************
```

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

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

  1           ID
  2           ID        SUN CITY WEST EXPANSION
  3           ID        STANLEY CONSULTANTS JOB # 11028   DATE: 9 JAN 92
  4           ID        HEC-1 MODEL 11028H (NATURAL CONDITIONS OVERALL)
  5           ID        CLARK UNIT HYDROGRAPH
  6           ID
  7           ID        2-HR STORM DISTRIBUTION (TABLE 2.2) P100 = 2.77"
  8           ID        NO AREAL REDUCTION FACTOR
  9           ID
 10           ID        GREEN-AMPT LOSS RATES FOR EXISTING CONDITIONS BASED ON
 11           ID              AREA-WEIGHTED VALUES OF EXISTING SOILS ASSUMING DTHETA NORMAL
 12           ID              AND VEGETATIVE COVER 25 PERCENT.
 13           ID              IA ASSUMED TO BE 0.25 INCHES AND PERCENT IMPERVIOUS ASSUMED
 14           ID              TO BE 1 PERCENT.
 15           ID
 16           ID        Kb BASED ON m = -0.025 and b = 0.15
 17           ID
 18           ID        TIME OF CONCENTRATION AND STORAGE COEFFICIENT R
 19           ID              BASED ON RESULTS FROM MCUHP1
 20           ID
 21           ID        TIME-AREA RELATION FROM TABLE 5.2, USE NATURAL
 22           ID              TIME-AREA UA RECORD
 23           ID
              *DIAGRAM
 24           IT      5                   150
 25           IO      3

 26           KK  SUBTOT
 27           KM   SUB-BASIN TOTAL - OFFSITE AREAS A, B1, B2, C AND D AND ONSITE AREA E
 28           KM   CONC. PT. IS AT THE SOUTH EAST CORNER OF THE JOBSITE
 29           BA   2.930
 30           IN      5
 31           PB   2.770
 32           PC    .000    .011    .018    .023    .028    .032    .046    .071    .100    .137
 33           PC    .176    .232    .327    .601    .743    .863    .901    .930    .954    .962
 34           PC    .970    .979    .982    .992   1.000
 35           LG    .250     .26    5.55     .22   1.000
 36           UC   1.383    .627
 37           UA      0       3       5       8      12      20      43      75      90      96
 38           UA    100
 39           ZZ
```

1

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

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   26      SUBTOT

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*            SEPTEMBER 1990            *                    *   HYDROLOGIC ENGINEERING CENTER      *
*             VERSION 4.0              *                    *         609 SECOND STREET            *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE  01/10/1992  TIME  11:06:53 *                    *          (916) 756-1104              *
*                                      *                    *                                      *
****************************************                    ****************************************
```

SUN CITY WEST EXPANSION
STANLEY CONSULTANTS JOB # 11028 DATE: 9 JAN 92
HEC-1 MODEL 11028H (NATURAL CONDITIONS OVERALL)
CLARK UNIT HYDROGRAPH

2-HR STORM DISTRIBUTION (TABLE 2.2) P100 = 2.77"
NO AREAL REDUCTION FACTOR

GREEN-AMPT LOSS RATES FOR EXISTING CONDITIONS BASED ON
AREA-WEIGHTED VALUES OF EXISTING SOILS ASSUMING DTHETA NORMAL
AND VEGETATIVE COVER 25 PERCENT.
IA ASSUMED TO BE 0.25 INCHES AND PERCENT IMPERVIOUS ASSUMED
TO BE 1 PERCENT.

Kb BASED ON m = -0.025 and b = 0.15

TIME OF CONCENTRATION AND STORAGE COEFFICIENT R
BASED ON RESULTS FROM MCUHP1

TIME-AREA RELATION FROM TABLE 5.2, USE NATURAL
TIME-AREA UA RECORD

```
 25 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        150  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME       1225  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE   12.42 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
              STORAGE VOLUME         ACRE-FEET
              SURFACE AREA           ACRES
              TEMPERATURE            DEGREES FAHRENHEIT
```

*** ***

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

```
26 KK     *    SUBTOT  *
          *            *
          **************
                         SUB-BASIN TOTAL - OFFSITE AREAS A, B1, B2, C AND D AND ONSITE AREA E
                         CONC. PT. IS AT THE SOUTH EAST CORNER OF THE JOBSITE

30 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN           5  TIME INTERVAL IN MINUTES
                   JXDATE      1    0  STARTING DATE
                   JXTIME           0  STARTING TIME

             SUBBASIN RUNOFF DATA

29 BA          SUBBASIN CHARACTERISTICS
                    TAREA        2.93  SUBBASIN AREA

               PRECIPITATION DATA

31 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

32 PI            INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

35 LG          GREEN AND AMPT LOSS RATE
                   STRTL         .25  STARTING LOSS
                     DTH         .26  MOISTURE DEFICIT
                    PSIF        5.55  WETTING FRONT SUCTION
                   XKSAT         .22  HYDRAULIC CONDUCTIVITY
                   RTIMP        1.00  PERCENT IMPERVIOUS AREA

36 UC          CLARK UNITGRAPH
                      TC        1.38  TIME OF CONCENTRATION
                       R         .63  STORAGE COEFFICIENT

37 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                   100.0
                                                          ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                            CLARK   TC=  1.38 HR,       R=   .63 HR
                                           SNYDER   TP=  1.11 HR,      CP=   .96

                                                      UNIT HYDROGRAPH
                                                 51 END-OF-PERIOD ORDINATES
                26.       71.      101.      129.      161.      201.      256.      339.      523.      815.
              1185.     1527.     1682.     1672.     1586.     1473.     1344.     1196.     1047.      917.
               803.      703.      615.      538.      471.      413.      361.      316.      277.      242.
               212.      186.      162.      142.      124.      109.       95.       84.       73.       64.
                56.       49.       43.       38.       33.       29.       25.       22.       19.       17.
                15.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUBTOT

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.17, TOTAL EXCESS =    1.60

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                          (CFS)
+    2551.      2.17                   503.        243.        243.        243.
                         (INCHES)    1.595       1.595       1.595       1.595
                          (AC-FT)      249.        249.        249.        249.

                        CUMULATIVE AREA =    2.93 SQ MI

1
                                                   RUNOFF SUMMARY
                                             FLOW IN CUBIC FEET PER SECOND
                                           TIME IN HOURS,  AREA IN SQUARE MILES

                                      PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
        OPERATION      STATION       FLOW    PEAK                                           AREA      STAGE     MAX STAGE
+                                                          6-HOUR     24-HOUR     72-HOUR
```

	HYDROGRAPH AT						
+		SUBTOT	2551.	2.17	503.	243.	243.	2.93

*** NORMAL END OF HEC-1 ***

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*          SEPTEMBER 1990              *
*           VERSION 4.0                *
*                                      *
  RUN DATE  01/10/1992  TIME  11:07:40 *
*                                      *
****************************************
```

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

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X    X         XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X    X         X
X     X  XXXXXXX   XXXXX         XXX
```

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

  1           ID
  2           ID        SUN CITY WEST EXPANSION
  3           ID        STANLEY CONSULTANTS JOB # 11028   DATE: 08 JAN 92
  4           ID        HEC-1 MODEL 11028I (NATURAL COND ONSITE AND OFFSITE)
  5           ID
  6           ID        CLARK UNIT HYDROGRAPH
  7           ID
  8           ID        2-HR STORM DISTRIBUTION (TABLE 2.2) P100 = 2.77"
  9           ID        NO AREAL REDUCTION FACTOR  (TYPICAL FOR ALL AREAS)
 10           ID
 11           ID        GREEN-AMPT LOSS RATES FOR EXISTING CONDITIONS BASED ON
 12           ID              AREA-WEIGHTED VALUES OF EXISTING SOILS ASSUMING DTHETA NORMAL
 13           ID              AND VEGETATIVE COVER 25 PERCENT.
 14           ID              IA ASSUMED TO BE 0.25 INCHES AND PERCENT IMPERVIOUS ASSUMED
 15           ID              TO BE 1 PERCENT.
 16           ID
 17           ID        Kb BASED ON m = -0.025 and b = 0.15
 18           ID
 19           ID        TIME OF CONCENTRATION AND STORAGE COEFFICIENT R
 20           ID              BASED ON RESULTS FROM MCUHP1
 21           ID
 22           ID        TIME-AREA RELATION FROM TABLE 5.2, ALL AREAS USE A NATURAL
 23           ID              TIME-AREA UA RECORD
 24           ID
 25           ID        OFFSITE FLOWS ARE ROUTED THROUGH HYPOTHETICAL CHANNELS USING
 26           ID              MODIFIED PULS ROUTING.  CHANNELS REFLECT EXISTING
 27           ID              CROSS-SECTIONS AND EXISTING ROUGHNESS.
 28           ID
 29           ID
              *DIAGRAM
 30           IT       5                    150
 31           IO       3

 32           KK   SUBB1        RUNOFF HG FROM SUB-BASIN B1
 33           BA    .169
 34           IN       5
 35           PB   2.770
 36           PC    .000    .011    .018    .023    .028    .032    .046    .071    .100    .137
 37           PC    .176    .232    .327    .601    .743    .863    .901    .930    .954    .962
 38           PC    .970    .979    .982    .992   1.000
 39           LG    .250    .320   5.090    .280   1.000
 40           UC    .533    .323
```

```
 41          UA       0       3       5       8      12      20      43      75      90      96
 42          UA     100

 43          KK   RCHAB         ROUTE HG SUBB1 THRU REACH AB; HYPOTHETICAL CHANNEL
 44          RS       2    FLOW      -1
 45          RC    .050    .035    .050    2800    .005
 46          RX     500     500     513     525     530     542     550     550
 47          RY     100     100      97      95      95      97     100     100
1                                          HEC-1 INPUT                                          PAGE  2

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

 48          KK    SUBA         RUNOFF HG FROM SUB-BASIN A
 49          BA    .867
 50          LG     .25     .25    6.15     .21       1
 51          UC    .967    .539
 52          UA       0       3       5       8      12      20      43      75      90      96
 53          UA     100

 54          KK   SUBB2         RUNOFF HG FROM SUB-BASIN B2
 55          BA    .180
 56          LG     .25     .32    5.09     .28       1
 57          UC    .733    .697
 58          UA       0       3       5       8      12      20      43      75      90      96
 59          UA     100

 60          KK   SUMAB         COMBINE HG FROM RCHAB, SUBA & SUBB2
 61          HC       3

 62          KK  RCHSUM         ROUTE HG SUMAB THRU REACH SUM; HYPOTHETICAL CHANNEL
 63          RS       6    FLOW      -1
 64          RC    .035    .050    .050    8670    .004
 65          RX     500     500     560     560     580     580     600     600
 66          RY     100     100      93      93      93      93     100     100

 67          KK    SUBC         RUNOFF HG FROM SUB-BASIN C
 68          BA    .195
 69          LG     .25     .25    6.05      .2       1
 70          UC    .700    .508
 71          UA       0       3       5       8      12      20      43      75      90      96
 72          UA     100

 73          KK   RCHCD         ROUTE HG SUBC THRU REACH CD; HYPOTHETICAL CHANNEL
 74          RS       1    FLOW      -1
 75          RC    .050    .035    .050    2020    .004
 76          RX     500     500     513     525     530     542     550     550
 77          RY     100     100      97      95      95      97     100     100

 78          KK    SUBD         RUNOFF HG FROM SUB-BASIN D
 79          BA    .227
 80          LG     .25     .28    4.34     .26       1
 81          UC    .617    .413
 82          UA       0       3       5       8      12      20      43      75      90      96
 83          UA     100

 84          KK   SUMCD         COMBINE HG FROM SUBC & SUBD
 85          HC       2

 86          KK  RCHSUM         ROUTE HG SUMCD THRU REACH SUM; HYPOTHETICAL CHANNEL
 87          RS       4    FLOW      -1
 88          RC    .050    .035    .050    5520    .005
 89          RX     500     500     513     525     530     542     550     550
 90          RY     100     100      97      95      95      97     100     100
1                                          HEC-1 INPUT                                          PAGE  3

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

 91          KK    SUBE         RUNOFF HG FROM SUB-BASIN E
 92          BA   1.297
 93          LG     .25     .27    5.05     .23       1
 94          UC   1.083    .568
 95          UA       0       3       5       8      12      20      43      75      90      96
 96          UA     100

 97          KK  SUMTOT         COMBINE HG FROM RCHSUM (WEST & NORTH)
 98          HC       3
 99          ZZ
1
```

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

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  32        SUBB1
                V
                V
  43        RCHAB
                .
                .
  48            .        SUBA
                .           .
                .           .
  54            .           .       SUBB2
                .           .           .
                .           .           .
  60        SUMAB.......................
                V
                V
  62       RCHSUM
                .
                .
  67            .        SUBC
                .           V
                .           V
  73            .       RCHCD
                .           .
                .           .
  78            .           .        SUBD
                .           .           .
                .           .           .
  84            .       SUMCD............
                .           V
                .           V
  86            .      RCHSUM
                .           .
                .           .
  91            .           .        SUBE
                .           .           .
                .           .           .
  97       SUMTOT......................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
*  RUN DATE  01/10/1992  TIME  11:07:40 *
*                                      *
****************************************
```

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

SUN CITY WEST EXPANSION
STANLEY CONSULTANTS JOB # 11028 DATE: 08 JAN 92
HEC-1 MODEL 11028I (NATURAL COND ONSITE AND OFFSITE)

CLARK UNIT HYDROGRAPH

2-HR STORM DISTRIBUTION (TABLE 2.2) P100 = 2.77"
NO AREAL REDUCTION FACTOR (TYPICAL FOR ALL AREAS)

GREEN-AMPT LOSS RATES FOR EXISTING CONDITIONS BASED ON
AREA-WEIGHTED VALUES OF EXISTING SOILS ASSUMING DTHETA NORMAL
AND VEGETATIVE COVER 25 PERCENT.
IA ASSUMED TO BE 0.25 INCHES AND PERCENT IMPERVIOUS ASSUMED
TO BE 1 PERCENT.

Kb BASED ON m = -0.025 and b = 0.15

TIME OF CONCENTRATION AND STORAGE COEFFICIENT R
BASED ON RESULTS FROM MCUHP1

```
                    TIME-AREA RELATION FROM TABLE 5.2, ALL AREAS USE A NATURAL
                          TIME-AREA UA RECORD

                    OFFSITE FLOWS ARE ROUTED THROUGH HYPOTHETICAL CHANNELS USING
                          MODIFIED PULS ROUTING.  CHANNELS REFLECT EXISTING
                          CROSS-SECTIONS AND EXISTING ROUGHNESS.

 31 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        150  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME       1225  ENDING TIME
                    ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   12.42 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 32 KK      *     SUBB1  *            RUNOFF HG FROM SUB-BASIN B1
            *            *
            **************

 34 IN        TIME DATA FOR INPUT TIME SERIES
                    JXMIN          5  TIME INTERVAL IN MINUTES
                   JXDATE      1   0  STARTING DATE
                   JXTIME          0  STARTING TIME

            SUBBASIN RUNOFF DATA

 33 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .17  SUBBASIN AREA

              PRECIPITATION DATA

 35 PB              STORM       2.77  BASIN TOTAL PRECIPITATION

 36 PI          INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

 39 LG        GREEN AND AMPT LOSS RATE
                    STRTL        .25  STARTING LOSS
                      DTH        .32  MOISTURE DEFICIT
                     PSIF       5.09  WETTING FRONT SUCTION
                    XKSAT        .28  HYDRAULIC CONDUCTIVITY
                    RTIMP       1.00  PERCENT IMPERVIOUS AREA

 40 UC        CLARK UNITGRAPH
                       TC        .53  TIME OF CONCENTRATION
                        R        .32  STORAGE COEFFICIENT

 41 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                    100.0
```

```
                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .53 HR,       R=   .32 HR
                                  SNYDER   TP=   .46 HR,      CP=   .86

                                          UNIT HYDROGRAPH
                                     25 END-OF-PERIOD ORDINATES
              6.      17.      34.      90.     173.     203.     176.     139.     107.      83.
             64.      49.      38.      29.      23.      17.      13.      10.       8.       6.
              5.       4.       3.       2.       2.

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    SUBB1

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.31, TOTAL EXCESS =    1.46

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                          (CFS)
+     251.      1.58                26.         13.         13.         13.
                        (INCHES)    1.449       1.449       1.449       1.449
                         (AC-FT)    13.         13.         13.         13.

                       CUMULATIVE AREA =     .17 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  43 KK    *     RCHAB  *            ROUTE HG SUBB1 THRU REACH AB; HYPOTHETICAL CHANNEL
           *            *
           **************

              HYDROGRAPH ROUTING DATA

  44 RS          STORAGE ROUTING
                      NSTPS          2  NUMBER OF SUBREACHES
                       ITYP       FLOW  TYPE OF INITIAL CONDITION
                     RSVRIC      -1.00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

  45 RC          NORMAL DEPTH CHANNEL
                        ANL       .050  LEFT OVERBANK N-VALUE
                       ANCH       .035  MAIN CHANNEL N-VALUE
                        ANR       .050  RIGHT OVERBANK N-VALUE
                      RLNTH      2800.  REACH LENGTH
                        SEL      .0050  ENERGY SLOPE
                      ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                      CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
  47 RY       ELEVATION    100.00    100.00     97.00     95.00     95.00     97.00    100.00    100.00
  46 RX       DISTANCE     500.00    500.00    513.00    525.00    530.00    542.00    550.00    550.00

                                                  ***

                                      COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .11       .28       .49       .77      1.09      1.47      1.90      2.38      2.90
          OUTFLOW       .00      1.85      6.74     15.09     27.43     44.30     66.20     93.64    130.36    178.41
        ELEVATION     95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

          STORAGE      3.45      4.03      4.65      5.29      5.96      6.67      7.41      8.17      8.97      9.80
          OUTFLOW    232.95    293.99    361.56    435.70    516.44    603.85    698.00    798.95    906.78   1021.56
        ELEVATION     97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    RCHAB

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     12.42-HR
```

```
+   (CFS)       (HR)
                          (CFS)
+     227.      1.67                  26.         13.         13.         13.
                         (INCHES)    1.449       1.449       1.449       1.449
                          (AC-FT)     13.         13.         13.         13.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR       72-HR     12.42-HR
+  (AC-FT)      (HR)
       2.       1.67                    0.          0.          0.          0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     12.42-HR
+   (FEET)      (HR)
    97.60       1.67                  95.54       95.26       95.26       95.26

                         CUMULATIVE AREA =     .17 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  48 KK     *     SUBA   *            RUNOFF HG FROM SUB-BASIN A
            *            *
            **************

               SUBBASIN RUNOFF DATA

  49 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .87  SUBBASIN AREA

                 PRECIPITATION DATA

  35 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

  36 PI            INCREMENTAL PRECIPITATION PATTERN
                       .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                       .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                       .01       .00       .01       .01

  50 LG          GREEN AND AMPT LOSS RATE
                       STRTL        .25  STARTING LOSS
                         DTH        .25  MOISTURE DEFICIT
                        PSIF       6.15  WETTING FRONT SUCTION
                       XKSAT        .21  HYDRAULIC CONDUCTIVITY
                       RTIMP       1.00  PERCENT IMPERVIOUS AREA

  51 UC          CLARK UNITGRAPH
                          TC        .97  TIME OF CONCENTRATION
                           R        .54  STORAGE COEFFICIENT

  52 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                     100.0

                                                        ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .97 HR,       R=   .54 HR
                                        SNYDER   TP=   .79 HR,      CP=   .86

                                                   UNIT HYDROGRAPH
                                            42 END-OF-PERIOD ORDINATES
                12.       32.       48.       66.       94.      149.      270.      461.      599.      619.
               586.      532.      466.      399.      342.      293.      251.      215.      184.      158.
               135.      116.       99.       85.       73.       62.       53.       46.       39.       33.
                29.       25.       21.       18.       15.       13.       11.       10.        8.        7.
                 6.        5.

     ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION     SUBA

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.17, TOTAL EXCESS =    1.60

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
```

```
                                    6-HR        24-HR        72-HR      12.42-HR
+   (CFS)       (HR)
                          (CFS)
+    915.       1.92                149.         72.          72.          72.
                        (INCHES)    1.595       1.595        1.595        1.595
                         (AC-FT)     74.         74.          74.          74.

                        CUMULATIVE AREA =     .87 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  54 KK     *    SUBB2   *            RUNOFF HG FROM SUB-BASIN B2
            *            *
            **************

               SUBBASIN RUNOFF DATA

  55 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .18  SUBBASIN AREA

                 PRECIPITATION DATA

  35 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

  36 PI            INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

  56 LG          GREEN AND AMPT LOSS RATE
                       STRTL         .25  STARTING LOSS
                         DTH         .32  MOISTURE DEFICIT
                        PSIF        5.09  WETTING FRONT SUCTION
                       XKSAT         .28  HYDRAULIC CONDUCTIVITY
                       RTIMP        1.00  PERCENT IMPERVIOUS AREA

  57 UC          CLARK UNITGRAPH
                          TC         .73  TIME OF CONCENTRATION
                           R         .70  STORAGE COEFFICIENT

  58 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                     100.0

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .73 HR,       R=   .70 HR
                                        SNYDER   TP=   .65 HR,      CP=   .65

                                                   UNIT HYDROGRAPH
                                              50 END-OF-PERIOD ORDINATES
                 3.        7.       11.       18.       37.       74.      108.      117.      112.      102.
                91.       81.       71.       63.       56.       50.       44.       39.       35.       31.
                27.       24.       22.       19.       17.       15.       13.       12.       11.        9.
                 8.        7.        7.        6.        5.        5.        4.        4.        3.        3.
                 3.        2.        2.        2.        2.        1.        1.        1.        1.        1.

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    SUBB2

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.31, TOTAL EXCESS =    1.46

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR      12.42-HR
+   (CFS)       (HR)
                          (CFS)
    159.        1.75                 28.         14.          14.          14.
                        (INCHES)    1.448       1.448        1.448        1.448
                         (AC-FT)     14.         14.          14.          14.

                        CUMULATIVE AREA =     .18 SQ MI
```

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  60 KK   *    SUMAB   *          COMBINE HG FROM RCHAB, SUBA & SUBB2
          *            *
          **************

  61 HC        HYDROGRAPH COMBINATION
                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION    SUMAB

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     12.42-HR
+  (CFS)       (HR)
                        (CFS)
+   1244.      1.83                203.         98.         98.         98.
                      (INCHES)    1.553       1.553       1.553       1.553
                       (AC-FT)    101.        101.        101.        101.

                      CUMULATIVE AREA =    1.22 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  62 KK   *   RCHSUM   *          ROUTE HG SUMAB THRU REACH SUM; HYPOTHETICAL CHANNEL
          *            *
          **************

             HYDROGRAPH ROUTING DATA

  63 RS        STORAGE ROUTING
                    NSTPS          6  NUMBER OF SUBREACHES
                     ITYP       FLOW  TYPE OF INITIAL CONDITION
                   RSVRIC      -1.00  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

  64 RC        NORMAL DEPTH CHANNEL
                      ANL       .035  LEFT OVERBANK N-VALUE
                     ANCH       .050  MAIN CHANNEL N-VALUE
                      ANR       .050  RIGHT OVERBANK N-VALUE
                    RLNTH      8670.  REACH LENGTH
                      SEL      .0040  ENERGY SLOPE
                    ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
  66 RY       ELEVATION   100.00    100.00     93.00     93.00     93.00     93.00    100.00    100.00
  65 RX       DISTANCE    500.00    500.00    560.00    560.00    580.00    580.00    600.00    600.00

                                                          ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00      1.62      3.55      5.79      8.34     11.19     14.36     17.83     21.61     25.70
          OUTFLOW       .00      7.76     26.59     56.12     96.88    149.57    214.94    293.75    386.76    494.74
        ELEVATION     93.00     93.37     93.74     94.11     94.47     94.84     95.21     95.58     95.95     96.32

          STORAGE     30.10     34.81     39.83     45.16     50.79     56.73     62.99     69.55     76.42     83.60
          OUTFLOW    618.43    758.55    915.85   1091.02   1284.76   1497.76   1730.70   1984.24   2259.05   2555.77
        ELEVATION     96.68     97.05     97.42     97.79     98.16     98.53     98.89     99.26     99.63    100.00

     ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   RCHSUM
```

```
 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                          (CFS)
   1100.       2.25                 203.         98.         98.         98.
                         (INCHES)  1.549       1.553       1.553       1.553
                          (AC-FT)  100.        101.        101.        101.

 PEAK STORAGE  TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     12.42-HR
+  (AC-FT)      (HR)
       8.      2.25                   2.          1.          1.          1.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     12.42-HR
+   (FEET)      (HR)
    97.81      2.25                 94.54       93.75       93.75       93.75

                         CUMULATIVE AREA =    1.22 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  67 KK     *      SUBC  *            RUNOFF HG FROM SUB-BASIN C
            *            *
            **************

               SUBBASIN RUNOFF DATA

  68 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .19  SUBBASIN AREA

                 PRECIPITATION DATA

  35 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  36 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

  69 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .25  STARTING LOSS
                        DTH         .25  MOISTURE DEFICIT
                       PSIF        6.05  WETTING FRONT SUCTION
                      XKSAT         .20  HYDRAULIC CONDUCTIVITY
                      RTIMP        1.00  PERCENT IMPERVIOUS AREA

  70 UC          CLARK UNITGRAPH
                         TC         .70  TIME OF CONCENTRATION
                          R         .51  STORAGE COEFFICIENT

  71 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                     100.0

                                                   ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .70 HR,       R=   .51 HR
                                       SNYDER   TP=   .59 HR,      CP=   .73

                                                UNIT HYDROGRAPH
                                           38 END-OF-PERIOD ORDINATES
                 4.       10.       17.       28.       60.      118.      158.      158.      143.      124.
               105.       89.       75.       64.       54.       46.       39.       33.       28.       24.
                20.       17.       15.       12.       10.        9.        8.        6.        5.        5.
                 4.        3.        3.        2.        2.        2.        1.        1.

     ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION     SUBC

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.14, TOTAL EXCESS =    1.63
```

```
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                              (CFS)
+     230.      1.75                 34.         16.         16.         16.
                          (INCHES)  1.619       1.619       1.619       1.619
                           (AC-FT)   17.         17.         17.         17.

                          CUMULATIVE AREA =     .19 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  73 KK     *     RCHCD  *            ROUTE HG SUBC THRU REACH CD; HYPOTHETICAL CHANNEL
            *            *
            **************

               HYDROGRAPH ROUTING DATA

  74 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       FLOW  TYPE OF INITIAL CONDITION
                     RSVRIC      -1.00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

  75 RC          NORMAL DEPTH CHANNEL
                        ANL       .050  LEFT OVERBANK N-VALUE
                       ANCH       .035  MAIN CHANNEL N-VALUE
                        ANR       .050  RIGHT OVERBANK N-VALUE
                      RLNTH      2020.  REACH LENGTH
                        SEL      .0040  ENERGY SLOPE
                      ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                     CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
  77 RY        ELEVATION   100.00    100.00     97.00     95.00     95.00     97.00    100.00    100.00
  76 RX        DISTANCE    500.00    500.00    513.00    525.00    530.00    542.00    550.00    550.00

                                                          ***

                                     COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .08       .20       .36       .55       .79      1.06      1.37      1.72      2.09
            OUTFLOW        .00      1.65      6.03     13.49     24.53     39.62     59.21     83.75    116.59    159.58
          ELEVATION      95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

            STORAGE       2.49      2.91      3.35      3.82      4.30      4.81      5.34      5.90      6.47      7.07
            OUTFLOW     208.36    262.96    323.39    389.70    461.92    540.10    624.31    714.60    811.05    913.71
          ELEVATION      97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    RCHCD

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                              (CFS)
+     215.      1.83                 34.         16.         16.         16.
                          (INCHES)  1.619       1.619       1.619       1.619
                           (AC-FT)   17.         17.         17.         17.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     12.42-HR
+  (AC-FT)      (HR)
       3.       1.83                  1.          0.          0.          0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     12.42-HR
+   (FEET)      (HR)
    97.67       1.83                 95.76      95.37       95.37       95.37

                          CUMULATIVE AREA =     .19 SQ MI
```

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

          **************
          *            *
 78 KK    *     SUBD   *            RUNOFF HG FROM SUB-BASIN D
          *            *
          **************

             SUBBASIN RUNOFF DATA

 79 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .23  SUBBASIN AREA

                PRECIPITATION DATA

 35 PB               STORM         2.77  BASIN TOTAL PRECIPITATION

 36 PI            INCREMENTAL PRECIPITATION PATTERN
                     .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                     .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                     .01      .00      .01      .01

 80 LG          GREEN AND AMPT LOSS RATE
                     STRTL          .25  STARTING LOSS
                       DTH          .28  MOISTURE DEFICIT
                      PSIF         4.34  WETTING FRONT SUCTION
                     XKSAT          .26  HYDRAULIC CONDUCTIVITY
                     RTIMP         1.00  PERCENT IMPERVIOUS AREA

 81 UC          CLARK UNITGRAPH
                        TC          .62  TIME OF CONCENTRATION
                         R          .41  STORAGE COEFFICIENT

 82 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
                    100.0

                                                   ***

                                              UNIT HYDROGRAPH PARAMETERS
                                       CLARK   TC=   .62 HR,      R=   .41 HR
                                      SNYDER   TP=   .52 HR,     CP=   .78

                                              UNIT HYDROGRAPH
                                         31 END-OF-PERIOD ORDINATES
              6.      16.      27.      58.     135.     210.     221.     195.     163.     133.
            109.      89.      73.      59.      48.      40.      32.      26.      22.      18.
             14.      12.      10.       8.       6.       5.       4.       3.       3.       2.
              2.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     SUBD

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.19, TOTAL EXCESS =    1.58

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                          (CFS)
+    304.       1.67                  38.         19.         19.         19.
                         (INCHES)   1.576      1.576       1.576       1.576
                          (AC-FT)     19.         19.         19.         19.

                        CUMULATIVE AREA =     .23 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 84 KK    *     SUMCD  *            COMBINE HG FROM SUBC & SUBD
```

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          *            *
          **************

 85 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION    SUMCD

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                          (CFS)
+    483.       1.75                 72.         35.         35.         35.
                        (INCHES)    1.595       1.596       1.596       1.596
                         (AC-FT)     36.         36.         36.         36.

                        CUMULATIVE AREA =     .42 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 86 KK    *    RCHSUM  *            ROUTE HG SUMCD THRU REACH SUM; HYPOTHETICAL CHANNEL
          *            *
          **************

            HYDROGRAPH ROUTING DATA

 87 RS          STORAGE ROUTING
                     NSTPS           4  NUMBER OF SUBREACHES
                      ITYP        FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC       -1.00  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

 88 RC          NORMAL DEPTH CHANNEL
                       ANL        .050  LEFT OVERBANK N-VALUE
                      ANCH        .035  MAIN CHANNEL N-VALUE
                       ANR        .050  RIGHT OVERBANK N-VALUE
                     RLNTH       5520.  REACH LENGTH
                       SEL       .0050  ENERGY SLOPE
                     ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 90 RY       ELEVATION   100.00    100.00     97.00     95.00     95.00     97.00    100.00    100.00
 89 RX       DISTANCE    500.00    500.00    513.00    525.00    530.00    542.00    550.00    550.00

                                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .22       .54       .97      1.51      2.15      2.90      3.75      4.70      5.72
          OUTFLOW        .00      1.85      6.74     15.09     27.43     44.30     66.20     93.64    130.36    178.41
        ELEVATION      95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

          STORAGE       6.81      7.95      9.16     10.43     11.76     13.15     14.60     16.11     17.69     19.33
          OUTFLOW     232.95    293.99    361.56    435.70    516.44    603.85    698.00    798.95    906.78   1021.56
        ELEVATION      97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   RCHSUM

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     12.42-HR
+   (CFS)       (HR)
                          (CFS)
+    451.       1.92                 72.         35.         35.         35.
                        (INCHES)    1.595       1.596       1.596       1.596
                         (AC-FT)     36.         36.         36.         36.
```

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PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     12.42-HR
+  (AC-FT)     (HR)
       3.      1.92                    1.          0.          0.          0.

PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     12.42-HR
+   (FEET)     (HR)
    98.47      1.92                  96.06       95.52       95.52       95.52

                        CUMULATIVE AREA =     .42 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  91 KK     *     SUBE   *            RUNOFF HG FROM SUB-BASIN E
            *            *
            **************

               SUBBASIN RUNOFF DATA

  92 BA          SUBBASIN CHARACTERISTICS
                       TAREA        1.30  SUBBASIN AREA

                 PRECIPITATION DATA

  35 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

  36 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

  93 LG          GREEN AND AMPT LOSS RATE
                       STRTL         .25  STARTING LOSS
                         DTH         .27  MOISTURE DEFICIT
                        PSIF        5.05  WETTING FRONT SUCTION
                       XKSAT         .23  HYDRAULIC CONDUCTIVITY
                       RTIMP        1.00  PERCENT IMPERVIOUS AREA

  94 UC          CLARK UNITGRAPH
                           TC        1.08  TIME OF CONCENTRATION
                            R         .57  STORAGE COEFFICIENT

  95 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                     100.0

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=  1.08 HR,       R=   .57 HR
                                        SNYDER   TP=   .88 HR,      CP=   .88

                                                   UNIT HYDROGRAPH
                                              45 END-OF-PERIOD ORDINATES
                 16.       42.       61.       82.      108.      152.      252.      430.      672.      837.
                861.      822.      759.      677.      584.      504.      435.      376.      325.      280.
                242.      209.      180.      156.      134.      116.      100.       86.       75.       64.
                 56.       48.       41.       36.       31.       27.       23.       20.       17.       15.
                 13.       11.       10.        8.        7.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     SUBE

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.17, TOTAL EXCESS =    1.60

PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     12.42-HR
+   (CFS)      (HR)
                          (CFS)
+    1287.     2.00                  222.        107.        107.        107.
                        (INCHES)   1.594       1.594       1.594       1.594
                         (AC-FT)     110.        110.        110.        110.
```

CUMULATIVE AREA = 1.30 SQ MI

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              **************
              *            *
  97 KK       *   SUMTOT   *          COMBINE HG FROM RCHSUM (WEST & NORTH)
              *            *
              **************

  98 HC          HYDROGRAPH COMBINATION
                      ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   SUMTOT

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     12.42-HR
+  (CFS)       (HR)
                            (CFS)
+   2543.      2.17                497.        241.        241.        241.
                          (INCHES)  1.573       1.577       1.577       1.577
                           (AC-FT)  246.        247.        247.        247.

                        CUMULATIVE AREA =    2.93 SQ MI

1
                                                RUNOFF SUMMARY
                                          FLOW IN CUBIC FEET PER SECOND
                                        TIME IN HOURS,  AREA IN SQUARE MILES

                                   PEAK   TIME OF    AVERAGE FLOW FOR MAXIMUM PERIOD     BASIN    MAXIMUM    TIME OF
        OPERATION       STATION    FLOW    PEAK                                          AREA     STAGE    MAX STAGE
+                                                     6-HOUR     24-HOUR     72-HOUR

        HYDROGRAPH AT
+                        SUBB1     251.    1.58        26.         13.         13.       .17
        ROUTED TO
+                        RCHAB     227.    1.67        26.         13.         13.       .17
+                                                                                          97.60      1.67

        HYDROGRAPH AT
+                         SUBA     915.    1.92       149.         72.         72.       .87
        HYDROGRAPH AT
+                        SUBB2     159.    1.75        28.         14.         14.       .18
        3 COMBINED AT
+                        SUMAB    1244.    1.83       203.         98.         98.      1.22
        ROUTED TO
+                        RCHSUM   1100.    2.25       203.         98.         98.      1.22
+                                                                                          97.81      2.25

        HYDROGRAPH AT
+                         SUBC     230.    1.75        34.         16.         16.       .19
        ROUTED TO
+                        RCHCD     215.    1.83        34.         16.         16.       .19
+                                                                                          97.67      1.83

        HYDROGRAPH AT
+                         SUBD     304.    1.67        38.         19.         19.       .23
        2 COMBINED AT
+                        SUMCD     483.    1.75        72.         35.         35.       .42
        ROUTED TO
+                        RCHSUM    451.    1.92        72.         35.         35.       .42
+                                                                                          98.47      1.92
```

	HYDROGRAPH AT							
+		SUBE	1287.	2.00	222.	107.	107.	1.30
	3 COMBINED AT							
+		SUMTOT	2543.	2.17	497.	241.	241.	2.93

*** NORMAL END OF HEC-1 ***

```
1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*          SEPTEMBER 1990              *                    *   HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.0                *                    *         609 SECOND STREET            *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
* RUN DATE  01/10/1992  TIME  15:17:39 *                    *          (916) 756-1104              *
*                                      *                    *                                      *
****************************************                    ****************************************

X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                          HEC-1 INPUT                                          PAGE  1

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

  1           ID
  2           ID        SUN CITY WEST EXPANSION
  3           ID        STANLEY CONSULTANTS JOB # 11028   DATE: 10 JAN 92
  4           ID        HEC-1 MODEL 11028M (DESIGN COND ONSITE, NATURAL COND OFFSITE)
  5           ID
  6           ID        CLARK UNIT HYDROGRAPH
  7           ID
  8           ID        2-HR STORM DISTRIBUTION (FCDMC HYDROLOGIC DESIGN MANUAL; TABLE 2.2)
  9           ID              P100 = 2.77"
 10           ID
 11           ID        NO AREAL REDUCTION FACTOR  (TYPICAL FOR ALL AREAS)
 12           ID
 13           ID        COMPUTATION TIME INTERVAL 5 MINUTES
 14           ID
 15           ID        GREEN-AMPT LOSS RATES FOR OFFSITE EXISTING CONDITIONS BASED ON
 16           ID              AREA-WEIGHTED VALUES OF EXISTING SOILS ASSUMING DTHETA NORMAL
 17           ID              AND VEGETATIVE COVER 25 PERCENT.
 18           ID              IA ASSUMED TO BE 0.25 INCHES AND PERCENT IMPERVIOUS ASSUMED
 19           ID              TO BE 1 PERCENT.
 20           ID
 21           ID        GREEN-AMPT LOSS RATES FOR ONSITE DEVELOPED CONDITIONS ARE AREA-WEIGHTED
 22           ID              FROM TABLE  2   OF THE CONCEPTUAL MASTER DRAINAGE REPORT.
 23           ID              BASIC LOSS RATES AND PERCENT IMPERVIOUS (FOR DEVELOPED CONDITION)
 24           ID              SELECTED TO PRODUCE RAINFALL EXCESS SIMILAR TO CORRESPONDING
 25           ID              RATIONAL RUNOFF COEFFICIENT FOR PARTICULAR LAND USE.
 26           ID
 27           ID        TIME OF CONCENTRATION AND STORAGE COEFFICIENT R ARE BASED ON RESULTS
 28           ID              FROM MCUHP1 WITH LENGTHS AND SLOPES ESTIMATED FROM PRELIMINARY
 29           ID              LOT LAYOUTS AND GRADING.
 30           ID
 31           ID        Kb BASED ON HYDRO MANUAL FIGURE/TABLE 3.1  (m=-0.025, b=.15 for exist)
 32           ID                                                   (m=-0.00625, b=.04 for urban)
 33           ID
 34           ID        TIME-AREA RELATION FROM TABLE 5.2:
 35           ID              OFFSITE AREAS USE A NATURAL TIME-AREA UA RECORD
 36           ID              ONSITE AREAS USE AN URBAN TIME-AREA UA RECORD
 37           ID
 38           ID        HYDROGRAPH ROUTING THROUGH STREET REACHES USES KENEMATIC WAVE
 39           ID              RECTANGULAR CHANNEL WITH WIDTH OF 68 FEET AND "n"=0.015
 40           ID
 41           ID        OFFSITE FLOWS COMBINE WITH ONSITE FLOWS IN DETENTION BASINS
 42           ID
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 43          ID        HYDROGRAPH ROUTING THROUGH GUNITE-LINED, TRAPEZOIDAL CHANNEL ASSUMES:
 44          ID              Wbase = 10'(MIN), 20'(MAX); Side Slope = .5:1 (H\V); n = .016
 45          ID
 46          ID        HYDROGRAPH ROUTING THROUGH GOLF COURSE CHANNELS ASSUMES:
 47          ID              MODIFIED PULS ROUTING, 100 FOOT TOTAL TOPWIDTH
 48          ID              LOW FLOW CHANNEL IS 10' BOTTOM WIDTH, SS=4:1, MANNING n = 0.025
 49          ID              (UNLESS SPECIFIED OTHERWISE)
 50          ID              OVERBANK WIDTHS VARY AND HAVE SS=6:1, MANNING n = 0.030
 51          ID              CHANNEL SLOPE RANGES FROM 0.003 TO 0.006 FEET PER FEET
 52          ID              NSTPS (ON RS RECORD) = LENGTH \ (VEL * 300 SEC)
 53          ID              (VEL ASSUMED @ 5 FPS, TIME INTERVAL 5 MINUTES)
 54          ID
 55          ID        CULVERTS ARE ASSUMED TO NOT INFLUENCE CHANNEL ROUTING
1                                        HEC-1 INPUT                                          PAGE  2

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

 56          ID
 57          ID        HYDROGRAPH ROUTING THROUGH DETENTION BASINS ASSUMES:
 58          ID              TRAPEZOIDAL, LEVEL BOTTOM, 6:1 SIDESLOPES
 59          ID              BOTTOM WIDTHS RANGE FROM 50' TO 250' (100' TYPICAL)
 60          ID              BASIN OUTLETS ASSUME PIPE WITH INLET CONTROL.
 61          ID              PIPE SIZE RANGES FROM SINGLE 18" CMP TO 4 - 48" CMP
 62          ID              LOW-FLOWS ASSUME ORFICE EQUATION:
 63          ID              Q = C * A(pipe) * H(above FL)^0.5
 64          ID              WHERE C IS ORIFICE COEFFICIENT ESTIMATED TO BE 0.37
 65          ID              (GIVES FLOWS SIMILAR TO RESULTS OF BPR INLET CONTROL CURVES)
 66          ID              WIERS ARE USED IN COMBINATION WITH PIPES
             *DIAGRAM
 67          IT       5                    200
 68          IO       3

 69          KK   SUBB1        RUNOFF HG FROM SUB-BASIN B1
 70          BA    .169
 71          IN       5
 72          PB   2.770
 73          PC    .000    .011    .018    .023    .028    .032    .046    .071    .100    .137
 74          PC    .176    .232    .327    .601    .743    .863    .901    .930    .954    .962
 75          PC    .970    .979    .982    .992   1.000
 76          LG    .250    .320   5.090    .280   1.000
 77          UC    .533    .323
 78          UA       0       3       5       8      12      20      43      75      90      96
 79          UA     100

 80          KK   RCH21        ROUTE HG SUBB1 THRU REACH 21; GUNITE CHANNEL
 81          RK     840    .004    .016            TRAP      20      .5

 82          KK   SUB10        RUNOFF HG FROM SUB-BASIN 10
 83          BA    .020
 84          LG     .15     .28     3.4     .80      37
 85          UC    .183    .208
 86          UA       0       5      16      30      65      77      84      90      94      97
 87          UA     100

 88          KK   SUB20        RUNOFF HG FROM SUB-BASIN 20
 89          BA    .012
 90          LG    .225    .295    2.65    1.10      10
 91          UC    .400    .422
 92          UA       0       5      16      30      65      77      84      90      94      97
 93          UA     100

 94          KK   SUM21        COMBINE HG FROM RCH21, SUB10 & SUB20
 95          KM                INFLOW INTO DETENTION BASIN 21
 96          HC       3

 97          KK   DET21        ROUTE HG SUM21 THRU DET BASIN 21; Wb = 100'; L = 500'
 98          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-48" CMP
 99          KO       1
100          RS       1    STOR
101          SV       0    2.57    5.69    9.37
102          SE     100     102     104     106
103          SL     102    25.1     .37      .5
1                                        HEC-1 INPUT                                          PAGE  3

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

104          SS   105.9     100     2.6     1.5

105          KK   RCH51        ROUTE HG DET21 THRU REACH 51
106          RS       5    FLOW      -1
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107          RC     .03    .025     .03    1400    .005
108          RX     500     512     533     545     555     567     588     600
109          RY     100      98      98      95      95      98      98     100

110          KK   SUB30        RUNOFF HG FROM SUB-BASIN 30
111          BA    .017
112          LG    .150     .28     3.4     .80      37
113          UC    .200    .286
114          UA       0       5      16      30      65      77      84      90      94      97
115          UA     100

116          KK   SUB40        RUNOFF HG FROM SUB-BASIN 40
117          BA    .016
118          LG    .150     .28     3.4     .80      37
119          UC    .183    .273
120          UA       0       5      16      30      65      77      84      90      94      97
121          UA     100

122          KK   SUM51        COMBINE HG FROM  RCH51, SUB30 & SUB40
123          HC       3

124          KK   RCH71        ROUTE HG SUM51 THRU REACH 71
125          RS       1    FLOW      -1
126          RC     .03    .025     .03    1400    .005
127          RX     500     512     533     545     555     567     588     600
128          RY     100      98      98      95      95      98      98     100

129          KK    SUBA        RUNOFF HG FROM SUB-BASIN A
130          BA    .867
131          LG    .250    .250   6.150    .210   1.000
132          UC    .967    .539
133          UA       0       3       5       8      12      20      43      75      90      96
134          UA     100

135          KK   SUBB2        RUNOFF HG FROM SUB-BASIN B2
136          BA    .180
137          LG    .250    .320   5.090    .280   1.000
138          UC    .733    .697
139          UA       0       3       5       8      12      20      43      75      90      96
140          UA     100

141          KK    SUM7        COMBINE HG FROM SUBA AND SUBB2
142          HC       2

143          KK   RCH71        ROUTE HG SUM7 THRU REACH 71; GUNITE CHANNEL
144          RK    1280    .003    .016            TRAP      20      .5
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

145          KK   SUB50        RUNOFF HG FROM SUB-BASIN 50
146          BA    .022
147          LG    .225    .295    2.65    1.10      10
148          UC    .517    .602
149          UA       0       5      16      30      65      77      84      90      94      97
150          UA     100

151          KK   SUB60        RUNOFF HG FROM SUB-BASIN 60
152          BA    .036
153          LG     .14     .28     3.4     .80      43
154          UC    .267    .361
155          UA       0       5      16      30      65      77      84      90      94      97
156          UA     100

157          KK   SUB70        RUNOFF HG FROM SUB-BASIN 70
158          BA    .030
159          LG     .15     .28     3.4     .80      37
160          UC    .217    .233
161          UA       0       5      16      30      65      77      84      90      94      97
162          UA     100

163          KK   SUM71        COMBINE HG FROM RCH71(NORTH & WEST), SUB50, SUB60 & SUB70
164          HC       5

165          KK   RCH77        ROUTE HG SUM71 THRU REACH 77
166          RS       1    FLOW      -1
167          RC     .03    .025     .03    1900    .005
168          RX     500     512     533     545     555     567     588     600
169          RY     100      98      98      95      95      98      98     100
```

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170          KK   SUB75        RUNOFF HG FROM SUB-BASIN 75
171          BA    .024
172          LG     .15     .28     3.4     .80      37
173          UC    .250    .382
174          UA       0       5      16      30      65      77      84      90      94      97
175          UA     100
176          KK   SUM77        COMBINE HG FROM RCH77 AND SUB75
177          HC       2
178          KK  RCH241        ROUTE HG SUM77 THRU REACH 241 (WEST)
179          RS       1    FLOW      -1
180          RC     .03    .025     .03    1480    .004
181          RX     500     512     533     545     555     567     588     600
182          RY     100      98      98      95      95      98      98     100
183          KK   SUB76        RUNOFF HG FROM SUB-BASIN 76
184          BA    .056
185          LG    .225    .295    2.65    1.10      10
186          UC    .917   1.256
187          UA       0       5      16      30      65      77      84      90      94      97
188          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

189          KK   SUB80        RUNOFF HG FROM SUB-BASIN 80
190          KM        ***** BEGIN NEW BRANCH ********
191          BA    .037
192          LG    .150     .28     3.4     .80      37
193          UC    .233    .277
194          UA       0       5      16      30      65      77      84      90      94      97
195          UA     100
196          KK   SUB90        RUNOFF HG FROM SUB-BASIN 90
197          BA    .058
198          LG    .150     .28     3.4     .80      37
199          UC    .383    .397
200          UA       0       5      16      30      65      77      84      90      94      97
201          UA     100
202          KK   SUM91        COMBINE HG FROM SUB80 AND SUB90
203          KM                INFLOW INTO DETENTION BASIN 91
204          HC       2
205          KK   DET91        ROUTE HG SUM91 THRU DET BASIN 91; Wb = 100'; L =400'
206          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-18" CMP
207          KO       1
208          RS       1    STOR
209          SV       0    2.06    4.55    7.49
210          SE     100     102     104     106
211          SL     102     3.5     .37      .5
212          SS   105.9     100     2.6     1.5
213          KK  RCH137        ROUTE HG DET91 THRU REACH 137   50-FOOT CHANNEL
214          RS       1    FLOW      -1
215          RC     .03    .025     .03    1660    .004
216          RX     500     508     508     520     530     542     542     550
217          RY     100      99      99      96      96      99      99     100
218          KK  SUB100        RUNOFF HG FROM SUB-BASIN 100
219          BA    .027
220          LG    .225    .295    2.65    1.10      10
221          UC   1.033   1.283
222          UA       0       5      16      30      65      77      84      90      94      97
223          UA     100
224          KK  SUB110        RUNOFF HG FROM SUB-BASIN 110
225          BA    .022
226          LG    .150     .28     3.4     .80      37
227          UC    .167    .168
228          UA       0       5      16      30      65      77      84      90      94      97
229          UA     100
230          KK  SUB130        RUNOFF HG FROM SUB-BASIN 130
231          BA    .026
232          LG    .150     .28     3.4     .80      37
233          UC    .250    .330
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234          UA       0       5      16      30      65      77      84      90      94      97
235          UA     100
1                                          HEC-1 INPUT                                                PAGE  6

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


236          KK  SUM131        COMBINE HG FROM SUB110 AND SUB130
237          KM                INFLOW INTO DETENTION BASIN 131
238          HC       2

239          KK  DET131        ROUTE HG SUM131 THRU DET BASIN 131; Wb = 100'; L  = 200'
240          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-18" CMP
241          KO       1
242          RS       1    STOR
243          SV       0    1.03    2.28    3.75
244          SE     100     102     104     106
245          SL     102     3.5     .37      .5
246          SS   105.9     100     2.6     1.5

247          KK  SUM137        COMBINE HG FROM RCH137, DET131 AND SUB100
248          HC       3

249          KK  RCH147        ROUTE HG SUM137 THRU REACH 147, 50-FOOT CHANNEL
250          RS       1    FLOW      -1
251          RC     .03    .025     .03     600    .004
252          RX     500     508     508     520     530     542     542     550
253          RY     100      99      99      96      96      99      99     100

254          KK  SUB140        RUNOFF HG FROM SUB-BASIN 140
255          KM                INFLOW INTO DETENTION BASIN 141
256          BA    .016
257          LG    .150     .28     3.4     .80      37
258          UC    .133    .127
259          UA       0       5      16      30      65      77      84      90      94      97
260          UA     100

261          KK  DET141        ROUTE HG SUB140 THRU DET BASIN 141; Wb = 50'; L = 200'
262          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-18" CMP
263          KO       1
264          RS       1    STOR
265          SV       0    1.03    2.28    3.75
266          SE     100     102     104     106
267          SL     102     1.8     .37      .5
268          SS   105.9     100     2.6     1.5

269          KK  SUM147        COMBINE HG FROM RCH147 & DET141
270          HC       2

271          KK  RCH167        ROUTE HG SUM147 THRU REACH 167
272          RS       1    FLOW      -1
273          RC     .03    .025     .03    1280    .004
274          RX     500     508     508     520     530     542     542     550
275          RY     100      99      99      96      96      99      99     100

276          KK  SUB150        RUNOFF HG FROM SUB-BASIN 150
277          BA    .017
278          LG    .150     .28     3.4     .80      37
279          UC    .167    .203
280          UA       0       5      16      30      65      77      84      90      94      97
281          UA     100
1                                          HEC-1 INPUT                                                PAGE  7

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


282          KK  SUB160        RUNOFF HG FROM SUB-BASIN 160
283          BA    .039
284          LG    .150     .28     3.4     .80      37
285          UC    .200    .207
286          UA       0       5      16      30      65      77      84      90      94      97
287          UA     100

288          KK  SUM161        COMBINE HG FROM SUB150 & SUB160
289          KM                INFLOW INTO DETENTION BASIN 161
290          HC       2

291          KK  DET161        ROUTE HG SUM161 THRU DET BASIN 161; Wb = 100'; L  = 200'
292          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-36" CMP
293          KO       1
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294          RS       1    STOR
295          SV       0    1.03    2.28    3.75
296          SE     100     102     104     106
297          SL     102     7.1     .37      .5
298          SS   105.9     100     2.6     1.5

299          KK  SUM167        COMBINE HG FROM RCH167 & DET161
300          HC       2

301          KK  RCH181        ROUTE HG SUM147 THRU REACH 181, 50-FOOT CHANNEL
302          RS       1    FLOW      -1
303          RC     .03    .025     .03    1460    .005
304          RX     500     508     508     520     530     542     542     550
305          RY     100      99      99      96      96      99      99     100

306          KK  SUB170        RUNOFF HG FROM SUB-BASIN 170
307          BA    .053
308          LG    .150     .28     3.4     .80      37
309          UC    .250    .259
310          UA       0       5      16      30      65      77      84      90      94      97
311          UA     100

312          KK  SUB175        RUNOFF HG FROM SUB-BASIN 175
313          BA    .063
314          LG    .230    .296     2.6    1.12     8.2
315          UC    .750    .887
316          UA       0       5      16      30      65      77      84      90      94      97
317          UA     100

318          KK  SUB180        RUNOFF HG FROM SUB-BASIN 180
319          BA    .006
320          LG    .150     .28     3.4     .80      37
321          UC    .267    .506
322          UA       0       5      16      30      65      77      84      90      94      97
323          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

324          KK  SUM181        COMBINE HG FROM RCH181, SUB170, SUB175 AND SUB180
325          KM                INFLOW INTO DETENTION BASIN 181
326          HC       4

327          KK  DET181        ROUTE HG SUM181 THRU DET BASIN 181; Wb = 100'; L  = 300'
328          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-48" CMP
329          KO       1
330          RS       1    STOR
331          SV       0    1.54    3.42    5.62
332          SE     100     102     104     106
333          SL     102    25.1     .37      .5
334          SS   105.9     100     2.6     1.5

335          KK  SUB190        RUNOFF HG FROM SUB-BASIN 190
336          BA    .056
337          LG    .150     .28     3.4     .80      37
338          UC    .267    .273
339          UA       0       5      16      30      65      77      84      90      94      97
340          UA     100

341          KK  RCH207        ROUTE HG SUB190 THRU REACH 207 (WEST); 68' STREET
342          RK    2440    .003    .015            DEEP      68

343          KK  SUB200        RUNOFF HG FROM SUB-BASIN 200
344          BA    .050
345          LG     .15     .28     3.4     .80      37
346          UC    .300    .341
347          UA       0       5      16      30      65      77      84      90      94      97
348          UA     100

349          KK  SUM207        COMBINE HG FROM DET181, RCH207 (WEST) AND SUB200
350          HC       3

351          KK  SUB210        RUNOFF HG FROM SUB-BASIN 210
352          BA    .025
353          LG     .15     .28     3.4     .80      37
354          UC    .167    .143
355          UA       0       5      16      30      65      77      84      90      94      97
356          UA     100
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357          KK  RCH227        ROUTE HG SUB210 THRU REACH 227; 10' GUNITE CHANNEL
358          RK     560    .002    .016            TRAP      10       .5

359          KK  SUB220        RUNOFF HG FROM SUB-BASIN 220
360          BA    .046
361          LG     .15     .28     3.4     .80      37
362          UC    .333    .436
363          UA       0       5      16      30      65      77      84      90      94      97
364          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

365          KK  SUB225        RUNOFF HG FROM SUB-BASIN 225
366          BA    .014
367          LG     .15     .28     3.4     .80      37
368          UC    .150    .157
369          UA       0       5      16      30      65      77      84      90      94      97
370          UA     100

371          KK  SUM227        COMBINE HG FROM RCH227, SUB220 & SUB225
372          HC       3

373          KK  SUB230        RUNOFF HG FROM SUB-BASIN 230
374          BA    .041
375          LG     .22    .298     2.5    1.16      16
376          UC    .450    .317
377          UA       0       5      16      30      65      77      84      90      94      97
378          UA     100

379          KK  SUM231        COMBINE HG FROM SUM207, SUM227 & SUB230
380          KM                INFLOW INTO DETENTION BASIN 231
381          HC       3

382          KK  DET231        ROUTE HG SUM231 THRU DET BASIN 231; Wb = 250'; L = 800'
383          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-48" CMP
384          KO       1
385          RS       1    STOR
386          SV       0    9.62   20.13   31.52
387          SE     100     102     104     106
388          SL     102    12.6     .37      .5
389          SS   105.9     100     2.6     1.5

390          KK  SUM241        COMBINE HG FROM RCH241 (WEST), DET231 & SUB76
391          HC       3

392          KK  RCH267        ROUTE HG SUM241 THRU REACH 267
393          RS       1    FLOW      -1
394          RC     .03    .025     .03     700    .006
395          RX     500     512     533     545     555     567     588     600
396          RY     100      98      98      95      95      98      98     100

397          KK  SUB250        RUNOFF HG FROM SUB-BASIN 250
398          BA    .023
399          LG     .15     .28     3.4     .80      37
400          UC    .233    .333
401          UA       0       5      16      30      65      77      84      90      94      97
402          UA     100

403          KK  SUB260        RUNOFF HG FROM SUB-BASIN 260
404          BA    .013
405          LG     .15     .28     3.4     .80      37
406          UC    .150    .198
407          UA       0       5      16      30      65      77      84      90      94      97
408          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

409          KK  SUM267        COMBINE HG FROM RCH267, SUB250 & SUB260
410          HC       3

411          KK  RCH281        ROUTE HG SUM267 THRU REACH 281
412          RS       1    FLOW      -1
413          RC     .03    .025     .03    1180    .004
414          RX     500     512     533     545     555     567     588     600
415          RY     100      98      98      95      95      98      98     100
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416          KK  SUB270        RUNOFF HG FROM SUB-BASIN 270
417          BA    .024
418          LG    .225    .295    2.65    1.10      10
419          UC    .900    .953
420          UA       0       5      16      30      65      77      84      90      94      97
421          UA     100

422          KK  SUB280        RUNOFF HG FROM SUB-BASIN 280
423          BA    .024
424          LG    .150     .28     3.4     .80      37
425          UC    .183    .222
426          UA       0       5      16      30      65      77      84      90      94      97
427          UA     100

428          KK  SUM281        COMBINE HG FROM RCH281, SUB270 & SUB280
429          KM                INFLOW INTO DETENTION BASIN 281
430          HC       3

431          KK  DET281        ROUTE HG SUM281 THRU DET BASIN 281; Wb = 100'; L  = 800'
432          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 4-48" CMP
433          KO       1
434          RS       1    STOR
435          SV       0    4.11    9.11   14.99
436          SE     100     102     104     106
437          SL     102    50.3     .37      .5
438          SS   103.5     100     2.6     1.5

439          KK  RCH441        ROUTE HG DET281 THRU REACH 441 (WEST)
440          RS       1    FLOW      -1
441          RC     .03    .025     .03     580    .004
442          RX     500     512     533     545     555     567     588     600
443          RY     100      98      98      95      95      98      98     100

444          KK  SUB290        RUNOFF HG FROM SUB-BASIN 290
445          KM          ************ BEGIN NEW BRANCH *************
446          BA    .021
447          LG    .225    .295    2.65    1.10      10
448          UC    .400    .437
449          UA       0       5      16      30      65      77      84      90      94      97
450          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

451          KK  SUB300        RUNOFF HG FROM SUB-BASIN 300
452          BA    .021
453          LG    .150     .28     3.4     .80      37
454          UC    .167    .211
455          UA       0       5      16      30      65      77      84      90      94      97
456          UA     100

457          KK  SUM301        COMBINE HG FROM SUB290 & SUB300
458          KM                INFLOW INTO DETENTION BASIN 301
459          HC       2

460          KK  DET301        ROUTE HG SUM301 THRU DET BASIN 301; Wb = 100'; L  = 200'
461          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-18" CMP
462          KO       1
463          RS       1    STOR
464          SV       0    1.03    2.28    3.75
465          SE     100     102     104     106
466          SL     102     1.8     .37      .5
467          SS   105.9     100     2.6     1.5

468          KK  RCH349        ROUTE HG DET301 THRU REACH 349 (WEST)
469          RS       1    FLOW      -1
470          RC     .03    .025     .03    1800    .004
471          RX     500     508     508     520     530     542     542     550
472          RY     100      99      99      96      96      99      99     100

473          KK  SUB310        RUNOFF HG FROM SUB-BASIN 310
474          BA    .027
475          LG    .225    .295    2.65    1.10      10
476          UC    .600    .726
477          UA       0       5      16      30      65      77      84      90      94      97
478          UA     100

479          KK  SUB320        RUNOFF HG FROM SUB-BASIN 320
480          BA    .015
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481          LG    .150     .28     3.4     .80      37
482          UC    .217    .342
483          UA       0       5      16      30      65      77      84      90      94      97
484          UA     100

485          KK  SUB330        RUNOFF HG FROM SUB-BASIN 330
486          BA    .027
487          LG     .25     .30     2.4    1.20       1
488          UC    .533   1.470
489          UA       0       5      16      30      65      77      84      90      94      97
490          UA     100

491          KK    SUBC        RUNOFF HG FROM SUB-BASIN C
492          BA    .195
493          LG     .25     .25    6.05      .2       1
494          UC    .700    .508
495          UA       0       3       5       8      12      20      43      75      90      96
496          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

497          KK  SUM337        COMBINE HG FROM SUB330 & SUBC
498          HC       2

499          KK  RCH347        ROUTE HG SUM337 THRU REACH 347
500          RS       1    FLOW      -1
501          RC     .03    .025     .03    2020    .004
502          RX     500     512     533     545     555     567     588     600
503          RY     100      98      98      95      95      98      98     100

504          KK    SUBD        RUNOFF HG FROM SUB-BASIN D
505          BA    .227
506          LG     .25     .28    4.34     .26       1
507          UC    .617    .413
508          UA       0       3       5       8      12      20      43      75      90      96
509          UA     100

510          KK  SUB340        RUNOFF HG FROM SUB-BASIN 340
511          BA    .008
512          LG     .25     .30     2.4    1.20       1
513          UC    .233    .371
514          UA       0       5      16      30      65      77      84      90      94      97
515          UA     100

516          KK  SUM347        COMBINE HG FROM RCH347, SUBD & SUB340
517          HC       3

518          KK  RCH349        ROUTE HG SUM347 THRU REACH 349 (NORTH); GUNITE CHANNEL
519          RK     440    .007    .016            TRAP      20      .5

520          KK  SUM349        COMBINE HG FROM RCH349 (WEST & NORTH), SUB310 & SUB320
521          KM                INFLOW INTO DETENTION BASIN 349
522          HC       4

523          KK  DET349        ROUTE HG SUM349 THRU DET BASIN 349; Wb = 100'; L  = 600'
524          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 4-48" CMP
525          KO       1
526          RS       1    STOR
527          SV       0    3.09    6.83   11.24
528          SE     100     102     104     106
529          SL     102    50.3     .37      .5
530          SS   105.0     100     2.6     1.5

531          KK  RCH377        ROUTE HG DET349 THRU REACH 377
532          RS       1    FLOW      -1
533          RC     .03    .025     .03     900    .004
534          RX     500     512     533     545     555     567     588     600
535          RY     100      98      98      95      95      98      98     100

536          KK  SUB350        RUNOFF HG FROM SUB-BASIN 350
537          BA    .013
538          LG    .225    .295    2.65    1.10      10
539          UC    .317    .309
540          UA       0       5      16      30      65      77      84      90      94      97
541          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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542          KK  SUB360        RUNOFF HG FROM SUB-BASIN 360
543          BA    .015
544          LG    .150    .28     3.4     .80     37
545          UC    .183   .243
546          UA       0      5      16      30     65     77     84     90     94     97
547          UA     100

548          KK  SUB370        RUNOFF HG FROM SUB-BASIN 370
549          BA    .028
550          LG    .150    .28     3.4     .80     37
551          UC    .250   .305
552          UA       0      5      16      30     65     77     84     90     94     97
553          UA     100

554          KK  SUM377        COMBINE HG FROM RCH377, SUB350, SUB360 & SUB370
555          HC       4

556          KK  RCH407        ROUTE HG SUM377 THRU REACH 407
557          RS       1   FLOW      -1
558          RC     .03   .025     .03    1820    .004
559          RX     500    512     533     545     555    567    588    600
560          RY     100     98      98      95      95     98     98    100

561          KK  SUB380        RUNOFF HG FROM SUB-BASIN 380
562          BA    .052
563          LG     .13    .28    3.40     .80     59
564          UC    .300   .349
565          UA       0      5      16      30     65     77     84     90     94     97
566          UA     100

567          KK  SUB390        RUNOFF HG FROM SUB-BASIN 390
568          BA    .028
569          LG     .15    .28     3.4     .80     37
570          UC    .267   .471
571          UA       0      5      16      30     65     77     84     90     94     97
572          UA     100

573          KK  SUM401        COMBINE HG FROM SUB380, SUB390
574          KM                INFLOW INTO DETENTION BASIN 401
575          HC       2

576          KK  DET401        ROUTE HG SUM401 THRU DET BASIN 401; Wb = 150'; L = 400'
577          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-36" CMP
578          KO       1
579          RS       1   STOR
580          SV       0   2.06    4.55    7.49
581          SE     100    102     104     106
582          SL     102    7.1     .37      .5
583          SS   105.9    100     2.6     1.5
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

584          KK  SUB400        RUNOFF HG FROM SUB-BASIN 400
585          BA    .058
586          LG    .192   .297    2.55    1.14     6.4
587          UC    .633   .473
588          UA       0      5      16      30     65     77     84     90     94     97
589          UA     100

590          KK  SUM407        COMBINE HG FROM SUB400, RCH407 & DET401
591          HC       3

592          KK  RCH441        ROUTE HG SUM407 THRU REACH 441 (NORTH)
593          RS       1   FLOW      -1
594          RC     .03   .025     .03    1160    .006
595          RX     500    512     533     545     555    567    588    600
596          RY     100     98      98      95      95     98     98    100

597          KK  SUB410        RUNOFF HG FROM SUB-BASIN 410
598          BA    .056
599          LG     .15    .28     3.4     .80     37
600          UC    .233   .242
601          UA       0      5      16      30     65     77     84     90     94     97
602          UA     100

603          KK  SUB425        RUNOFF HG FROM SUB-BASIN 425
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604          BA    .029
605          LG     .15     .28     3.4      .8      37
606          UC    .450    .759
607          UA       0       5      16      30      65      77      84      90      94      97
608          UA     100

609          KK  SUB440        RUNOFF HG FROM SUB-BASIN 440
610          BA    .035
611          LG    .192    .297    2.55    1.14     6.4
612          UC    .567    .622
613          UA       0       5      16      30      65      77      84      90      94      97
614          UA     100

615          KK  SUM441        COMBINE HG FROM RCH441 (WEST & NORTH), SUB410, SUB425 & SUB440
616          KM                INFLOW INTO DETENTION BASIN 441
617          HC       5

618          KK  DET441        ROUTE HG SUM401 THRU DET BASIN 441; Wb = 150'; L = 1000'
619          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 6-48" CMP
620          KM                ****** OUTFLOW EXITS AT SE CORNER OF EXPANSION AREA ******
621          KO       1
622          RS       1    STOR
623          SV       0    7.44   15.98   25.62
624          SE     100     102     104     106
625          SL     102    75.4     .37      .5
626          SS   103.0     100     2.6     1.5
627          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

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INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   69      SUBB1
               V
               V
   80      RCH21
               .
               .
   82          .       SUB10
               .          .
               .          .
   88          .          .       SUB20
               .          .          .
               .          .          .
   94      SUM21.......................
               V
               V
   97      DET21
               V
               V
  105      RCH51
               .
               .
  110          .       SUB30
               .          .
               .          .
  116          .          .       SUB40
               .          .          .
               .          .          .
  122      SUM51.......................
               V
               V
  124      RCH71
               .
               .
  129          .        SUBA
               .          .
               .          .
  135          .          .       SUBB2
               .          .          .
               .          .          .
  141          .       SUM7............
               .          V
               .          V
  143          .       RCH71
               .          .
               .          .
  145          .          .       SUB50
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                .         .         .
                .         .         .
151             .         .         .      SUB60
                .         .         .        .
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157             .         .         .        .      SUB70
                .         .         .        .        .
                .         .         .        .        .
163        SUM71.............................................
                V
                V
165        RCH77
                .
                .
170             .      SUB75
                .         .
                .         .
176        SUM77............
                V
                V
178       RCH241
                .
                .
183             .      SUB76
                .         .
                .         .
189             .         .      SUB80
                .         .         .
                .         .         .
196             .         .         .      SUB90
                .         .         .        .
                .         .         .        .
202             .         .      SUM91............
                .         .         V
                .         .         V
205             .         .      DET91
                .         .         V
                .         .         V
213             .         .     RCH137
                .         .         .
                .         .         .
218             .         .         .     SUB100
                .         .         .        .
                .         .         .        .
224             .         .         .        .     SUB110
                .         .         .        .        .
                .         .         .        .        .
230             .         .         .        .        .     SUB130
                .         .         .        .        .        .
                .         .         .        .        .        .
236             .         .         .        .     SUM131............
                .         .         .        .        V
                .         .         .        .        V
239             .         .         .        .     DET131
                .         .         .        .        .
                .         .         .        .        .
247             .         .     SUM137......................
                .         .         V
                .         .         V
249             .         .     RCH147
                .         .         .
                .         .         .
254             .         .         .     SUB140
                .         .         .        V
                .         .         .        V
261             .         .         .     DET141
                .         .         .        .
                .         .         .        .
269             .         .     SUM147............
                .         .         V
                .         .         V
271             .         .     RCH167
                .         .         .
                .         .         .
276             .         .         .     SUB150
                .         .         .        .
                .         .         .        .
282             .         .         .        .     SUB160
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288                                   SUM161............
                                          V
                                          V
291                                   DET161
                                          .
                                          .
299                           SUM167............
                                  V
                                  V
301                           RCH181
                                  .
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306                                   SUB170
                                          .
                                          .
312                                           SUB175
                                                  .
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318                                                   SUB180
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324                           SUM181.................................
                                  V
                                  V
327                           DET181
                                  .
                                  .
335                                   SUB190
                                          V
                                          V
341                                   RCH207
                                          .
                                          .
343                                           SUB200
                                                  .
                                                  .
349                           SUM207......................
                                  .
                                  .
351                                   SUB210
                                          V
                                          V
357                                   RCH227
                                          .
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359                                           SUB220
                                                  .
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365                                                   SUB225
                                                          .
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371                                   SUM227......................
                                          .
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373                                           SUB230
                                                  .
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379                           SUM231......................
                                  V
                                  V
382                           DET231
                                  .
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390                   SUM241......................
                          V
                          V
392                   RCH267
                          .
                          .
397                       SUB250
                              .
                              .
403                           SUB260
                                  .
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409                   SUM267......................
                          V
                          V
411                   RCH281
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416          .     SUB270
             .          .
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422          .          .     SUB280
             .          .          .
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428     SUM281.......................
             V
             V
431     DET281
             V
             V
439     RCH441
             .
             .
444          .     SUB290
             .          .
             .          .
451          .          .     SUB300
             .          .          .
             .          .          .
457          .     SUM301............
             .          V
             .          V
460          .     DET301
             .          V
             .          V
468          .     RCH349
             .          .
             .          .
473          .          .     SUB310
             .          .          .
             .          .          .
479          .          .          .     SUB320
             .          .          .          .
             .          .          .          .
485          .          .          .          .     SUB330
             .          .          .          .          .
             .          .          .          .          .
491          .          .          .          .          .          SUBC
             .          .          .          .          .            .
             .          .          .          .          .            .
497          .          .          .          .     SUM337............
             .          .          .          .          V
             .          .          .          .          V
499          .          .          .          .     RCH347
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             .          .          .          .          .
504          .          .          .          .          .          SUBD
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             .          .          .          .          .            .
510          .          .          .          .          .            .     SUB340
             .          .          .          .          .            .          .
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516          .          .          .          .     SUM347........................
             .          .          .          .          V
             .          .          .          .          V
518          .          .          .          .     RCH349
             .          .          .          .          .
             .          .          .          .          .
520          .     SUM349.................................
             .          V
             .          V
523          .     DET349
             .          V
             .          V
531          .     RCH377
             .          .
             .          .
536          .          .     SUB350
             .          .          .
             .          .          .
542          .          .          .     SUB360
             .          .          .          .
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548          .          .          .          .     SUB370
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554          .     SUM377.................................
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                .          V
                .          V
556             .      RCH407
                .          .
                .          .
561             .          .     SUB380
                .          .          .
                .          .          .
567             .          .          .     SUB390
                .          .          .          .
                .          .          .          .
573             .          .     SUM401............
                .          .          V
                .          .          V
576             .          .     DET401
                .          .          .
                .          .          .
584             .          .          .     SUB400
                .          .          .          .
                .          .          .          .
590             .      SUM407......................
                .          V
                .          V
592             .      RCH441
                .          .
                .          .
597             .          .     SUB410
                .          .          .
                .          .          .
603             .          .          .     SUB425
                .          .          .          .
                .          .          .          .
609             .          .          .          .     SUB440
                .          .          .          .          .
                .          .          .          .          .
615         SUM441.............................................
                V
                V
618         DET441
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
*  RUN DATE  01/10/1992  TIME  15:17:39 *
*                                      *
****************************************
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```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

SUN CITY WEST EXPANSION
STANLEY CONSULTANTS JOB # 11028 DATE: 10 JAN 92
HEC-1 MODEL 11028M (DESIGN COND ONSITE, NATURAL COND OFFSITE)

CLARK UNIT HYDROGRAPH

2-HR STORM DISTRIBUTION (FCDMC HYDROLOGIC DESIGN MANUAL; TABLE 2.2)
P100 = 2.77"

NO AREAL REDUCTION FACTOR (TYPICAL FOR ALL AREAS)

COMPUTATION TIME INTERVAL 5 MINUTES

GREEN-AMPT LOSS RATES FOR OFFSITE EXISTING CONDITIONS BASED ON
AREA-WEIGHTED VALUES OF EXISTING SOILS ASSUMING DTHETA NORMAL
AND VEGETATIVE COVER 25 PERCENT.
IA ASSUMED TO BE 0.25 INCHES AND PERCENT IMPERVIOUS ASSUMED
TO BE 1 PERCENT.

GREEN-AMPT LOSS RATES FOR ONSITE DEVELOPED CONDITIONS ARE AREA-WEIGHTED
FROM TABLE 2 OF THE CONCEPTUAL MASTER DRAINAGE REPORT.
BASIC LOSS RATES AND PERCENT IMPERVIOUS (FOR DEVELOPED CONDITION)
SELECTED TO PRODUCE RAINFALL EXCESS SIMILAR TO CORRESPONDING
RATIONAL RUNOFF COEFFICIENT FOR PARTICULAR LAND USE.

```
                    TIME OF CONCENTRATION AND STORAGE COEFFICIENT R ARE BASED ON RESULTS
                          FROM MCUHP1 WITH LENGTHS AND SLOPES ESTIMATED FROM PRELIMINARY
                          LOT LAYOUTS AND GRADING.

                    Kb BASED ON HYDRO MANUAL FIGURE/TABLE 3.1  (m=-0.025, b=.15 for exist)
                                                               (m=-0.00625, b=.04 for urban)

                    TIME-AREA RELATION FROM TABLE 5.2:
                          OFFSITE AREAS USE A NATURAL TIME-AREA UA RECORD
                          ONSITE AREAS USE AN URBAN TIME-AREA UA RECORD

                    HYDROGRAPH ROUTING THROUGH STREET REACHES USES KENEMATIC WAVE
                          RECTANGULAR CHANNEL WITH WIDTH OF 68 FEET AND "n"=0.015

                    OFFSITE FLOWS COMBINE WITH ONSITE FLOWS IN DETENTION BASINS

                    HYDROGRAPH ROUTING THROUGH GUNITE-LINED, TRAPEZOIDAL CHANNEL ASSUMES:
                          Wbase = 10'(MIN), 20'(MAX); Side Slope = .5:1 (H\V); n = .016

                    HYDROGRAPH ROUTING THROUGH GOLF COURSE CHANNELS ASSUMES:
                          MODIFIED PULS ROUTING, 100 FOOT TOTAL TOPWIDTH
                          LOW FLOW CHANNEL IS 10' BOTTOM WIDTH, SS=4:1, MANNING n = 0.025
                          (UNLESS SPECIFIED OTHERWISE)
                          OVERBANK WIDTHS VARY AND HAVE SS=6:1, MANNING n = 0.030
                          CHANNEL SLOPE RANGES FROM 0.003 TO 0.006 FEET PER FEET
                          NSTPS (ON RS RECORD) = LENGTH \ (VEL * 300 SEC)
                          (VEL ASSUMED @ 5 FPS, TIME INTERVAL 5 MINUTES)

                    CULVERTS ARE ASSUMED TO NOT INFLUENCE CHANNEL ROUTING

                    HYDROGRAPH ROUTING THROUGH DETENTION BASINS ASSUMES:
                          TRAPEZOIDAL, LEVEL BOTTOM, 6:1 SIDESLOPES
                          BOTTOM WIDTHS RANGE FROM 50' TO 250' (100' TYPICAL)
                          BASIN OUTLETS ASSUME PIPE WITH INLET CONTROL.
                          PIPE SIZE RANGES FROM SINGLE 18" CMP TO 4 - 48" CMP
                          LOW-FLOWS ASSUME ORFICE EQUATION:
                          Q = C * A(pipe) * H(above FL)^0.5
                          WHERE C IS ORIFICE COEFFICIENT ESTIMATED TO BE 0.37
                          (GIVES FLOWS SIMILAR TO RESULTS OF BPR INLET CONTROL CURVES)
                          WIERS ARE USED IN COMBINATION WITH PIPES

68 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1   0  ENDING DATE
                    NDTIME       1635  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE   16.58 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
69 KK     *     SUBB1  *            RUNOFF HG FROM SUB-BASIN B1
          *            *
          **************

71 IN          TIME DATA FOR INPUT TIME SERIES
```

```
                JXMIN          5  TIME INTERVAL IN MINUTES
               JXDATE      1   0  STARTING DATE
               JXTIME          0  STARTING TIME

          SUBBASIN RUNOFF DATA

 70 BA      SUBBASIN CHARACTERISTICS
                TAREA        .17  SUBBASIN AREA

            PRECIPITATION DATA

 72 PB          STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI        INCREMENTAL PRECIPITATION PATTERN
                .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                .01       .00       .01       .01

 76 LG      GREEN AND AMPT LOSS RATE
               STRTL        .25  STARTING LOSS
                 DTH        .32  MOISTURE DEFICIT
                PSIF       5.09  WETTING FRONT SUCTION
               XKSAT        .28  HYDRAULIC CONDUCTIVITY
               RTIMP       1.00  PERCENT IMPERVIOUS AREA

 77 UC      CLARK UNITGRAPH
                  TC        .53  TIME OF CONCENTRATION
                   R        .32  STORAGE COEFFICIENT

 78 UA      ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                 .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
               100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .53 HR,       R=   .32 HR
                                  SNYDER   TP=   .46 HR,      CP=   .86

                                            UNIT HYDROGRAPH
                                      25 END-OF-PERIOD ORDINATES
            6.       17.       34.       90.      173.      203.      176.      139.      107.       83.
           64.       49.       38.       29.       23.       17.       13.       10.        8.        6.
            5.        4.        3.        2.        2.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    SUBB1

  TOTAL RAINFALL =   2.77, TOTAL LOSS =    1.31, TOTAL EXCESS =    1.46

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+    251.      1.58                 26.         10.         10.         10.
                       (INCHES)    1.449       1.449       1.449       1.449
                        (AC-FT)     13.         13.         13.         13.

                      CUMULATIVE AREA =     .17 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 80 KK    *     RCH21  *          ROUTE HG SUBB1 THRU REACH 21; GUNITE CHANNEL
          *            *
          **************

            HYDROGRAPH ROUTING DATA

 81 RK      KINEMATIC WAVE STREAM ROUTING
                   L       840.  CHANNEL LENGTH
                   S      .0040  SLOPE
                   N       .016  CHANNEL ROUGHNESS COEFFICIENT
                  CA        .00  CONTRIBUTING AREA
```

```
          SHAPE        TRAP  CHANNEL SHAPE
             WD       20.00  BOTTOM WIDTH OR DIAMETER
              Z         .50  SIDE SLOPE
         NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                        COMPUTED KINEMATIC PARAMETERS
                             VARIABLE TIME STEP
                           (DT SHOWN IS A MINIMUM)

        ELEMENT    ALPHA       M        DT        DX      PEAK    TIME TO     VOLUME    MAXIMUM
                                                                     PEAK                CELERITY
                                         (MIN)     (FT)    (CFS)    (MIN)      (IN)      (FPS)

        MAIN         .99      1.56       .47    280.00    250.51    95.76      1.45      11.22

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1306E+02  EXCESS= .0000E+00 OUTFLOW= .1307E+02 BASIN STORAGE= .3862E-05 PERCENT ERROR=   -.1

                                  INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

        MAIN         .99      1.56      5.00              249.69    95.00      1.45

   ***          ***          ***          ***          ***

                   HYDROGRAPH AT STATION    RCH21

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                              6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                   (CFS)
+    250.      1.58              26.         10.         10.         10.
                (INCHES)      1.452       1.452       1.452       1.452
                 (AC-FT)        13.         13.         13.         13.

                CUMULATIVE AREA =     .17 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  82 KK   *     SUB10  *          RUNOFF HG FROM SUB-BASIN 10
          *            *
          **************

             SUBBASIN RUNOFF DATA

  83 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .02  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

  84 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

  85 UC        CLARK UNITGRAPH
                       TC         .18  TIME OF CONCENTRATION
                        R         .21  STORAGE COEFFICIENT

  86 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0
```

```
                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .18 HR,       R=   .21 HR
                                       SNYDER   TP=   .14 HR,      CP=   .45

                                                UNIT HYDROGRAPH
                                           14 END-OF-PERIOD ORDINATES
              19.       37.       32.       22.       15.       10.        7.        4.        3.        2.
               1.        1.        1.        0.

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    SUB10

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     43.       1.25                 4.          1.          1.          1.
                        (INCHES)   1.743       1.743       1.743       1.743
                         (AC-FT)     2.          2.          2.          2.

                        CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
   88 KK  *     SUB20  *            RUNOFF HG FROM SUB-BASIN 20
          *            *
          **************

             SUBBASIN RUNOFF DATA

   89 BA       SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

   72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

   73 PI         INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

   90 LG       GREEN AND AMPT LOSS RATE
                     STRTL         .22  STARTING LOSS
                       DTH         .29  MOISTURE DEFICIT
                      PSIF        2.65  WETTING FRONT SUCTION
                     XKSAT        1.10  HYDRAULIC CONDUCTIVITY
                     RTIMP       10.00  PERCENT IMPERVIOUS AREA

   91 UC       CLARK UNITGRAPH
                        TC         .40  TIME OF CONCENTRATION
                         R         .42  STORAGE COEFFICIENT

   92 UA       ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .40 HR,       R=   .42 HR
                                       SNYDER   TP=   .26 HR,      CP=   .40

                                                UNIT HYDROGRAPH
                                           29 END-OF-PERIOD ORDINATES
               1.        7.       11.       12.       11.        9.        8.        6.        5.        4.
               3.        3.        2.        2.        2.        1.        1.        1.        1.        1.
               0.        0.        0.        0.        0.        0.        0.        0.        0.
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   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    SUB20

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW -
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                        (CFS)
+     12.      1.42                 2.          1.          1.          1.
                      (INCHES)    1.175       1.175       1.175       1.175
                       (AC-FT)     1.          1.          1.          1.

                      CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 94 KK      *     SUM21  *            COMBINE HG FROM RCH21, SUB10 & SUB20
            *            *
            **************
                                     INFLOW INTO DETENTION BASIN 21

 96 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    SUM21

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                        (CFS)
+    274.      1.58                32.         11.         11.         11.
                      (INCHES)    1.464       1.464       1.464       1.464
                       (AC-FT)     16.         16.         16.         16.

                      CUMULATIVE AREA =     .20 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 97 KK      *     DET21  *            ROUTE HG SUM21 THRU DET BASIN 21; Wb = 100'; L = 500'
            *            *
            **************
                                     100-FOOT WIER USED FOR HIGH FLOWS AND 2-48" CMP

 99 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           1  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

100 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        STOR  TYPE OF INITIAL CONDITION
                     RSVRIC         .00  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

101 SV            STORAGE          .0       2.6       5.7       9.4

102 SE         -- ELEVATION      100.00    102.00    104.00    106.00

103 SL          LOW-LEVEL OUTLET
                      ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
```

CAREA	25.10	CROSS-SECTIONAL AREA
COQL	.37	COEFFICIENT
EXPL	.50	EXPONENT OF HEAD

104 SS SPILLWAY

CREL	105.90	SPILLWAY CREST ELEVATION
SPWID	100.00	SPILLWAY WIDTH
COQW	2.60	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	118.35	121.75	125.35	129.17	133.23	137.55	142.16	147.09
ELEVATION	100.00	102.00	104.53	104.67	104.83	105.01	105.20	105.41	105.64	105.90
OUTFLOW	147.31	147.56	147.96	148.52	149.29	150.29	151.55	153.10	154.96	157.19
ELEVATION	105.91	105.91	105.92	105.92	105.93	105.94	105.96	105.97	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	2.57	5.69	6.66	6.93	7.22	7.54	7.90	8.29	8.71
OUTFLOW	.00	.00	105.33	118.35	121.75	125.35	129.17	133.23	137.55	142.16
ELEVATION	100.00	102.00	104.00	104.53	104.67	104.83	105.01	105.20	105.41	105.64
STORAGE	9.19	9.21	9.23	9.27	9.29	9.31	9.34	9.37		
OUTFLOW	147.09	147.56	148.52	150.29	151.55	153.10	154.96	157.19		
ELEVATION	105.90	105.91	105.92	105.94	105.96	105.97	105.98	106.00		

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HYDROGRAPH AT STATION DET21

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	0.	2.6	102.0	*	1		1110	135	0.	2.6	102.0
1		0005	2	0.	.0	100.0	*	1		0540	69	0.	2.6	102.0	*	1		1115	136	0.	2.6	102.0
1		0010	3	0.	.0	100.0	*	1		0545	70	0.	2.6	102.0	*	1		1120	137	0.	2.6	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	0.	2.6	102.0	*	1		1125	138	0.	2.6	102.0
1		0020	5	0.	.0	100.0	*	1		0555	72	0.	2.6	102.0	*	1		1130	139	0.	2.6	102.0
1		0025	6	0.	.0	100.0	*	1		0600	73	0.	2.6	102.0	*	1		1135	140	0.	2.6	102.0
1		0030	7	0.	.0	100.0	*	1		0605	74	0.	2.6	102.0	*	1		1140	141	0.	2.6	102.0
1		0035	8	0.	.0	100.0	*	1		0610	75	0.	2.6	102.0	*	1		1145	142	0.	2.6	102.0
1		0040	9	0.	.0	100.0	*	1		0615	76	0.	2.6	102.0	*	1		1150	143	0.	2.6	102.0
1		0045	10	0.	.1	100.1	*	1		0620	77	0.	2.6	102.0	*	1		1155	144	0.	2.6	102.0
1		0050	11	0.	.1	100.1	*	1		0625	78	0.	2.6	102.0	*	1		1200	145	0.	2.6	102.0
1		0055	12	0.	.1	100.1	*	1		0630	79	0.	2.6	102.0	*	1		1205	146	0.	2.6	102.0
1		0100	13	0.	.2	100.1	*	1		0635	80	0.	2.6	102.0	*	1		1210	147	0.	2.6	102.0
1		0105	14	0.	.3	100.2	*	1		0640	81	0.	2.6	102.0	*	1		1215	148	0.	2.6	102.0
1		0110	15	0.	.6	100.5	*	1		0645	82	0.	2.6	102.0	*	1		1220	149	0.	2.6	102.0
1		0115	16	0.	1.1	100.9	*	1		0650	83	0.	2.6	102.0	*	1		1225	150	0.	2.6	102.0
1		0120	17	0.	1.9	101.5	*	1		0655	84	0.	2.6	102.0	*	1		1230	151	0.	2.6	102.0
1		0125	18	17.	3.1	102.3	*	1		0700	85	0.	2.6	102.0	*	1		1235	152	0.	2.6	102.0
1		0130	19	63.	4.4	103.2	*	1		0705	86	0.	2.6	102.0	*	1		1240	153	0.	2.6	102.0
1		0135	20	106.	5.7	104.0	*	1		0710	87	0.	2.6	102.0	*	1		1245	154	0.	2.6	102.0
1		0140	21	119.	6.7	104.6	*	1		0715	88	0.	2.6	102.0	*	1		1250	155	0.	2.6	102.0
1		0145	22	128.	7.4	104.9	*	1		0720	89	0.	2.6	102.0	*	1		1255	156	0.	2.6	102.0
1		0150	23	132.	7.8	105.1	*	1		0725	90	0.	2.6	102.0	*	1		1300	157	0.	2.6	102.0
1		0155	24	133.	7.9	105.2	*	1		0730	91	0.	2.6	102.0	*	1		1305	158	0.	2.6	102.0
1		0200	25	132.	7.8	105.1	*	1		0735	92	0.	2.6	102.0	*	1		1310	159	0.	2.6	102.0
1		0205	26	128.	7.5	105.0	*	1		0740	93	0.	2.6	102.0	*	1		1315	160	0.	2.6	102.0
1		0210	27	124.	7.1	104.8	*	1		0745	94	0.	2.6	102.0	*	1		1320	161	0.	2.6	102.0
1		0215	28	118.	6.6	104.5	*	1		0750	95	0.	2.6	102.0	*	1		1325	162	0.	2.6	102.0
1		0220	29	111.	6.1	104.2	*	1		0755	96	0.	2.6	102.0	*	1		1330	163	0.	2.6	102.0
1		0225	30	102.	5.6	103.9	*	1		0800	97	0.	2.6	102.0	*	1		1335	164	0.	2.6	102.0
1		0230	31	86.	5.1	103.6	*	1		0805	98	0.	2.6	102.0	*	1		1340	165	0.	2.6	102.0
1		0235	32	72.	4.7	103.4	*	1		0810	99	0.	2.6	102.0	*	1		1345	166	0.	2.6	102.0
1		0240	33	60.	4.4	103.1	*	1		0815	100	0.	2.6	102.0	*	1		1350	167	0.	2.6	102.0
1		0245	34	50.	4.1	103.0	*	1		0820	101	0.	2.6	102.0	*	1		1355	168	0.	2.6	102.0
1		0250	35	42.	3.8	102.8	*	1		0825	102	0.	2.6	102.0	*	1		1400	169	0.	2.6	102.0
1		0255	36	35.	3.6	102.7	*	1		0830	103	0.	2.6	102.0	*	1		1405	170	0.	2.6	102.0
1		0300	37	29.	3.4	102.5	*	1		0835	104	0.	2.6	102.0	*	1		1410	171	0.	2.6	102.0
1		0305	38	24.	3.3	102.4	*	1		0840	105	0.	2.6	102.0	*	1		1415	172	0.	2.6	102.0
1		0310	39	19.	3.1	102.4	*	1		0845	106	0.	2.6	102.0	*	1		1420	173	0.	2.6	102.0
1		0315	40	16.	3.0	102.3	*	1		0850	107	0.	2.6	102.0	*	1		1425	174	0.	2.6	102.0
1		0320	41	13.	2.9	102.2	*	1		0855	108	0.	2.6	102.0	*	1		1430	175	0.	2.6	102.0

1	0325	42	10.	2.9	102.2	*	1	0900	109	0.	2.6	102.0	*	1	1435	176	0.	2.6	102.0
1	0330	43	8.	2.8	102.2	*	1	0905	110	0.	2.6	102.0	*	1	1440	177	0.	2.6	102.0
1	0335	44	7.	2.8	102.1	*	1	0910	111	0.	2.6	102.0	*	1	1445	178	0.	2.6	102.0
1	0340	45	5.	2.7	102.1	*	1	0915	112	0.	2.6	102.0	*	1	1450	179	0.	2.6	102.0
1	0345	46	4.	2.7	102.1	*	1	0920	113	0.	2.6	102.0	*	1	1455	180	0.	2.6	102.0
1	0350	47	3.	2.7	102.1	*	1	0925	114	0.	2.6	102.0	*	1	1500	181	0.	2.6	[illegible]
1	0355	48	3.	2.6	102.0	*	1	0930	115	0.	2.6	102.0	*	1	1505	182	0.	2.6	102.0
1	0400	49	2.	2.6	102.0	*	1	0935	116	0.	2.6	102.0	*	1	1510	183	0.	2.6	102.0
1	0405	50	2.	2.6	102.0	*	1	0940	117	0.	2.6	102.0	*	1	1515	184	0.	2.6	102.0
1	0410	51	1.	2.6	102.0	*	1	0945	118	0.	2.6	102.0	*	1	1520	185	0.	2.6	102.0
1	0415	52	1.	2.6	102.0	*	1	0950	119	0.	2.6	102.0	*	1	1525	186	0.	2.6	102.0
1	0420	53	1.	2.6	102.0	*	1	0955	120	0.	2.6	102.0	*	1	1530	187	0.	2.6	102.0
1	0425	54	1.	2.6	102.0	*	1	1000	121	0.	2.6	102.0	*	1	1535	188	0.	2.6	102.0
1	0430	55	1.	2.6	102.0	*	1	1005	122	0.	2.6	102.0	*	1	1540	189	0.	2.6	102.0
1	0435	56	0.	2.6	102.0	*	1	1010	123	0.	2.6	102.0	*	1	1545	190	0.	2.6	102.0
1	0440	57	0.	2.6	102.0	*	1	1015	124	0.	2.6	102.0	*	1	1550	191	0.	2.6	102.0
1	0445	58	0.	2.6	102.0	*	1	1020	125	0.	2.6	102.0	*	1	1555	192	0.	2.6	102.0
1	0450	59	0.	2.6	102.0	*	1	1025	126	0.	2.6	102.0	*	1	1600	193	0.	2.6	102.0
1	0455	60	0.	2.6	102.0	*	1	1030	127	0.	2.6	102.0	*	1	1605	194	0.	2.6	102.0
1	0500	61	0.	2.6	102.0	*	1	1035	128	0.	2.6	102.0	*	1	1610	195	0.	2.6	102.0
1	0505	62	0.	2.6	102.0	*	1	1040	129	0.	2.6	102.0	*	1	1615	196	0.	2.6	102.0
1	0510	63	0.	2.6	102.0	*	1	1045	130	0.	2.6	102.0	*	1	1620	197	0.	2.6	102.0
1	0515	64	0.	2.6	102.0	*	1	1050	131	0.	2.6	102.0	*	1	1625	198	0.	2.6	102.0
1	0520	65	0.	2.6	102.0	*	1	1055	132	0.	2.6	102.0	*	1	1630	199	0.	2.6	102.0
1	0525	66	0.	2.6	102.0	*	1	1100	133	0.	2.6	102.0	*	1	1635	200	0.	2.6	102.0
1	0530	67	0.	2.6	102.0	*	1	1105	134	0.	2.6	102.0	*						
						*							*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 133.	1.92		26.	10.	10.	10.
		(INCHES)	1.225	1.225	1.225	1.225
		(AC-FT)	13.	13.	13.	13.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
8.	1.92	3.	3.	3.	3.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
105.19	1.92	102.56	102.05	102.05	102.05

CUMULATIVE AREA = .20 SQ MI

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          *            *
105 KK    *     RCH51  *          ROUTE HG DET21 THRU REACH 51
          *            *
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             HYDROGRAPH ROUTING DATA

106 RS          STORAGE ROUTING
                     NSTPS          5  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC      -1.00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

107 RC          NORMAL DEPTH CHANNEL
                       ANL       .030  LEFT OVERBANK N-VALUE
                      ANCH       .025  MAIN CHANNEL N-VALUE
                       ANR       .030  RIGHT OVERBANK N-VALUE
                     RLNTH      1400.  REACH LENGTH
                       SEL      .0050  ENERGY SLOPE
                      ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
109 RY       ELEVATION   100.00    98.00    98.00    95.00    95.00    98.00    98.00   100.00
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108 RX        DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00
                                                          ***

                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .09       .20       .33       .48       .65       .83      1.03      1.25      1.48
          OUTFLOW       .00      4.72     15.63     32.14     54.36     82.55    117.03    158.14    206.23    261.66
        ELEVATION     95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

          STORAGE      1.74      2.01      2.51      3.18      3.88      4.61      5.36      6.14      6.95      7.78
          OUTFLOW    324.77    395.91    492.94    627.46    786.91    969.25   1173.53   1399.24   1646.09   1913.99
        ELEVATION     97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN        5. TO     1914.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    RCH51

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+     133.     1.92                  26.         10.         10.         10.
                        (INCHES)   1.225       1.225       1.225       1.225
                         (AC-FT)     13.         13.         13.         13.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
       0.      1.92                   0.          0.          0.          0.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    96.68      1.92                 95.44       95.16       95.16       95.16

                        CUMULATIVE AREA =     .20 SQ MI


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            **************
            *            *
 110 KK     *    SUB30   *            RUNOFF HG FROM SUB-BASIN 30
            *            *
            **************

               SUBBASIN RUNOFF DATA

 111 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .02  SUBBASIN AREA

                 PRECIPITATION DATA

  72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

 112 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

 113 UC          CLARK UNITGRAPH
                         TC         .20  TIME OF CONCENTRATION
                          R         .29  STORAGE COEFFICIENT
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114 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .20 HR,       R=   .29 HR
                                         SNYDER   TP=   .15 HR,      CP=   .36

                                                UNIT HYDROGRAPH
                                           20 END-OF-PERIOD ORDINATES
              11.       24.       24.       18.       14.       10.        8.        6.        4.        3.
               2.        2.        1.        1.        1.        1.        0.        0.        0.        0.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    SUB30

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     31.       1.25                  3.          1.          1.          1.
                         (INCHES)   1.745       1.745       1.745       1.745
                          (AC-FT)     2.          2.          2.          2.

                         CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 116 KK     *    SUB40   *            RUNOFF HG FROM SUB-BASIN 40
            *            *
            **************

              SUBBASIN RUNOFF DATA

 117 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .02  SUBBASIN AREA

                PRECIPITATION DATA

  72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI           INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

 118 LG         GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

 119 UC         CLARK UNITGRAPH
                         TC         .18  TIME OF CONCENTRATION
                          R         .27  STORAGE COEFFICIENT

 120 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .18 HR,       R=   .27 HR
                                         SNYDER   TP=   .15 HR,      CP=   .38

                                                UNIT HYDROGRAPH
                                           19 END-OF-PERIOD ORDINATES
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          12.       25.       23.       17.       13.        9.        7.        5.        4.        3.
           2.        1.        1.        1.        1.        0.        0.        0.        0.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    SUB40

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =   1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     30.      1.25                    3.          1.          1.          1.
                       (INCHES)     1.745       1.745       1.745       1.745
                        (AC-FT)       1.          1.          1.          1.

                       CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 122 KK   *     SUM51  *            COMBINE HG FROM  RCH51, SUB30 & SUB40
          *            *
          **************

 123 HC         HYDROGRAPH COMBINATION
                     ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    SUM51

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+    143.      1.92                   33.         12.         12.         12.
                       (INCHES)     1.298       1.298       1.298       1.298
                        (AC-FT)      16.         16.         16.         16.

                       CUMULATIVE AREA =     .23 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
 124 KK   *     RCH71  *            ROUTE HG SUM51 THRU REACH 71
          *            *
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            HYDROGRAPH ROUTING DATA

 125 RS         STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC       -1.00  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

 126 RC         NORMAL DEPTH CHANNEL
                       ANL        .030  LEFT OVERBANK N-VALUE
                      ANCH        .025  MAIN CHANNEL N-VALUE
                       ANR        .030  RIGHT OVERBANK N-VALUE
                     RLNTH       1400.  REACH LENGTH
                       SEL       .0050  ENERGY SLOPE
                     ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                     --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
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128 RY        ELEVATION    100.00     98.00     98.00     95.00     95.00     98.00     98.00    100.00
127 RX        DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .09       .20       .33       .48       .65       .83      1.03      1.25      1.48
            OUTFLOW        .00      4.72     15.63     32.14     54.36     82.55    117.03    158.14    206.23    261.66
          ELEVATION      95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

            STORAGE       1.74      2.01      2.51      3.18      3.88      4.61      5.36      6.14      6.95      7.78
            OUTFLOW     324.77    395.91    492.94    627.46    786.91    969.25   1173.53   1399.24   1646.09   1913.99
          ELEVATION      97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN     1399. TO     1914.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    RCH71

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+     142.     2.00                   33.         12.         12.         12.
                        (INCHES)    1.298       1.298       1.298       1.298
                         (AC-FT)      16.         16.         16.         16.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
       1.      2.00                    0.          0.          0.          0.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    96.74      2.00                  95.56       95.20       95.20       95.20

                        CUMULATIVE AREA =     .23 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
129 KK      *     SUBA   *            RUNOFF HG FROM SUB-BASIN A
            *            *
            **************

               SUBBASIN RUNOFF DATA

130 BA           SUBBASIN CHARACTERISTICS
                      TAREA         .87  SUBBASIN AREA

                 PRECIPITATION DATA

 72 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI             INCREMENTAL PRECIPITATION PATTERN
                       .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                       .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                       .01       .00       .01       .01

131 LG           GREEN AND AMPT LOSS RATE
                      STRTL        .25  STARTING LOSS
                        DTH        .25  MOISTURE DEFICIT
                       PSIF       6.15  WETTING FRONT SUCTION
                      XKSAT        .21  HYDRAULIC CONDUCTIVITY
                      RTIMP       1.00  PERCENT IMPERVIOUS AREA

132 UC           CLARK UNITGRAPH
                         TC        .97  TIME OF CONCENTRATION
                          R        .54  STORAGE COEFFICIENT
```

```
133 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                   100.0

                                                   ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .97 HR,       R=   .54 HR
                                         SNYDER   TP=   .79 HR,      CP=   .86

                                                UNIT HYDROGRAPH
                                           42 END-OF-PERIOD ORDINATES
              12.       32.       48.       66.       94.      149.      270.      461.      599.      619.
             586.      532.      466.      399.      342.      293.      251.      215.      184.      158.
             135.      116.       99.       85.       73.       62.       53.       46.       39.       33.
              29.       25.       21.       18.       15.       13.       11.       10.        8.        7.
               6.        5.

    ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION     SUBA

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.17, TOTAL EXCESS =    1.60

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    915.       1.92                  149.         54.         54.         54.
                        (INCHES)    1.595       1.595       1.595       1.595
                         (AC-FT)     74.         74.         74.         74.

                        CUMULATIVE AREA =     .87 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
135 KK      *     SUBB2  *            RUNOFF HG FROM SUB-BASIN B2
            *            *
            **************

               SUBBASIN RUNOFF DATA

136 BA            SUBBASIN CHARACTERISTICS
                       TAREA         .18  SUBBASIN AREA

                  PRECIPITATION DATA

 72 PB                 STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI              INCREMENTAL PRECIPITATION PATTERN
                       .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                       .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                       .01       .00       .01       .01

137 LG            GREEN AND AMPT LOSS RATE
                       STRTL         .25  STARTING LOSS
                         DTH         .32  MOISTURE DEFICIT
                        PSIF        5.09  WETTING FRONT SUCTION
                       XKSAT         .28  HYDRAULIC CONDUCTIVITY
                       RTIMP        1.00  PERCENT IMPERVIOUS AREA

138 UC            CLARK UNITGRAPH
                          TC         .73  TIME OF CONCENTRATION
                           R         .70  STORAGE COEFFICIENT

139 UA            ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                   100.0

                                                   ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .73 HR,       R=   .70 HR
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                                   SNYDER   TP=   .65 HR,      CP=   .65

                                                UNIT HYDROGRAPH
                                           50 END-OF-PERIOD ORDINATES
              3.       7.      11.      18.      37.      74.     108.     117.     112.     102.
             91.      81.      71.      63.      56.      50.      44.      39.      35.      31.
             27.      24.      22.      19.      17.      15.      13.      12.      11.       9.
              8.       7.       7.       6.       5.       5.       4.       4.       3.       3.
              3.       2.       2.       2.       2.       1.       1.       1.       1.       1.

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION    SUBB2

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.31, TOTAL EXCESS =    1.46

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     159.      1.75                  28.         10.         10.         10.
                        (INCHES)    1.448       1.448       1.448       1.448
                         (AC-FT)      14.         14.         14.         14.

                        CUMULATIVE AREA =     .18 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  141 KK    *     SUM7   *            COMBINE HG FROM SUBA AND SUBB2
            *            *
            **************

  142 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     SUM7

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    1055.      1.92                 177.         64.         64.         64.
                        (INCHES)    1.570       1.570       1.570       1.570
                         (AC-FT)      88.         88.         88.         88.

                        CUMULATIVE AREA =    1.05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  143 KK    *    RCH71   *            ROUTE HG SUM7 THRU REACH 71; GUNITE CHANNEL
            *            *
            **************

               HYDROGRAPH ROUTING DATA

  144 RK          KINEMATIC WAVE STREAM ROUTING
                            L       1280.  CHANNEL LENGTH
                            S      .0030  SLOPE
                            N       .016  CHANNEL ROUGHNESS COEFFICIENT
                           CA        .00  CONTRIBUTING AREA
                        SHAPE       TRAP  CHANNEL SHAPE
                           WD      20.00  BOTTOM WIDTH OR DIAMETER
                            Z        .50  SIDE SLOPE
                       NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS
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                                                  ***
                                   COMPUTED KINEMATIC PARAMETERS
                                        VARIABLE TIME STEP
                                     (DT SHOWN IS A MINIMUM)

                 ELEMENT    ALPHA       M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                CELERITY
                                                (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

                 MAIN         .86      1.56       .50    426.67   1054.13    115.30       1.57      17.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8764E+02  EXCESS= .0000E+00 OUTFLOW= .8766E+02 BASIN STORAGE= .2712E-04 PERCENT ERROR=    .0

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN         .86      1.56      5.00            1053.66    115.00       1.57

     ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION    RCH71

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                        (CFS)
+   1054.      1.92                177.        64.         64.         64.
                      (INCHES)    1.571       1.571       1.571       1.571
                       (AC-FT)     88.         88.         88.         88.

                      CUMULATIVE AREA =    1.05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  145 KK  *     SUB50  *            RUNOFF HG FROM SUB-BASIN 50
          *            *
          **************

             SUBBASIN RUNOFF DATA

  146 BA       SUBBASIN CHARACTERISTICS
                    TAREA         .02  SUBBASIN AREA

               PRECIPITATION DATA

   72 PB            STORM        2.77  BASIN TOTAL PRECIPITATION

   73 PI        INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

  147 LG       GREEN AND AMPT LOSS RATE
                    STRTL         .22  STARTING LOSS
                      DTH         .29  MOISTURE DEFICIT
                     PSIF        2.65  WETTING FRONT SUCTION
                    XKSAT        1.10  HYDRAULIC CONDUCTIVITY
                    RTIMP       10.00  PERCENT IMPERVIOUS AREA

  148 UC       CLARK UNITGRAPH
                       TC         .52  TIME OF CONCENTRATION
                        R         .60  STORAGE COEFFICIENT

  149 UA       ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                        UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .52 HR,       R=   .60 HR
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```
                                        SNYDER   TP=   .33 HR,      CP=   .37

                                                UNIT HYDROGRAPH
                                          41 END-OF-PERIOD ORDINATES
              1.       5.      12.      15.      16.      15.      14.      12.      10.       9.
              8.       7.       6.       5.       5.       4.       3.       3.       3.       2.
              2.       2.       1.       1.       1.       1.       1.       1.       1.       1.
              0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
              0.

     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    SUB50

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     17.       1.50                3.          1.          1.          1.
                         (INCHES)  1.175       1.175       1.175       1.175
                          (AC-FT)  1.          1.          1.          1.

                         CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 151 KK   *    SUB60   *            RUNOFF HG FROM SUB-BASIN 60
          *            *
          **************

             SUBBASIN RUNOFF DATA

 152 BA        SUBBASIN CHARACTERISTICS
                     TAREA          .04  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB              STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                    .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                    .01      .00      .01      .01

 153 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .14  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       43.00  PERCENT IMPERVIOUS AREA

 154 UC        CLARK UNITGRAPH
                       TC         .27  TIME OF CONCENTRATION
                        R         .36  STORAGE COEFFICIENT

 155 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .27 HR,      R=   .36 HR
                                    SNYDER   TP=   .22 HR,     CP=   .44

                                                UNIT HYDROGRAPH
                                          25 END-OF-PERIOD ORDINATES
             10.      32.      44.      39.      32.      25.      20.      16.      13.      10.
              8.       6.       5.       4.       3.       2.       2.       2.       1.       1.
              1.       1.       0.       0.       0.

     ***            ***            ***            ***            ***
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                    HYDROGRAPH AT STATION    SUB60

   TOTAL RAINFALL =    2.77, TOTAL LOSS =     .92, TOTAL EXCESS =    1.85

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     59.      1.33                 7.          3.          3.          3.
                        (INCHES)  1.842       1.842       1.842       1.842
                         (AC-FT)    4.          4.          4.          4.

                        CUMULATIVE AREA =     .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
157 KK    *    SUB70   *            RUNOFF HG FROM SUB-BASIN 70
          *            *
          **************

             SUBBASIN RUNOFF DATA

158 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

159 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

160 UC          CLARK UNITGRAPH
                         TC         .22  TIME OF CONCENTRATION
                          R         .23  STORAGE COEFFICIENT

161 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .22 HR,       R=   .23 HR
                                  SNYDER   TP=   .15 HR,      CP=   .41

                                            UNIT HYDROGRAPH
                                     16 END-OF-PERIOD ORDINATES
              21.       47.       47.       35.       25.       17.       12.        8.        6.        4.
               3.        2.        1.        1.        1.        0.

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    SUB70

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     60.      1.25                 6.          2.          2.          2.
                        (INCHES)  1.743       1.743       1.743       1.743
                         (AC-FT)    3.          3.          3.          3.
```

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                    CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 163 KK   *    SUM71   *          COMBINE HG FROM RCH71(NORTH & WEST), SUB50, SUB60 & SUB70
          *            *
          **************

 164 HC         HYDROGRAPH COMBINATION
                     ICOMP          5  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    SUM71

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+   1230.      1.92                225.        81.         81.         81.
                       (INCHES)   1.529       1.529       1.529       1.529
                        (AC-FT)   112.        112.        112.        112.

                      CUMULATIVE AREA =    1.37 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 165 KK   *    RCH77   *          ROUTE HG SUM71 THRU REACH 77
          *            *
          **************

            HYDROGRAPH ROUTING DATA

 166 RS         STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC      -1.00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

 167 RC         NORMAL DEPTH CHANNEL
                       ANL       .030  LEFT OVERBANK N-VALUE
                      ANCH       .025  MAIN CHANNEL N-VALUE
                       ANR       .030  RIGHT OVERBANK N-VALUE
                     RLNTH      1900.  REACH LENGTH
                       SEL      .0050  ENERGY SLOPE
                     ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 169 RY       ELEVATION   100.00    98.00    98.00    95.00    95.00    98.00    98.00   100.00
 168 RX       DISTANCE    500.00   512.00   533.00   545.00   555.00   567.00   588.00   600.00

                                                          ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00      .13      .28      .45      .65      .88     1.12     1.40     1.69     2.01
          OUTFLOW       .00     4.72    15.63    32.14    54.36    82.55   117.03   158.14   206.23   261.66
        ELEVATION     95.00    95.26    95.53    95.79    96.05    96.32    96.58    96.84    97.11    97.37

          STORAGE      2.36     2.72     3.41     4.32     5.27     6.25     7.28     8.33     9.43    10.56
          OUTFLOW    324.77   395.91   492.94   627.46   786.91   969.25  1173.53  1399.24  1646.09  1913.99
        ELEVATION     97.63    97.89    98.16    98.42    98.68    98.95    99.21    99.47    99.74   100.00
```

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***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    RCH77

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
  (CFS)        (HR)
                          (CFS)
+   1203.      2.00                225.         81.         81.         81.
                        (INCHES)  1.529       1.529       1.529       1.529
                         (AC-FT)  112.        112.        112.        112.

 PEAK STORAGE  TIME                        MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
      7.       2.00                  2.          1.          1.          1.

 PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    99.24      2.00               96.44       95.52       95.52       95.52

                     CUMULATIVE AREA =    1.37 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 170 KK   *    SUB75   *            RUNOFF HG FROM SUB-BASIN 75
          *            *
          **************

             SUBBASIN RUNOFF DATA

 171 BA        SUBBASIN CHARACTERISTICS
                    TAREA          .02  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 172 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

 173 UC        CLARK UNITGRAPH
                       TC         .25  TIME OF CONCENTRATION
                        R         .38  STORAGE COEFFICIENT

 174 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .25 HR,       R=   .38 HR
                                  SNYDER   TP=   .22 HR,      CP=   .42

                                          UNIT HYDROGRAPH
                                     26 END-OF-PERIOD ORDINATES
               8.       22.       28.       25.       20.       16.       13.       10.        8.        7.
               5.        4.        3.        3.        2.        2.        1.        1.        1.        1.
               1.        0.        0.        0.        0.        0.

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    SUB75
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   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     37.      1.33                   5.          2.          2.          2.
                         (INCHES)    1.743       1.743       1.743       1.743
                          (AC-FT)      2.          2.          2.          2.

                         CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 176 KK     *     SUM77  *            COMBINE HG FROM RCH77 AND SUB75
            *            *
            **************

 177 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    SUM77

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    1212.     2.00                 230.         83.         83.         83.
                         (INCHES)    1.532       1.533       1.533       1.533
                          (AC-FT)     114.        114.        114.        114.

                         CUMULATIVE AREA =    1.39 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 178 KK     *    RCH241  *            ROUTE HG SUM77 THRU REACH 241 (WEST)
            *            *
            **************

               HYDROGRAPH ROUTING DATA

 179 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        FLOW  TYPE OF INITIAL CONDITION
                       RSVRIC       -1.00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

 180 RC          NORMAL DEPTH CHANNEL
                         ANL        .030  LEFT OVERBANK N-VALUE
                        ANCH        .025  MAIN CHANNEL N-VALUE
                         ANR        .030  RIGHT OVERBANK N-VALUE
                       RLNTH       1480.  REACH LENGTH
                         SEL       .0040  ENERGY SLOPE
                       ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                      CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 182 RY        ELEVATION    100.00     98.00     98.00     95.00     95.00     98.00     98.00    100.00
 181 RX        DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00

                                                                  ***

                                      COMPUTED STORAGE-OUTFLOW-ELEVATION DATA
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STORAGE	.00	.10	.22	.35	.51	.68	.88	1.09	1.32	1.57
OUTFLOW	.00	4.22	13.98	28.75	48.62	73.83	104.67	141.44	184.46	234.04
ELEVATION	95.00	95.26	95.53	95.79	96.05	96.32	96.58	96.84	97.11	97.37
STORAGE	1.84	2.12	2.66	3.37	4.10	4.87	5.67	6.49	7.34	8.22
OUTFLOW	290.48	354.11	440.90	561.22	703.83	866.93	1049.64	1251.52	1472.31	1711.92
ELEVATION	97.63	97.89	98.16	98.42	98.68	98.95	99.21	99.47	99.74	100.00

*** *** *** *** ***

HYDROGRAPH AT STATION RCH241

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1205.	2.00		230.	83.	83.	83.
		(INCHES)	1.532	1.533	1.533	1.533
		(AC-FT)	114.	114.	114.	114.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
6.	2.00	1.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
99.41	2.00	96.55	95.56	95.56	95.56

CUMULATIVE AREA = 1.39 SQ MI

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              *            *
183 KK        *    SUB76   *          RUNOFF HG FROM SUB-BASIN 76
              *            *
              **************

                SUBBASIN RUNOFF DATA

184 BA            SUBBASIN CHARACTERISTICS
                      TAREA        .06  SUBBASIN AREA

                  PRECIPITATION DATA

 72 PB                STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI              INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

185 LG            GREEN AND AMPT LOSS RATE
                      STRTL        .22  STARTING LOSS
                        DTH        .29  MOISTURE DEFICIT
                       PSIF       2.65  WETTING FRONT SUCTION
                      XKSAT       1.10  HYDRAULIC CONDUCTIVITY
                      RTIMP      10.00  PERCENT IMPERVIOUS AREA

186 UC            CLARK UNITGRAPH
                         TC        .92  TIME OF CONCENTRATION
                          R       1.26  STORAGE COEFFICIENT

187 UA            ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .92 HR,      R=  1.26 HR
                                    SNYDER   TP=   .66 HR,     CP=   .36
```

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                                        UNIT HYDROGRAPH
                                   85 END-OF-PERIOD ORDINATES
          1.      3.      5.     10.     16.     19.     20.     20.     20.     19.
         19.     18.     17.     16.     15.     14.     13.     12.     11.     11.
         10.      9.      9.      8.      8.      7.      7.      6.      6.      5.
          5.      5.      4.      4.      4.      4.      3.      3.      3.      3.
          3.      2.      2.      2.      2.     -2.      2.      2.      2.      1.
          1.      1.      1.      1.      1.      1.      1.      1.      1.      1.
          1.      1.      1.      1.      1.      1.      0.      0.      0.      0.
          0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
          0.      0.      0.      0.      0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    SUB76

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     23.      1.75                7.          3.          3.          3.
                        (INCHES)  1.162       1.175       1.175       1.175
                         (AC-FT)  3.          4.          4.          4.

                       CUMULATIVE AREA =     .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 189 KK   *    SUB80   *          RUNOFF HG FROM SUB-BASIN 80
          *            *
          **************
                          ***** BEGIN NEW BRANCH ********

            SUBBASIN RUNOFF DATA

 191 BA       SUBBASIN CHARACTERISTICS
                   TAREA         .04  SUBBASIN AREA

              PRECIPITATION DATA

  72 PB            STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI         INCREMENTAL PRECIPITATION PATTERN
                   .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                   .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                   .01      .00      .01      .01

 192 LG       GREEN AND AMPT LOSS RATE
                   STRTL         .15  STARTING LOSS
                     DTH         .28  MOISTURE DEFICIT
                    PSIF        3.40  WETTING FRONT SUCTION
                   XKSAT         .80  HYDRAULIC CONDUCTIVITY
                   RTIMP       37.00  PERCENT IMPERVIOUS AREA

 193 UC       CLARK UNITGRAPH
                      TC         .23  TIME OF CONCENTRATION
                       R         .28  STORAGE COEFFICIENT

 194 UA       ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
               100.0

                                                  ***

                                        UNIT HYDROGRAPH PARAMETERS
                                  CLARK   TC=   .23 HR,       R=   .28 HR
                                 SNYDER   TP=   .18 HR,      CP=   .43

                                        UNIT HYDROGRAPH
                                   19 END-OF-PERIOD ORDINATES
          19.     48.     54.     43.     32.     24.     17.     13.     10.      7.
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          5.       4.       3.       2.       1.       1.       1.       0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    SUB80

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     66.      1.33                 7.          3.          3.          3.
                       (INCHES)   1.743       1.743       1.743       1.743
                        (AC-FT)     3.          3.          3.          3.

                       CUMULATIVE AREA =     .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 196 KK   *    SUB90   *          RUNOFF HG FROM SUB-BASIN 90
          *            *
          **************

            SUBBASIN RUNOFF DATA

 197 BA       SUBBASIN CHARACTERISTICS
                    TAREA         .06  SUBBASIN AREA

              PRECIPITATION DATA

  72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI         INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

 198 LG       GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

 199 UC       CLARK UNITGRAPH
                       TC         .38  TIME OF CONCENTRATION
                        R         .40  STORAGE COEFFICIENT

 200 UA       ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .38 HR,       R=   .40 HR
                                    SNYDER   TP=   .24 HR,      CP=   .40

                                            UNIT HYDROGRAPH
                                       28 END-OF-PERIOD ORDINATES
          8.       36.       58.       59.       53.       45.       36.       29.       24.       19.
         16.       13.       10.        8.        7.        5.        4.        4.        3.        2.
          2.        2.        1.        1.        1.        1.        1.        0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    SUB90

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
```

```
                    (CFS)
+     82.     1.42                 11.         4.         4.         4.
                  (INCHES)       1.744      1.744      1.744      1.744
                   (AC-FT)          5.         5.         5.         5.

                  CUMULATIVE AREA =     .06 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 202 KK   *     SUM91  *            COMBINE HG FROM SUB80 AND SUB90
          *            *
          **************
                                    INFLOW INTO DETENTION BASIN 91

 204 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***             ***             ***             ***             ***

                     HYDROGRAPH AT STATION    SUM91

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                    (CFS)
+     147.     1.33                 18.         6.         6.         6.
                  (INCHES)       1.744      1.744      1.744      1.744
                   (AC-FT)          9.         9.         9.         9.

                  CUMULATIVE AREA =     .09 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 205 KK   *     DET91  *            ROUTE HG SUM91 THRU DET BASIN 91; Wb = 100'; L =400'
          *            *
          **************
                                    100-FOOT WIER USED FOR HIGH FLOWS AND 2-18" CMP

 207 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

 208 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        STOR  TYPE OF INITIAL CONDITION
                      RSVRIC         .00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 209 SV            STORAGE          .0       2.1       4.6       7.5

 210 SE          ELEVATION      100.00    102.00    104.00    106.00

 211 SL          LOW-LEVEL OUTLET
                       ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
                       CAREA        3.50  CROSS-SECTIONAL AREA
                        COQL         .37  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 212 SS          SPILLWAY
                        CREL      105.90  SPILLWAY CREST ELEVATION
                       SPWID      100.00  SPILLWAY WIDTH
                        COQW        2.60  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	10.50	11.28	12.20	13.27	14.56	16.12	18.05	20.51
ELEVATION	100.00	102.00	103.02	103.18	103.38	103.63	103.96	104.41	105.02	105.90
OUTFLOW	20.53	20.61	20.79	21.13	21.67	22.46	23.54	24.96	26.76	28.99
ELEVATION	105.90	105.90	105.91	105.92	105.93	105.94	105.95	105.96	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	2.06	3.33	3.53	3.78	4.09	4.51	4.55	5.15	6.05
OUTFLOW	.00	.00	10.50	11.28	12.20	13.27	14.56	14.69	16.12	18.05
ELEVATION	100.00	102.00	103.02	103.18	103.38	103.63	103.96	104.00	104.41	105.02
STORAGE	7.34	7.37	7.40	7.42	7.44	7.46	7.49			
OUTFLOW	20.51	21.13	22.46	23.54	24.96	26.76	28.99			
ELEVATION	105.90	105.92	105.94	105.95	105.96	105.98	106.00			

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HYDROGRAPH AT STATION DET91

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	1		0535	68	10.	3.2	102.9	1		1110	135	0.	2.1	102.0
1		0005	2	0.	.0	100.0	1		0540	69	9.	3.2	102.9	1		1115	136	0.	2.1	102.0
1		0010	3	0.	.0	100.0	1		0545	70	9.	3.1	102.8	1		1120	137	0.	2.1	102.0
1		0015	4	0.	.0	100.0	1		0550	71	8.	3.0	102.8	1		1125	138	0.	2.1	102.0
1		0020	5	0.	.0	100.0	1		0555	72	8.	3.0	102.7	1		1130	139	0.	2.1	102.0
1		0025	6	0.	.1	100.0	1		0600	73	7.	2.9	102.7	1		1135	140	0.	2.1	102.0
1		0030	7	0.	.1	100.1	1		0605	74	7.	2.9	102.7	1		1140	141	0.	2.1	102.0
1		0035	8	0.	.1	100.1	1		0610	75	6.	2.8	102.6	1		1145	142	0.	2.1	102.0
1		0040	9	0.	.1	100.1	1		0615	76	6.	2.8	102.6	1		1150	143	0.	2.1	102.0
1		0045	10	0.	.2	100.2	1		0620	77	6.	2.8	102.6	1		1155	144	0.	2.1	102.0
1		0050	11	0.	.3	100.3	1		0625	78	5.	2.7	102.5	1		1200	145	0.	2.1	102.0
1		0055	12	0.	.4	100.4	1		0630	79	5.	2.7	102.5	1		1205	146	0.	2.1	102.0
1		0100	13	0.	.5	100.5	1		0635	80	5.	2.6	102.5	1		1210	147	0.	2.1	102.0
1		0105	14	0.	.8	100.7	1		0640	81	5.	2.6	102.4	1		1215	148	0.	2.1	102.0
1		0110	15	0.	1.3	101.2	1		0645	82	4.	2.6	102.4	1		1220	149	0.	2.1	102.0
1		0115	16	0.	2.0	102.0	1		0650	83	4.	2.6	102.4	1		1225	150	0.	2.1	102.0
1		0120	17	8.	3.0	102.7	1		0655	84	4.	2.5	102.4	1		1230	151	0.	2.1	102.0
1		0125	18	13.	3.9	103.5	1		0700	85	4.	2.5	102.4	1		1235	152	0.	2.1	102.0
1		0130	19	15.	4.7	104.1	1		0705	86	3.	2.5	102.3	1		1240	153	0.	2.1	102.0
1		0135	20	17.	5.3	104.5	1		0710	87	3.	2.5	102.3	1		1245	154	0.	2.1	102.0
1		0140	21	18.	5.8	104.9	1		0715	88	3.	2.4	102.3	1		1250	155	0.	2.1	102.0
1		0145	22	18.	6.2	105.1	1		0720	89	3.	2.4	102.3	1		1255	156	0.	2.1	102.0
1		0150	23	19.	6.5	105.3	1		0725	90	3.	2.4	102.3	1		1300	157	0.	2.1	102.0
1		0155	24	19.	6.7	105.5	1		0730	91	3.	2.4	102.3	1		1305	158	0.	2.1	102.0
1		0200	25	20.	6.8	105.5	1		0735	92	2.	2.4	102.2	1		1310	159	0.	2.1	102.0
1		0205	26	20.	6.9	105.6	1		0740	93	2.	2.3	102.2	1		1315	160	0.	2.1	102.0
1		0210	27	20.	6.9	105.6	1		0745	94	2.	2.3	102.2	1		1320	161	0.	2.1	102.0
1		0215	28	20.	7.0	105.6	1		0750	95	2.	2.3	102.2	1		1325	162	0.	2.1	102.0
1		0220	29	20.	6.9	105.6	1		0755	96	2.	2.3	102.2	1		1330	163	0.	2.1	102.0
1		0225	30	20.	6.9	105.6	1		0800	97	2.	2.3	102.2	1		1335	164	0.	2.1	102.0
1		0230	31	20.	6.8	105.6	1		0805	98	2.	2.3	102.2	1		1340	165	0.	2.1	102.0
1		0235	32	19.	6.8	105.5	1		0810	99	2.	2.3	102.2	1		1345	166	0.	2.1	102.0
1		0240	33	19.	6.7	105.4	1		0815	100	2.	2.2	102.2	1		1350	167	0.	2.1	102.0
1		0245	34	19.	6.6	105.4	1		0820	101	1.	2.2	102.1	1		1355	168	0.	2.1	102.0
1		0250	35	19.	6.5	105.3	1		0825	102	1.	2.2	102.1	1		1400	169	0.	2.1	102.0
1		0255	36	19.	6.4	105.2	1		0830	103	1.	2.2	102.1	1		1405	170	0.	2.1	102.0
1		0300	37	18.	6.2	105.2	1		0835	104	1.	2.2	102.1	1		1410	171	0.	2.1	102.0
1		0305	38	18.	6.1	105.1	1		0840	105	1.	2.2	102.1	1		1415	172	0.	2.1	102.0
1		0310	39	18.	6.0	105.0	1		0845	106	1.	2.2	102.1	1		1420	173	0.	2.1	102.0
1		0315	40	18.	5.9	104.9	1		0850	107	1.	2.2	102.1	1		1425	174	0.	2.1	102.0
1		0320	41	18.	5.8	104.8	1		0855	108	1.	2.2	102.1	1		1430	175	0.	2.1	102.0
1		0325	42	17.	5.7	104.8	1		0900	109	1.	2.2	102.1	1		1435	176	0.	2.1	102.0
1		0330	43	17.	5.6	104.7	1		0905	110	1.	2.2	102.1	1		1440	177	0.	2.1	102.0
1		0335	44	17.	5.4	104.6	1		0910	111	1.	2.2	102.1	1		1445	178	0.	2.1	102.0
1		0340	45	17.	5.3	104.5	1		0915	112	1.	2.2	102.1	1		1450	179	0.	2.1	102.0
1		0345	46	16.	5.2	104.5	1		0920	113	1.	2.1	102.1	1		1455	180	0.	2.1	102.0
1		0350	47	16.	5.1	104.4	1		0925	114	1.	2.1	102.1	1		1500	181	0.	2.1	102.0
1		0355	48	16.	5.0	104.3	1		0930	115	1.	2.1	102.1	1		1505	182	0.	2.1	102.0
1		0400	49	16.	4.9	104.2	1		0935	116	1.	2.1	102.1	1		1510	183	0.	2.1	102.0
1		0405	50	15.	4.8	104.2	1		0940	117	1.	2.1	102.1	1		1515	184	0.	2.1	102.0

1	0410	51	15.	4.7	104.1	*	1	0945	118	1.	2.1	102.1	*	1	1520	185	0.	2.1	102.0
1	0415	52	15.	4.6	104.0	*	1	0950	119	1.	2.1	102.1	*	1	1525	186	0.	2.1	102.0
1	0420	53	14.	4.5	103.9	*	1	0955	120	0.	2.1	102.0	*	1	1530	187	0.	2.1	102.0
1	0425	54	14.	4.4	103.9	*	1	1000	121	0.	2.1	102.0	*	1	1535	188	0.	2.1	102.0
1	0430	55	14.	4.3	103.8	*	1	1005	122	0.	2.1	102.0	*	1	1540	189	0.	2.1	102.0
1	0435	56	14.	4.2	103.7	*	1	1010	123	0.	2.1	102.0	*	1	1545	190	0.	2.1	102.0
1	0440	57	13.	4.1	103.6	*	1	1015	124	0.	2.1	102.0	*	1	1550	191	0.	2.1	102.0
1	0445	58	13.	4.0	103.6	*	1	1020	125	0.	2.1	102.0	*	1	1555	192	0.	2.1	102.0
1	0450	59	13.	3.9	103.5	*	1	1025	126	0.	2.1	102.0	*	1	1600	193	0.	2.1	102.0
1	0455	60	12.	3.8	103.4	*	1	1030	127	0.	2.1	102.0	*	1	1605	194	0.	2.1	102.0
1	0500	61	12.	3.7	103.4	*	1	1035	128	0.	2.1	102.0	*	1	1610	195	0.	2.1	102.0
1	0505	62	12.	3.7	103.3	*	1	1040	129	0.	2.1	102.0	*	1	1615	196	0.	2.1	102.0
1	0510	63	11.	3.6	103.2	*	1	1045	130	0.	2.1	102.0	*	1	1620	197	0.	2.1	102.0
1	0515	64	11.	3.5	103.2	*	1	1050	131	0.	2.1	102.0	*	1	1625	198	0.	2.1	102.0
1	0520	65	11.	3.4	103.1	*	1	1055	132	0.	2.1	102.0	*	1	1630	199	0.	2.1	102.0
1	0525	66	11.	3.4	103.0	*	1	1100	133	0.	2.1	102.0	*	1	1635	200	0.	2.1	102.0
1	0530	67	10.	3.3	103.0	*	1	1105	134	0.	2.1	102.0	*						
						*							*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 20.	2.25		13.	5.	5.	5.
		(INCHES)	1.264	1.337	1.337	1.337
		(AC-FT)	6.	7.	7.	7.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
7.	2.25	5.	3.	3.	3.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
105.64	2.25	103.89	102.58	102.58	102.58

CUMULATIVE AREA = .09 SQ MI

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              *            *
213 KK        *    RCH137  *          ROUTE HG DET91 THRU REACH 137   50-FOOT CHANNEL
              *            *
              **************

                 HYDROGRAPH ROUTING DATA

214 RS             STORAGE ROUTING
                        NSTPS          1  NUMBER OF SUBREACHES
                         ITYP       FLOW  TYPE OF INITIAL CONDITION
                        RSVRIC      -1.00  INITIAL CONDITION
                             X        .00 WORKING R AND D COEFFICIENT

215 RC             NORMAL DEPTH CHANNEL
                          ANL       .030  LEFT OVERBANK N-VALUE
                         ANCH       .025  MAIN CHANNEL N-VALUE
                          ANR       .030  RIGHT OVERBANK N-VALUE
                        RLNTH      1660.  REACH LENGTH
                          SEL      .0040  ENERGY SLOPE
                        ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                      CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
217 RY          ELEVATION   100.00    99.00    99.00    96.00    96.00    99.00    99.00   100.00
216 RX          DISTANCE    500.00   508.00   508.00   520.00   530.00   542.00   542.00   550.00

                                                  ***

                                      COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE       .00      .09      .19      .30      .43      .57      .72      .89     1.07     1.27
            OUTFLOW       .00     2.89     9.47    19.29    32.31    48.62    68.35    91.64   118.65   149.53
          ELEVATION     96.00    96.21    96.42    96.63    96.84    97.05    97.26    97.47    97.68    97.89
```

STORAGE	1.48	1.70	1.94	2.18	2.45	2.73	3.03	3.37	3.73	4.12
OUTFLOW	184.46	223.58	267.05	315.04	367.71	434.87	510.93	593.28	682.35	778.52
ELEVATION	98.11	98.32	98.53	98.74	98.95	99.16	99.37	99.58	99.79	100.00

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HYDROGRAPH AT STATION RCH137

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 20.	2.42		13.	5.	5.	5.
		(INCHES)	1.251	1.337	1.337	1.337
		(AC-FT)	6.	7.	7.	7.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
0.	2.42	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
96.64	2.42	96.48	96.20	96.20	96.20

CUMULATIVE AREA = .09 SQ MI

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              *            *
218 KK        *   SUB100   *          RUNOFF HG FROM SUB-BASIN 100
              *            *
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SUBBASIN RUNOFF DATA

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219 BA          SUBBASIN CHARACTERISTICS
                      TAREA        .03  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB                STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

220 LG          GREEN AND AMPT LOSS RATE
                      STRTL        .22  STARTING LOSS
                        DTH        .29  MOISTURE DEFICIT
                       PSIF       2.65  WETTING FRONT SUCTION
                      XKSAT       1.10  HYDRAULIC CONDUCTIVITY
                      RTIMP      10.00  PERCENT IMPERVIOUS AREA

221 UC          CLARK UNITGRAPH
                         TC       1.03  TIME OF CONCENTRATION
                          R       1.28  STORAGE COEFFICIENT

222 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0
```

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 1.03 HR, R= 1.28 HR

SNYDER TP= .70 HR, CP= .36

UNIT HYDROGRAPH

87 END-OF-PERIOD ORDINATES

0.	1.	2.	4.	6.	8.	9.	9.	9.	9.

```
          9.      9.      8.      8.      7.      7.      6.      6.      6.      5.
          5.      5.      4.      4.      4.      4.      3.      3.      3.      3.
          3.      2.      2.      2.      2.      2.      2.      2.      2.      1.
          1.      1.      1.      1.      1.      1.      1.      1.      1.      1.
          1.      1.      1.      1.      1.      1.      0.      0.      0.      0.
          0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
          0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
          0.      0.      0.      0.      0.      0.      0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB100

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     11.      1.83                  3.          1.          1.          1.
                         (INCHES)   1.160       1.175       1.175       1.175
                          (AC-FT)    2.          2.          2.          2.

                         CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
224 KK    *   SUB110   *          RUNOFF HG FROM SUB-BASIN 110
          *            *
          **************

             SUBBASIN RUNOFF DATA

225 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .02  SUBBASIN AREA

               PRECIPITATION DATA

 72 PB              STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI           INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

226 LG         GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

227 UC         CLARK UNITGRAPH
                       TC         .17  TIME OF CONCENTRATION
                        R         .17  STORAGE COEFFICIENT

228 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .17 HR,       R=   .17 HR
                                  SNYDER   TP=   .13 HR,      CP=   .51

                                          UNIT HYDROGRAPH
                                     12 END-OF-PERIOD ORDINATES
          26.      50.      38.      23.      14.       8.       5.       3.       2.       1.
           1.       0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB110
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   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
   (CFS)       (HR)
                          (CFS)
+     52.      1.25                    4.          1.          1.          1.
                        (INCHES)    1.745       1.745       1.745       1.745
                         (AC-FT)      2.          2.          2.          2.

                        CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 230 KK    *   SUB130   *            RUNOFF HG FROM SUB-BASIN 130
           *            *
           **************

              SUBBASIN RUNOFF DATA

 231 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

  72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI           INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

 232 LG         GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

 233 UC         CLARK UNITGRAPH
                         TC         .25  TIME OF CONCENTRATION
                          R         .33  STORAGE COEFFICIENT

 234 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                   ***

                                              UNIT HYDROGRAPH PARAMETERS
                                       CLARK   TC=   .25 HR,       R=   .33 HR
                                      SNYDER   TP=   .21 HR,      CP=   .45

                                              UNIT HYDROGRAPH
                                          23 END-OF-PERIOD ORDINATES
                9.       27.       34.       29.       23.       18.       14.       11.        8.        6.
                5.        4.        3.        2.        2.        1.        1.        1.        1.        1.
                0.        0.        0.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUB130

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
   (CFS)       (HR)
                          (CFS)
+     43.      1.33                    5.          2.          2.          2.
                        (INCHES)    1.744       1.744       1.744       1.744
                         (AC-FT)      2.          2.          2.          2.
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                    CUMULATIVE AREA =     .03 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 236 KK     *   SUM131   *          COMBINE HG FROM SUB110 AND SUB130
            *            *
            **************
                                    INFLOW INTO DETENTION BASIN 131

 238 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   SUM131

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                         (CFS)
+     93.      1.25                   9.          3.          3.          3.
                       (INCHES)     1.745       1.745       1.745       1.745
                        (AC-FT)       4.          4.          4.          4.

                       CUMULATIVE AREA =     .05 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 239 KK     *   DET131   *          ROUTE HG SUM131 THRU DET BASIN 131; Wb = 100'; L  = 200'
            *            *
            **************
                                    100-FOOT WIER USED FOR HIGH FLOWS AND 2-18" CMP

 241 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          1  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

 242 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC        .00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

 243 SV            STORAGE         .0       1.0       2.3       3.8

 244 SE          ELEVATION     100.00    102.00    104.00    106.00

 245 SL          LOW-LEVEL OUTLET
                      ELEVL     102.00  ELEVATION AT CENTER OF OUTLET
                      CAREA       3.50  CROSS-SECTIONAL AREA
                       COQL        .37  COEFFICIENT
                       EXPL        .50  EXPONENT OF HEAD

 246 SS          SPILLWAY
                       CREL     105.90  SPILLWAY CREST ELEVATION
                      SPWID     100.00  SPILLWAY WIDTH
                       COQW       2.60  WEIR COEFFICIENT
                       EXPW       1.50  EXPONENT OF HEAD

                                                                  ***

                                    COMPUTED OUTFLOW-ELEVATION DATA
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OUTFLOW	.00	.00	10.50	11.28	12.20	13.27	14.56	16.12	18.05	20.51
ELEVATION	100.00	102.00	103.02	103.18	103.38	103.63	103.96	104.41	105.02	105.90
OUTFLOW	20.53	20.61	20.79	21.13	21.67	22.46	23.54	24.96	26.76	28.99
ELEVATION	105.90	105.90	105.91	105.92	105.93	105.94	105.95	105.96	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.03	1.67	1.77	1.89	2.05	2.26	2.28	2.58	3.03
OUTFLOW	.00	.00	10.50	11.28	12.20	13.27	14.56	14.69	16.12	18.05
ELEVATION	100.00	102.00	103.02	103.18	103.38	103.63	103.96	104.00	104.41	105.02
STORAGE	3.68	3.69	3.70	3.71	3.72	3.74	3.75			
OUTFLOW	20.51	21.13	22.46	23.54	24.96	26.76	28.99			
ELEVATION	105.90	105.92	105.94	105.95	105.96	105.98	106.00			

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HYDROGRAPH AT STATION DET131

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	1.	1.1	102.1	*	1		1110	135	0.	1.0	102.0
1		0005	2	0.	.0	100.0	*	1		0540	69	0.	1.1	102.0	*	1		1115	136	0.	1.0	102.0
1		0010	3	0.	.0	100.0	*	1		0545	70	0.	1.1	102.0	*	1		1120	137	0.	1.0	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	0.	1.1	102.0	*	1		1125	138	0.	1.0	102.0
1		0020	5	0.	.0	100.1	*	1		0555	72	0.	1.1	102.0	*	1		1130	139	0.	1.0	102.0
1		0025	6	0.	.0	100.1	*	1		0600	73	0.	1.0	102.0	*	1		1135	140	0.	1.0	102.0
1		0030	7	0.	.1	100.1	*	1		0605	74	0.	1.0	102.0	*	1		1140	141	0.	1.0	102.0
1		0035	8	0.	.1	100.1	*	1		0610	75	0.	1.0	102.0	*	1		1145	142	0.	1.0	102.0
1		0040	9	0.	.1	100.2	*	1		0615	76	0.	1.0	102.0	*	1		1150	143	0.	1.0	102.0
1		0045	10	0.	.1	100.3	*	1		0620	77	0.	1.0	102.0	*	1		1155	144	0.	1.0	102.0
1		0050	11	0.	.2	100.4	*	1		0625	78	0.	1.0	102.0	*	1		1200	145	0.	1.0	102.0
1		0055	12	0.	.3	100.5	*	1		0630	79	0.	1.0	102.0	*	1		1205	146	0.	1.0	102.0
1		0100	13	0.	.4	100.7	*	1		0635	80	0.	1.0	102.0	*	1		1210	147	0.	1.0	102.0
1		0105	14	0.	.6	101.1	*	1		0640	81	0.	1.0	102.0	*	1		1215	148	0.	1.0	102.0
1		0110	15	0.	1.0	101.9	*	1		0645	82	0.	1.0	102.0	*	1		1220	149	0.	1.0	102.0
1		0115	16	9.	1.6	102.8	*	1		0650	83	0.	1.0	102.0	*	1		1225	150	0.	1.0	102.0
1		0120	17	14.	2.1	103.7	*	1		0655	84	0.	1.0	102.0	*	1		1230	151	0.	1.0	102.0
1		0125	18	16.	2.5	104.3	*	1		0700	85	0.	1.0	102.0	*	1		1235	152	0.	1.0	102.0
1		0130	19	17.	2.8	104.7	*	1		0705	86	0.	1.0	102.0	*	1		1240	153	0.	1.0	102.0
1		0135	20	18.	3.0	105.0	*	1		0710	87	0.	1.0	102.0	*	1		1245	154	0.	1.0	102.0
1		0140	21	18.	3.1	105.2	*	1		0715	88	0.	1.0	102.0	*	1		1250	155	0.	1.0	102.0
1		0145	22	19.	3.2	105.2	*	1		0720	89	0.	1.0	102.0	*	1		1255	156	0.	1.0	102.0
1		0150	23	19.	3.2	105.2	*	1		0725	90	0.	1.0	102.0	*	1		1300	157	0.	1.0	102.0
1		0155	24	19.	3.2	105.2	*	1		0730	91	0.	1.0	102.0	*	1		1305	158	0.	1.0	102.0
1		0200	25	18.	3.1	105.1	*	1		0735	92	0.	1.0	102.0	*	1		1310	159	0.	1.0	102.0
1		0205	26	18.	3.1	105.1	*	1		0740	93	0.	1.0	102.0	*	1		1315	160	0.	1.0	102.0
1		0210	27	18.	3.0	105.0	*	1		0745	94	0.	1.0	102.0	*	1		1320	161	0.	1.0	102.0
1		0215	28	18.	2.9	104.8	*	1		0750	95	0.	1.0	102.0	*	1		1325	162	0.	1.0	102.0
1		0220	29	17.	2.8	104.7	*	1		0755	96	0.	1.0	102.0	*	1		1330	163	0.	1.0	102.0
1		0225	30	17.	2.7	104.6	*	1		0800	97	0.	1.0	102.0	*	1		1335	164	0.	1.0	102.0
1		0230	31	16.	2.6	104.5	*	1		0805	98	0.	1.0	102.0	*	1		1340	165	0.	1.0	102.0
1		0235	32	16.	2.5	104.3	*	1		0810	99	0.	1.0	102.0	*	1		1345	166	0.	1.0	102.0
1		0240	33	15.	2.4	104.2	*	1		0815	100	0.	1.0	102.0	*	1		1350	167	0.	1.0	102.0
1		0245	34	15.	2.3	104.1	*	1		0820	101	0.	1.0	102.0	*	1		1355	168	0.	1.0	102.0
1		0250	35	14.	2.2	103.9	*	1		0825	102	0.	1.0	102.0	*	1		1400	169	0.	1.0	102.0
1		0255	36	14.	2.1	103.8	*	1		0830	103	0.	1.0	102.0	*	1		1405	170	0.	1.0	102.0
1		0300	37	13.	2.0	103.6	*	1		0835	104	0.	1.0	102.0	*	1		1410	171	0.	1.0	102.0
1		0305	38	13.	2.0	103.5	*	1		0840	105	0.	1.0	102.0	*	1		1415	172	0.	1.0	102.0
1		0310	39	12.	1.9	103.4	*	1		0845	106	0.	1.0	102.0	*	1		1420	173	0.	1.0	102.0
1		0315	40	11.	1.8	103.2	*	1		0850	107	0.	1.0	102.0	*	1		1425	174	0.	1.0	102.0
1		0320	41	11.	1.7	103.1	*	1		0855	108	0.	1.0	102.0	*	1		1430	175	0.	1.0	102.0
1		0325	42	10.	1.6	103.0	*	1		0900	109	0.	1.0	102.0	*	1		1435	176	0.	1.0	102.0
1		0330	43	9.	1.6	102.9	*	1		0905	110	0.	1.0	102.0	*	1		1440	177	0.	1.0	102.0
1		0335	44	8.	1.5	102.8	*	1		0910	111	0.	1.0	102.0	*	1		1445	178	0.	1.0	102.0
1		0340	45	7.	1.5	102.7	*	1		0915	112	0.	1.0	102.0	*	1		1450	179	0.	1.0	102.0
1		0345	46	6.	1.4	102.6	*	1		0920	113	0.	1.0	102.0	*	1		1455	180	0.	1.0	102.0
1		0350	47	6.	1.4	102.6	*	1		0925	114	0.	1.0	102.0	*	1		1500	181	0.	1.0	102.0
1		0355	48	5.	1.3	102.5	*	1		0930	115	0.	1.0	102.0	*	1		1505	182	0.	1.0	102.0
1		0400	49	5.	1.3	102.4	*	1		0935	116	0.	1.0	102.0	*	1		1510	183	0.	1.0	102.0
1		0405	50	4.	1.3	102.4	*	1		0940	117	0.	1.0	102.0	*	1		1515	184	0.	1.0	102.0
1		0410	51	4.	1.3	102.4	*	1		0945	118	0.	1.0	102.0	*	1		1520	185	0.	1.0	102.0
1		0415	52	3.	1.2	102.3	*	1		0950	119	0.	1.0	102.0	*	1		1525	186	0.	1.0	102.0
1		0420	53	3.	1.2	102.3	*	1		0955	120	0.	1.0	102.0	*	1		1530	187	0.	1.0	102.0
1		0425	54	3.	1.2	102.3	*	1		1000	121	0.	1.0	102.0	*	1		1535	188	0.	1.0	102.0
1		0430	55	2.	1.2	102.2	*	1		1005	122	0.	1.0	102.0	*	1		1540	189	0.	1.0	102.0

```
 1    0435  56    2.    1.2   102.2 *  1    1010 123    0.    1.0   102.0 *  1    1545 190    0.    1.0   102.0
 1    0440  57    2.    1.1   102.2 *  1    1015 124    0.    1.0   102.0 *  1    1550 191    0.    1.0   102.0
 1    0445  58    2.    1.1   102.2 *  1    1020 125    0.    1.0   102.0 *  1    1555 192    0.    1.0   102.0
 1    0450  59    1.    1.1   102.1 *  1    1025 126    0.    1.0   102.0 *  1    1600 193    0.    1.0   102.0
 1    0455  60    1.    1.1   102.1 *  1    1030 127    0.    1.0   102.0 *  1    1605 194    0.    1.0   102.0
 1    0500  61    1.    1.1   102.1 *  1    1035 128    0.    1.0   102.0 *  1    1610 195    0.    1.0   102.0
 1    0505  62    1.    1.1   102.1 *  1    1040 129    0.    1.0   102.0 *  1    1615 196    0.    1.0   102.0
 1    0510  63    1.    1.1   102.1 *  1    1045 130   -0.    1.0   102.0 *  1    1620 197    0.    1.0   102.0
 1    0515  64    1.    1.1   102.1 *  1    1050 131    0.    1.0   102.0 *  1    1625 198    0.    1.0   102.0
 1    0520  65    1.    1.1   102.1 *  1    1055 132    0.    1.0   102.0 *  1    1630 199    0.    1.0   102.0
 1    0525  66    1.    1.1   102.1 *  1    1100 133    0.    1.0   102.0 *  1    1635 200    0.    1.0   102.0
 1    0530  67    1.    1.1   102.1 *  1    1105 134    0.    1.0   102.0 *
                                      *                                    *
*****************************************************************************************************************

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     19.      1.83                   7.          3.          3.          3.
                        (INCHES)   1.341       1.342       1.342       1.342
                         (AC-FT)      3.          3.          3.          3.

 PEAK STORAGE  TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+ (AC-FT)      (HR)
       3.      1.83                   2.          1.          1.          1.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (FEET)      (HR)
   105.23      1.83                 102.96      102.23      102.23      102.23

                        CUMULATIVE AREA =     .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 247 KK     *   SUM137   *          COMBINE HG FROM RCH137, DET131 AND SUB100
            *            *
            **************

 248 HC          HYDROGRAPH COMBINATION
                      ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUM137

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     47.      2.00                  23.          9.          9.          9.
                        (INCHES)   1.255       1.313       1.313       1.313
                         (AC-FT)     11.         12.         12.         12.

                        CUMULATIVE AREA =     .17 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 249 KK     *   RCH147   *          ROUTE HG SUM137 THRU REACH 147, 50-FOOT CHANNEL
            *            *
            **************

            HYDROGRAPH ROUTING DATA
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250 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC      -1.00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

251 RC          NORMAL DEPTH CHANNEL
                       ANL       .030  LEFT OVERBANK N-VALUE
                      ANCH       .025  MAIN CHANNEL N-VALUE
                       ANR       .030  RIGHT OVERBANK N-VALUE
                     RLNTH       600.  REACH LENGTH
                       SEL      .0040  ENERGY SLOPE
                     ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                         --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
253 RY       ELEVATION   100.00    99.00    99.00    96.00    96.00    99.00    99.00   100.00
252 RX       DISTANCE    500.00   508.00   508.00   520.00   530.00   542.00   542.00   550.00

                                                        ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00      .03      .07      .11      .16      .21      .26      .32      .39      .46
          OUTFLOW       .00     2.89     9.47    19.29    32.31    48.62    68.35    91.64   118.65   149.53
        ELEVATION     96.00    96.21    96.42    96.63    96.84    97.05    97.26    97.47    97.68    97.89

          STORAGE       .53      .61      .70      .79      .88      .99     1.10     1.22     1.35     1.49
          OUTFLOW    184.46   223.58   267.05   315.04   367.71   434.87   510.93   593.28   682.35   778.52
        ELEVATION     98.11    98.32    98.53    98.74    98.95    99.16    99.37    99.58    99.79   100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      32. TO      779.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   RCH147

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+     47.      2.08                   23.         9.          9.          9.
                        (INCHES)    1.253       1.313       1.313       1.313
                         (AC-FT)     11.         12.         12.         12.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
      0.       2.00                    0.          0.          0.          0.

  PEAK STAGE   TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    97.03      2.08                  96.65       96.26       96.26       96.26

                        CUMULATIVE AREA =     .17 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
254 KK      *   SUB140   *            RUNOFF HG FROM SUB-BASIN 140
            *            *
            **************
                                      INFLOW INTO DETENTION BASIN 141

               SUBBASIN RUNOFF DATA

256 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .02  SUBBASIN AREA

                PRECIPITATION DATA
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 72 PB              STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI          INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

257 LG         GREEN AND AMPT LOSS RATE
                  STRTL        .15  STARTING LOSS
                    DTH        .28  MOISTURE DEFICIT
                   PSIF       3.40  WETTING FRONT SUCTION
                  XKSAT        .80  HYDRAULIC CONDUCTIVITY
                  RTIMP      37.00  PERCENT IMPERVIOUS AREA

258 UC         CLARK UNITGRAPH
                     TC        .13  TIME OF CONCENTRATION
                      R        .13  STORAGE COEFFICIENT

259 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                     .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                  100.0

                                                   ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .13 HR,       R=   .13 HR
                                         SNYDER   TP=   .11 HR,      CP=   .54

                                                UNIT HYDROGRAPH
                                            9 END-OF-PERIOD ORDINATES
            26.       44.       27.       13.        7.        3.        2.        1.        0.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUB140

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+     42.      1.17                    3.          1.          1.          1.
                         (INCHES)    1.745       1.745       1.745       1.745
                          (AC-FT)      1.          1.          1.          1.

                         CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 261 KK     *    DET141  *            ROUTE HG SUB140 THRU DET BASIN 141; Wb = 50'; L = 200'
            *            *
            **************
                                      100-FOOT WIER USED FOR HIGH FLOWS AND 1-18" CMP

 263 KO         OUTPUT CONTROL VARIABLES
                  IPRNT           1  PRINT CONTROL
                  IPLOT           0  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

 264 RS         STORAGE ROUTING
                  NSTPS           1  NUMBER OF SUBREACHES
                   ITYP        STOR  TYPE OF INITIAL CONDITION
                 RSVRIC         .00  INITIAL CONDITION
                      X         .00 WORKING R AND D COEFFICIENT

 265 SV           STORAGE         .0       1.0       2.3       3.8

 266 SE         ELEVATION     100.00    102.00    104.00    106.00

 267 SL         LOW-LEVEL OUTLET
                  ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
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	CAREA	1.80	CROSS-SECTIONAL AREA
	COQL	.37	COEFFICIENT
	EXPL	.50	EXPONENT OF HEAD
268 SS	SPILLWAY		
	CREL	105.90	SPILLWAY CREST ELEVATION
	SPWID	100.00	SPILLWAY WIDTH
	COQW	2.60	WEIR COEFFICIENT
	EXPW	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	4.62	5.02	5.50	6.08	6.80	7.72	8.91	10.55
ELEVATION	100.00	102.00	102.75	102.88	103.06	103.30	103.62	104.09	104.78	105.90
OUTFLOW	10.56	10.63	10.80	11.12	11.64	12.41	13.47	14.88	16.67	18.90
ELEVATION	105.90	105.90	105.91	105.92	105.93	105.94	105.95	105.96	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.03	1.50	1.58	1.69	1.84	2.04	2.28	2.34	2.86
OUTFLOW	.00	.00	4.62	5.02	5.50	6.08	6.80	7.55	7.72	8.91
ELEVATION	100.00	102.00	102.75	102.88	103.06	103.30	103.62	104.00	104.09	104.78
STORAGE	3.68	3.69	3.70	3.71	3.72	3.74	3.75			
OUTFLOW	10.55	11.12	12.41	13.47	14.88	16.67	18.90			
ELEVATION	105.90	105.92	105.94	105.95	105.96	105.98	106.00			

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HYDROGRAPH AT STATION DET141

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	1		0535	68	0.	1.0	102.0	1		1110	135	0.	1.0	102.0
1		0005	2	0.	.0	100.0	1		0540	69	0.	1.0	102.0	1		1115	136	0.	1.0	102.0
1		0010	3	0.	.0	100.0	1		0545	70	0.	1.0	102.0	1		1120	137	0.	1.0	102.0
1		0015	4	0.	.0	100.0	1		0550	71	0.	1.0	102.0	1		1125	138	0.	1.0	102.0
1		0020	5	0.	.0	100.0	1		0555	72	0.	1.0	102.0	1		1130	139	0.	1.0	102.0
1		0025	6	0.	.0	100.0	1		0600	73	0.	1.0	102.0	1		1135	140	0.	1.0	102.0
1		0030	7	0.	.0	100.0	1		0605	74	0.	1.0	102.0	1		1140	141	0.	1.0	102.0
1		0035	8	0.	.0	100.1	1		0610	75	0.	1.0	102.0	1		1145	142	0.	1.0	102.0
1		0040	9	0.	.0	100.1	1		0615	76	0.	1.0	102.0	1		1150	143	0.	1.0	102.0
1		0045	10	0.	.1	100.1	1		0620	77	0.	1.0	102.0	1		1155	144	0.	1.0	102.0
1		0050	11	0.	.1	100.2	1		0625	78	0.	1.0	102.0	1		1200	145	0.	1.0	102.0
1		0055	12	0.	.1	100.2	1		0630	79	0.	1.0	102.0	1		1205	146	0.	1.0	102.0
1		0100	13	0.	.2	100.3	1		0635	80	0.	1.0	102.0	1		1210	147	0.	1.0	102.0
1		0105	14	0.	.3	100.6	1		0640	81	0.	1.0	102.0	1		1215	148	0.	1.0	102.0
1		0110	15	0.	.5	101.0	1		0645	82	0.	1.0	102.0	1		1220	149	0.	1.0	102.0
1		0115	16	0.	.8	101.6	1		0650	83	0.	1.0	102.0	1		1225	150	0.	1.0	102.0
1		0120	17	0.	1.1	102.0	1		0655	84	0.	1.0	102.0	1		1230	151	0.	1.0	102.0
1		0125	18	2.	1.2	102.3	1		0700	85	0.	1.0	102.0	1		1235	152	0.	1.0	102.0
1		0130	19	3.	1.3	102.4	1		0705	86	0.	1.0	102.0	1		1240	153	0.	1.0	102.0
1		0135	20	3.	1.3	102.5	1		0710	87	0.	1.0	102.0	1		1245	154	0.	1.0	102.0
1		0140	21	3.	1.4	102.5	1		0715	88	0.	1.0	102.0	1		1250	155	0.	1.0	102.0
1		0145	22	3.	1.4	102.5	1		0720	89	0.	1.0	102.0	1		1255	156	0.	1.0	102.0
1		0150	23	3.	1.3	102.5	1		0725	90	0.	1.0	102.0	1		1300	157	0.	1.0	102.0
1		0155	24	3.	1.3	102.5	1		0730	91	0.	1.0	102.0	1		1305	158	0.	1.0	102.0
1		0200	25	3.	1.3	102.5	1		0735	92	0.	1.0	102.0	1		1310	159	0.	1.0	102.0
1		0205	26	3.	1.3	102.4	1		0740	93	0.	1.0	102.0	1		1315	160	0.	1.0	102.0
1		0210	27	3.	1.3	102.4	1		0745	94	0.	1.0	102.0	1		1320	161	0.	1.0	102.0
1		0215	28	2.	1.3	102.4	1		0750	95	0.	1.0	102.0	1		1325	162	0.	1.0	102.0
1		0220	29	2.	1.3	102.4	1		0755	96	0.	1.0	102.0	1		1330	163	0.	1.0	102.0
1		0225	30	2.	1.3	102.4	1		0800	97	0.	1.0	102.0	1		1335	164	0.	1.0	102.0
1		0230	31	2.	1.2	102.3	1		0805	98	0.	1.0	102.0	1		1340	165	0.	1.0	102.0
1		0235	32	2.	1.2	102.3	1		0810	99	0.	1.0	102.0	1		1345	166	0.	1.0	102.0
1		0240	33	2.	1.2	102.3	1		0815	100	0.	1.0	102.0	1		1350	167	0.	1.0	102.0
1		0245	34	2.	1.2	102.3	1		0820	101	0.	1.0	102.0	1		1355	168	0.	1.0	102.0
1		0250	35	2.	1.2	102.3	1		0825	102	0.	1.0	102.0	1		1400	169	0.	1.0	102.0
1		0255	36	1.	1.2	102.2	1		0830	103	0.	1.0	102.0	1		1405	170	0.	1.0	102.0
1		0300	37	1.	1.2	102.2	1		0835	104	0.	1.0	102.0	1		1410	171	0.	1.0	102.0
1		0305	38	1.	1.2	102.2	1		0840	105	0.	1.0	102.0	1		1415	172	0.	1.0	102.0
1		0310	39	1.	1.1	102.2	1		0845	106	0.	1.0	102.0	1		1420	173	0.	1.0	102.0
1		0315	40	1.	1.1	102.2	1		0850	107	0.	1.0	102.0	1		1425	174	0.	1.0	102.0
1		0320	41	1.	1.1	102.2	1		0855	108	0.	1.0	102.0	1		1430	175	0.	1.0	102.0

1	0325	42	1.	1.1	102.2	*	1	0900	109	0.	1.0	102.0	*	1	1435	176	0.	1.0	102.0
1	0330	43	1.	1.1	102.1	*	1	0905	110	0.	1.0	102.0	*	1	1440	177	0.	1.0	102.0
1	0335	44	1.	1.1	102.1	*	1	0910	111	0.	1.0	102.0	*	1	1445	178	0.	1.0	102.0
1	0340	45	1.	1.1	102.1	*	1	0915	112	0.	1.0	102.0	*	1	1450	179	0.	1.0	102.0
1	0345	46	1.	1.1	102.1	*	1	0920	113	0.	1.0	102.0	*	1	1455	180	0.	1.0	102.0
1	0350	47	1.	1.1	102.1	*	1	0925	114	0.	1.0	102.0	*	1	1500	181	0.	1.0	[illegible]
1	0355	48	1.	1.1	102.1	*	1	0930	115	0.	1.0	102.0	*	1	1505	182	0.	1.0	102.0
1	0400	49	1.	1.1	102.1	*	1	0935	116	0.	1.0	102.0	*	1	1510	183	0.	1.0	102.0
1	0405	50	1.	1.1	102.1	*	1	0940	117	0.	1.0	102.0	*	1	1515	184	0.	1.0	102.0
1	0410	51	1.	1.1	102.1	*	1	0945	118	0.	1.0	102.0	*	1	1520	185	0.	1.0	102.0
1	0415	52	0.	1.1	102.1	*	1	0950	119	0.	1.0	102.0	*	1	1525	186	0.	1.0	102.0
1	0420	53	0.	1.1	102.1	*	1	0955	120	0.	1.0	102.0	*	1	1530	187	0.	1.0	102.0
1	0425	54	0.	1.1	102.1	*	1	1000	121	0.	1.0	102.0	*	1	1535	188	0.	1.0	102.0
1	0430	55	0.	1.1	102.1	*	1	1005	122	0.	1.0	102.0	*	1	1540	189	0.	1.0	102.0
1	0435	56	0.	1.1	102.1	*	1	1010	123	0.	1.0	102.0	*	1	1545	190	0.	1.0	102.0
1	0440	57	0.	1.1	102.1	*	1	1015	124	0.	1.0	102.0	*	1	1550	191	0.	1.0	102.0
1	0445	58	0.	1.1	102.1	*	1	1020	125	0.	1.0	102.0	*	1	1555	192	0.	1.0	102.0
1	0450	59	0.	1.1	102.0	*	1	1025	126	0.	1.0	102.0	*	1	1600	193	0.	1.0	102.0
1	0455	60	0.	1.1	102.0	*	1	1030	127	0.	1.0	102.0	*	1	1605	194	0.	1.0	102.0
1	0500	61	0.	1.1	102.0	*	1	1035	128	0.	1.0	102.0	*	1	1610	195	0.	1.0	102.0
1	0505	62	0.	1.1	102.0	*	1	1040	129	0.	1.0	102.0	*	1	1615	196	0.	1.0	102.0
1	0510	63	0.	1.1	102.0	*	1	1045	130	0.	1.0	102.0	*	1	1620	197	0.	1.0	102.0
1	0515	64	0.	1.1	102.0	*	1	1050	131	0.	1.0	102.0	*	1	1625	198	0.	1.0	102.0
1	0520	65	0.	1.1	102.0	*	1	1055	132	0.	1.0	102.0	*	1	1630	199	0.	1.0	102.0
1	0525	66	0.	1.0	102.0	*	1	1100	133	0.	1.0	102.0	*	1	1635	200	0.	1.0	102.0
1	0530	67	0.	1.0	102.0	*	1	1105	134	0.	1.0	102.0	*						
						*							*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 3.	1.67		1.	0.	0.	0.
		(INCHES)	.533	.538	.538	.538
		(AC-FT)	0.	0.	0.	0.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
1.	1.67	1.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
102.52	1.67	102.15	101.92	101.92	101.92

CUMULATIVE AREA = .02 SQ MI

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              *            *
269 KK        *   SUM147   *          COMBINE HG FROM RCH147 & DET141
              *            *
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270 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION SUM147

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 50.	2.00		24.	9.	9.	9.
		(INCHES)	1.191	1.246	1.246	1.246
		(AC-FT)	12.	12.	12.	12.

CUMULATIVE AREA = .19 SQ MI

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
271 KK    *    RCH167  *            ROUTE HG SUM147 THRU REACH 167
          *            *
          **************

             HYDROGRAPH ROUTING DATA

272 RS         STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC      -1.00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

273 RC         NORMAL DEPTH CHANNEL
                       ANL       .030  LEFT OVERBANK N-VALUE
                      ANCH       .025  MAIN CHANNEL N-VALUE
                       ANR       .030  RIGHT OVERBANK N-VALUE
                     RLNTH      1280.  REACH LENGTH
                       SEL      .0040  ENERGY SLOPE
                     ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
275 RY       ELEVATION   100.00    99.00    99.00    96.00    96.00    99.00    99.00   100.00
274 RX       DISTANCE    500.00   508.00   508.00   520.00   530.00   542.00   542.00   550.00

                                                   ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00      .07      .14      .23      .33      .44      .56      .69      .83      .98
          OUTFLOW       .00     2.89     9.47    19.29    32.31    48.62    68.35    91.64   118.65   149.53
        ELEVATION     96.00    96.21    96.42    96.63    96.84    97.05    97.26    97.47    97.68    97.89

          STORAGE      1.14     1.31     1.49     1.68     1.89     2.10     2.34     2.60     2.87     3.17
          OUTFLOW    184.46   223.58   267.05   315.04   367.71   434.87   510.93   593.28   682.35   778.52
        ELEVATION     98.11    98.32    98.53    98.74    98.95    99.16    99.37    99.58    99.79   100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      368. TO      779.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   RCH167

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+     50.      2.08                   24.         9.          9.          9.
                        (INCHES)    1.186       1.246       1.246       1.246
                        (AC-FT)       12.         12.         12.         12.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
       0.      2.08                    0.          0.          0.          0.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    97.06      2.08                  96.66       96.27       96.27       96.27

                        CUMULATIVE AREA =     .19 SQ MI

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              *            *
276 KK        *   SUB150   *          RUNOFF HG FROM SUB-BASIN 150
              *            *
              **************

                SUBBASIN RUNOFF DATA

277 BA            SUBBASIN CHARACTERISTICS
                       TAREA          .02  SUBBASIN AREA

                  PRECIPITATION DATA

 72 PB                 STORM         2.77  BASIN TOTAL PRECIPITATION

 73 PI              INCREMENTAL PRECIPITATION PATTERN
                      .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                      .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                      .01      .00      .01      .01

278 LG            GREEN AND AMPT LOSS RATE
                       STRTL          .15  STARTING LOSS
                         DTH          .28  MOISTURE DEFICIT
                        PSIF         3.40  WETTING FRONT SUCTION
                       XKSAT          .80  HYDRAULIC CONDUCTIVITY
                       RTIMP        37.00  PERCENT IMPERVIOUS AREA

279 UC            CLARK UNITGRAPH
                          TC          .17  TIME OF CONCENTRATION
                           R          .20  STORAGE COEFFICIENT

280 UA            ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                   ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .17 HR,       R=   .20 HR
                                         SNYDER   TP=   .14 HR,      CP=   .46

                                                UNIT HYDROGRAPH
                                           14 END-OF-PERIOD ORDINATES
                 17.       34.       27.       18.       12.        8.        5.        3.        2.        1.
                  1.        1.        0.        0.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUB150

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     37.       1.25                  3.          1.          1.          1.
                         (INCHES)   1.744       1.744       1.744       1.744
                          (AC-FT)     2.          2.          2.          2.

                         CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
282 KK        *   SUB160   *          RUNOFF HG FROM SUB-BASIN 160
              *            *
              **************

                SUBBASIN RUNOFF DATA

283 BA            SUBBASIN CHARACTERISTICS
                       TAREA          .04  SUBBASIN AREA

                  PRECIPITATION DATA
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 72 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

284 LG           GREEN AND AMPT LOSS RATE
                     STRTL        .15  STARTING LOSS
                       DTH        .28  MOISTURE DEFICIT
                      PSIF       3.40  WETTING FRONT SUCTION
                     XKSAT        .80  HYDRAULIC CONDUCTIVITY
                     RTIMP      37.00  PERCENT IMPERVIOUS AREA

285 UC           CLARK UNITGRAPH
                        TC        .20  TIME OF CONCENTRATION
                         R        .21  STORAGE COEFFICIENT

286 UA           ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                          ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                            CLARK   TC=   .20 HR,       R=   .21 HR
                                           SNYDER   TP=   .14 HR,      CP=   .45

                                                      UNIT HYDROGRAPH
                                                 14 END-OF-PERIOD ORDINATES
              34.       71.       64.       45.       30.       20.       13.        9.        6.        4.
               3.        2.        1.        1.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUB160

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                         (CFS)
+     83.      1.25                    7.          3.          3.          3.
                       (INCHES)     1.742       1.742       1.742       1.742
                        (AC-FT)       4.          4.          4.          4.

                       CUMULATIVE AREA =     .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 288 KK   *   SUM161   *            COMBINE HG FROM SUB150 & SUB160
          *            *
          **************
                                    INFLOW INTO DETENTION BASIN 161

 290 HC           HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUM161

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
   (CFS)       (HR)
                         (CFS)
+    120.      1.25                   10.          4.          4.          4.
                       (INCHES)     1.743       1.743       1.743       1.743
                        (AC-FT)       5.          5.          5.          5.
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CUMULATIVE AREA = .06 SQ MI

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          *            *
291 KK    *   DET161   *          ROUTE HG SUM161 THRU DET BASIN 161; Wb = 100'; L  = 200'
          *            *
          **************
                                   100-FOOT WIER USED FOR HIGH FLOWS AND 1-36" CMP

293 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          1  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

294 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC        .00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

295 SV            STORAGE          .0       1.0       2.3       3.8

296 SE          ELEVATION      100.00    102.00    104.00    106.00

297 SL          LOW-LEVEL OUTLET
                      ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
                      CAREA        7.10  CROSS-SECTIONAL AREA
                       COQL         .37  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

298 SS          SPILLWAY
                       CREL      105.90  SPILLWAY CREST ELEVATION
                      SPWID      100.00  SPILLWAY WIDTH
                       COQW        2.60  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	25.10	26.61	28.31	30.24	32.46	35.03	38.03	41.61
ELEVATION	100.00	102.00	103.42	103.59	103.81	104.06	104.37	104.76	105.26	105.90
OUTFLOW	41.64	41.74	41.96	42.34	42.92	43.74	44.86	46.30	48.12	50.36
ELEVATION	105.90	105.91	105.91	105.92	105.93	105.94	105.95	105.97	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.03	1.92	2.03	2.16	2.28	2.32	2.55	2.84	3.21
OUTFLOW	.00	.00	25.10	26.61	28.31	29.80	30.24	32.46	35.03	38.03
ELEVATION	100.00	102.00	103.42	103.59	103.81	104.00	104.06	104.37	104.76	105.26
STORAGE	3.68	3.68	3.70	3.70	3.71	3.72	3.74	3.75		
OUTFLOW	41.61	41.96	42.92	43.74	44.86	46.30	48.12	50.36		
ELEVATION	105.90	105.91	105.93	105.94	105.95	105.97	105.98	106.00		

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HYDROGRAPH AT STATION DET161

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	0.	1.0	102.0	*	1		1110	135	0.	1.0	[illegible]
1		0005	2	0.	.0	100.0	*	1		0540	69	0.	1.0	102.0	*	1		1115	136	0.	1.0	[illegible]
1		0010	3	0.	.0	100.0	*	1		0545	70	0.	1.0	102.0	*	1		1120	137	0.	1.0	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	0.	1.0	102.0	*	1		1125	138	0.	1.0	102.0
1		0020	5	0.	.0	100.1	*	1		0555	72	0.	1.0	102.0	*	1		1130	139	0.	1.0	102.0
1		0025	6	0.	.1	100.1	*	1		0600	73	0.	1.0	102.0	*	1		1135	140	0.	1.0	102.0
1		0030	7	0.	.1	100.1	*	1		0605	74	0.	1.0	102.0	*	1		1140	141	0.	1.0	102.0

1	0035	8	0.	.1	100.2	*	1	0610	75	0.	1.0	102.0	*	1	1145	142	0.	1.0	102.0
1	0040	9	0.	.1	100.2	*	1	0615	76	0.	1.0	102.0	*	1	1150	143	0.	1.0	102.0
1	0045	10	0.	.2	100.3	*	1	0620	77	0.	1.0	102.0	*	1	1155	144	0.	1.0	102.0
1	0050	11	0.	.2	100.5	*	1	0625	78	0.	1.0	102.0	*	1	1200	145	0.	1.0	102.0
1	0055	12	0.	.3	100.7	*	1	0630	79	0.	1.0	102.0	*	1	1205	146	0.	1.0	102.0
1	0100	13	0.	.5	100.9	*	1	0635	80	0.	1.0	102.0	*	1	1210	147	0.	1.0	102.0
1	0105	14	0.	.7	101.4	*	1	0640	81	0.	1.0	102.0	*	1	1215	148	0.	1.0	102.0
1	0110	15	8.	1.3	102.4	*	1	0645	82	0.	1.0	102.0	*	1	1220	149	0.	1.0	102.0
1	0115	16	26.	2.0	103.5	*	1	0650	83	0.	1.0	102.0	*	1	1225	150	0.	1.0	102.0
1	0120	17	32.	2.5	104.4	*	1	0655	84	0.	1.0	102.0	*	1	1230	151	0.	1.0	102.0
1	0125	18	36.	3.0	104.9	*	1	0700	85	0.	1.0	102.0	*	1	1235	152	0.	1.0	102.0
1	0130	19	38.	3.2	105.2	*	1	0705	86	0.	1.0	102.0	*	1	1240	153	0.	1.0	102.0
1	0135	20	39.	3.3	105.4	*	1	0710	87	0.	1.0	102.0	*	1	1245	154	0.	1.0	102.0
1	0140	21	38.	3.3	105.3	*	1	0715	88	0.	1.0	102.0	*	1	1250	155	0.	1.0	102.0
1	0145	22	38.	3.2	105.2	*	1	0720	89	0.	1.0	102.0	*	1	1255	156	0.	1.0	102.0
1	0150	23	37.	3.0	105.0	*	1	0725	90	0.	1.0	102.0	*	1	1300	157	0.	1.0	102.0
1	0155	24	35.	2.9	104.8	*	1	0730	91	0.	1.0	102.0	*	1	1305	158	0.	1.0	102.0
1	0200	25	34.	2.7	104.6	*	1	0735	92	0.	1.0	102.0	*	1	1310	159	0.	1.0	102.0
1	0205	26	32.	2.5	104.3	*	1	0740	93	0.	1.0	102.0	*	1	1315	160	0.	1.0	102.0
1	0210	27	30.	2.3	104.1	*	1	0745	94	0.	1.0	102.0	*	1	1320	161	0.	1.0	102.0
1	0215	28	28.	2.2	103.8	*	1	0750	95	0.	1.0	102.0	*	1	1325	162	0.	1.0	102.0
1	0220	29	26.	2.0	103.5	*	1	0755	96	0.	1.0	102.0	*	1	1330	163	0.	1.0	102.0
1	0225	30	23.	1.8	103.3	*	1	0800	97	0.	1.0	102.0	*	1	1335	164	0.	1.0	102.0
1	0230	31	19.	1.7	103.1	*	1	0805	98	0.	1.0	102.0	*	1	1340	165	0.	1.0	102.0
1	0235	32	15.	1.6	102.9	*	1	0810	99	0.	1.0	102.0	*	1	1345	166	0.	1.0	102.0
1	0240	33	13.	1.5	102.7	*	1	0815	100	0.	1.0	102.0	*	1	1350	167	0.	1.0	102.0
1	0245	34	11.	1.4	102.6	*	1	0820	101	0.	1.0	102.0	*	1	1355	168	0.	1.0	102.0
1	0250	35	9.	1.3	102.5	*	1	0825	102	0.	1.0	102.0	*	1	1400	169	0.	1.0	102.0
1	0255	36	7.	1.3	102.4	*	1	0830	103	0.	1.0	102.0	*	1	1405	170	0.	1.0	102.0
1	0300	37	6.	1.2	102.3	*	1	0835	104	0.	1.0	102.0	*	1	1410	171	0.	1.0	102.0
1	0305	38	5.	1.2	102.3	*	1	0840	105	0.	1.0	102.0	*	1	1415	172	0.	1.0	102.0
1	0310	39	4.	1.2	102.2	*	1	0845	106	0.	1.0	102.0	*	1	1420	173	0.	1.0	102.0
1	0315	40	3.	1.1	102.2	*	1	0850	107	0.	1.0	102.0	*	1	1425	174	0.	1.0	102.0
1	0320	41	3.	1.1	102.2	*	1	0855	108	0.	1.0	102.0	*	1	1430	175	0.	1.0	102.0
1	0325	42	2.	1.1	102.1	*	1	0900	109	0.	1.0	102.0	*	1	1435	176	0.	1.0	102.0
1	0330	43	2.	1.1	102.1	*	1	0905	110	0.	1.0	102.0	*	1	1440	177	0.	1.0	102.0
1	0335	44	1.	1.1	102.1	*	1	0910	111	0.	1.0	102.0	*	1	1445	178	0.	1.0	102.0
1	0340	45	1.	1.1	102.1	*	1	0915	112	0.	1.0	102.0	*	1	1450	179	0.	1.0	102.0
1	0345	46	1.	1.1	102.1	*	1	0920	113	0.	1.0	102.0	*	1	1455	180	0.	1.0	102.0
1	0350	47	1.	1.1	102.0	*	1	0925	114	0.	1.0	102.0	*	1	1500	181	0.	1.0	102.0
1	0355	48	1.	1.1	102.0	*	1	0930	115	0.	1.0	102.0	*	1	1505	182	0.	1.0	102.0
1	0400	49	1.	1.0	102.0	*	1	0935	116	0.	1.0	102.0	*	1	1510	183	0.	1.0	102.0
1	0405	50	0.	1.0	102.0	*	1	0940	117	0.	1.0	102.0	*	1	1515	184	0.	1.0	102.0
1	0410	51	0.	1.0	102.0	*	1	0945	118	0.	1.0	102.0	*	1	1520	185	0.	1.0	102.0
1	0415	52	0.	1.0	102.0	*	1	0950	119	0.	1.0	102.0	*	1	1525	186	0.	1.0	102.0
1	0420	53	0.	1.0	102.0	*	1	0955	120	0.	1.0	102.0	*	1	1530	187	0.	1.0	102.0
1	0425	54	0.	1.0	102.0	*	1	1000	121	0.	1.0	102.0	*	1	1535	188	0.	1.0	102.0
1	0430	55	0.	1.0	102.0	*	1	1005	122	0.	1.0	102.0	*	1	1540	189	0.	1.0	102.0
1	0435	56	0.	1.0	102.0	*	1	1010	123	0.	1.0	102.0	*	1	1545	190	0.	1.0	102.0
1	0440	57	0.	1.0	102.0	*	1	1015	124	0.	1.0	102.0	*	1	1550	191	0.	1.0	102.0
1	0445	58	0.	1.0	102.0	*	1	1020	125	0.	1.0	102.0	*	1	1555	192	0.	1.0	102.0
1	0450	59	0.	1.0	102.0	*	1	1025	126	0.	1.0	102.0	*	1	1600	193	0.	1.0	102.0
1	0455	60	0.	1.0	102.0	*	1	1030	127	0.	1.0	102.0	*	1	1605	194	0.	1.0	102.0
1	0500	61	0.	1.0	102.0	*	1	1035	128	0.	1.0	102.0	*	1	1610	195	0.	1.0	102.0
1	0505	62	0.	1.0	102.0	*	1	1040	129	0.	1.0	102.0	*	1	1615	196	0.	1.0	102.0
1	0510	63	0.	1.0	102.0	*	1	1045	130	0.	1.0	102.0	*	1	1620	197	0.	1.0	102.0
1	0515	64	0.	1.0	102.0	*	1	1050	131	0.	1.0	102.0	*	1	1625	198	0.	1.0	102.0
1	0520	65	0.	1.0	102.0	*	1	1055	132	0.	1.0	102.0	*	1	1630	199	0.	1.0	102.0
1	0525	66	0.	1.0	102.0	*	1	1100	133	0.	1.0	102.0	*	1	1635	200	0.	1.0	102.0
1	0530	67	0.	1.0	102.0	*	1	1105	134	0.	1.0	102.0	*						
						*							*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 39.	1.58		8.	3.	3.	3.
		(INCHES)	1.398	1.398	1.398	1.398
		(AC-FT)	4.	4.	4.	4.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
(AC-FT)	(HR)				
3.	1.58	1.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
105.35	1.58	102.61	102.11	102.11	102.11

```
                    CUMULATIVE AREA =     .06 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 299 KK     *   SUM167   *            COMBINE HG FROM RCH167 & DET161
            *            *
            **************

 300 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   SUM167

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                         (CFS)
+     83.       1.92                32.         12.         12.         12.
                       (INCHES)    1.229       1.281       1.281       1.281
                        (AC-FT)     16.         17.         17.         17.

                       CUMULATIVE AREA =     .24 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 301 KK     *   RCH181   *            ROUTE HG SUM147 THRU REACH 181, 50-FOOT CHANNEL
            *            *
            **************

               HYDROGRAPH ROUTING DATA

 302 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       FLOW  TYPE OF INITIAL CONDITION
                      RSVRIC     -1.00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

 303 RC          NORMAL DEPTH CHANNEL
                        ANL       .030  LEFT OVERBANK N-VALUE
                       ANCH       .025  MAIN CHANNEL N-VALUE
                        ANR       .030  RIGHT OVERBANK N-VALUE
                      RLNTH      1460.  REACH LENGTH
                        SEL      .0050  ENERGY SLOPE
                      ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                     CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 305 RY       ELEVATION    100.00     99.00     99.00     96.00     96.00     99.00     99.00    100.00
 304 RX       DISTANCE     500.00    508.00    508.00    520.00    530.00    542.00    542.00    550.00

                                                          ***

                                     COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .08       .16       .27       .38       .50       .64       .79       .94      1.12
          OUTFLOW        .00      3.23     10.59     21.57     36.12     54.36     76.42    102.46    132.65    167.18
        ELEVATION      96.00     96.21     96.42     96.63     96.84     97.05     97.26     97.47     97.68     97.89

          STORAGE       1.30      1.50      1.70      1.92      2.15      2.40      2.67      2.96      3.28      3.62
          OUTFLOW     206.23    249.96    298.57    352.23    411.11    486.19    571.23    663.30    762.89    870.42
        ELEVATION      98.11     98.32     98.53     98.74     98.95     99.16     99.37     99.58     99.79    100.00
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*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      411. TO      870.
               THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
               THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   RCH181

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                            (CFS)
+     83.       2.00                32.         12.         12.         12.
                         (INCHES)  1.224       1.281       1.281       1.281
                          (AC-FT)    16.         17.         17.         17.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)      (HR)
       1.       2.00                 0.          0.          0.          0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)      (HR)
    97.32       2.00               96.72       96.29       96.29       96.29

                         CUMULATIVE AREA =     .24 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 306 KK     *   SUB170   *            RUNOFF HG FROM SUB-BASIN 170
            *            *
            **************

               SUBBASIN RUNOFF DATA

 307 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .05  SUBBASIN AREA

                 PRECIPITATION DATA

  72 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

 308 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

 309 UC          CLARK UNITGRAPH
                         TC         .25  TIME OF CONCENTRATION
                          R         .26  STORAGE COEFFICIENT

 310 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .25 HR,       R=   .26 HR
                                  SNYDER   TP=   .19 HR,      CP=   .49

                                          UNIT HYDROGRAPH
                                     18 END-OF-PERIOD ORDINATES
                 24.       67.       82.       66.       48.       34.       25.       18.       13.        9.
                  7.        5.        4.        3.        2.        1.        1.        1.
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***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUB170

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     98.      1.33                 10.          4.          4.          4.
                        (INCHES)   1.743       1.743       1.743       1.743
                         (AC-FT)     5.          5.          5.          5.

                        CUMULATIVE AREA =     .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 312 KK   *   SUB175   *            RUNOFF HG FROM SUB-BASIN 175
          *            *
          **************

             SUBBASIN RUNOFF DATA

 313 BA        SUBBASIN CHARACTERISTICS
                     TAREA         .06  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB              STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

 314 LG        GREEN AND AMPT LOSS RATE
                     STRTL         .23  STARTING LOSS
                       DTH         .30  MOISTURE DEFICIT
                      PSIF        2.60  WETTING FRONT SUCTION
                     XKSAT        1.12  HYDRAULIC CONDUCTIVITY
                     RTIMP        8.20  PERCENT IMPERVIOUS AREA

 315 UC        CLARK UNITGRAPH
                        TC         .75  TIME OF CONCENTRATION
                         R         .89  STORAGE COEFFICIENT

 316 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .75 HR,      R=   .89 HR
                                  SNYDER   TP=   .50 HR,     CP=   .37

                                          UNIT HYDROGRAPH
                                     61 END-OF-PERIOD ORDINATES
                 1.       5.      13.      23.      29.      31.      30.      30.      28.      27.
                24.      22.      20.      18.      17.      15.      14.      13.      11.      10.
                 9.       9.       8.       7.       7.       6.       5.       5.       4.       4.
                 4.       3.       3.       3.       3.       2.       2.       2.       2.       2.
                 1.       1.       1.       1.       1.       1.       1.       1.       1.       1.
                 1.       1.       0.       0.       0.       0.       0.       0.       0.       0.
                 0.

***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUB175

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.63, TOTAL EXCESS =    1.14

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
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                                    6-HR        24-HR        72-HR      16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     34.       1.58                8.           3.           3.           3.
                        (INCHES)    1.136        1.136        1.136        1.136
                         (AC-FT)    4.           4.           4.           4.

                        CUMULATIVE AREA =     .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 318 KK     *   SUB180   *            RUNOFF HG FROM SUB-BASIN 180
            *            *
            **************

               SUBBASIN RUNOFF DATA

 319 BA          SUBBASIN CHARACTERISTICS
                       TAREA          .01  SUBBASIN AREA

                 PRECIPITATION DATA

  72 PB                STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI             INCREMENTAL PRECIPITATION PATTERN
                       .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                       .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                       .01       .00       .01       .01

 320 LG          GREEN AND AMPT LOSS RATE
                       STRTL          .15  STARTING LOSS
                         DTH          .28  MOISTURE DEFICIT
                        PSIF         3.40  WETTING FRONT SUCTION
                       XKSAT          .80  HYDRAULIC CONDUCTIVITY
                       RTIMP        37.00  PERCENT IMPERVIOUS AREA

 321 UC          CLARK UNITGRAPH
                          TC          .27  TIME OF CONCENTRATION
                           R          .51  STORAGE COEFFICIENT

 322 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .27 HR,       R=   .51 HR
                                        SNYDER   TP=   .23 HR,      CP=   .35

                                                   UNIT HYDROGRAPH
                                              34 END-OF-PERIOD ORDINATES
                 1.        4.        6.        5.        5.        4.        3.        3.        2.        2.
                 2.        1.        1.        1.        1.        1.        1.        1.        0.        0.
                 0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
                 0.        0.        0.        0.

     ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION   SUB180

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR      16.58-HR
+   (CFS)       (HR)
                          (CFS)
      8.       1.33                1.           0.           0.           0.
                        (INCHES)    1.743        1.743        1.743        1.743
                         (AC-FT)    1.           1.           1.           1.

                        CUMULATIVE AREA =     .01 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
324 KK    *   SUM181   *          COMBINE HG FROM RCH181, SUB170, SUB175 AND SUB180
          *            *
          **************
                                  INFLOW INTO DETENTION BASIN 181

326 HC          HYDROGRAPH COMBINATION
                     ICOMP          4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   SUM181

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                        (CFS)
+    151.      1.42                50.         19.         19.         19.
                     (INCHES)     1.274       1.331       1.331       1.331
                      (AC-FT)      25.         26.         26.         26.

                     CUMULATIVE AREA =     .36 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
327 KK    *   DET181   *          ROUTE HG SUM181 THRU DET BASIN 181; Wb = 100'; L  = 300'
          *            *
          **************
                                  100-FOOT WIER USED FOR HIGH FLOWS AND 2-48" CMP

329 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

330 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       STOR  TYPE OF INITIAL CONDITION
                    RSVRIC        .00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

331 SV            STORAGE         .0      1.5       3.4       5.6

332 SE          ELEVATION     100.00    102.00    104.00    106.00

333 SL          LOW-LEVEL OUTLET
                     ELEVL     102.00  ELEVATION AT CENTER OF OUTLET
                     CAREA      25.10  CROSS-SECTIONAL AREA
                      COQL        .37  COEFFICIENT
                      EXPL        .50  EXPONENT OF HEAD

334 SS          SPILLWAY
                      CREL     105.90  SPILLWAY CREST ELEVATION
                     SPWID     100.00  SPILLWAY WIDTH
                      COQW       2.60  WEIR COEFFICIENT
                      EXPW       1.50  EXPONENT OF HEAD

                                                          ***

                                       COMPUTED OUTFLOW-ELEVATION DATA

        OUTFLOW       .00       .00    118.35    121.75    125.35    129.17    133.23    137.55    142.16    147.09
      ELEVATION    100.00    102.00    104.53    104.67    104.83    105.01    105.20    105.41    105.64    105.90
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OUTFLOW	147.31	147.56	147.96	148.52	149.29	150.29	151.55	153.10	154.96	157.19
ELEVATION	105.91	105.91	105.92	105.92	105.93	105.94	105.96	105.97	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.54	3.42	4.00	4.16	4.34	4.53	4.74	4.97	5.23
OUTFLOW	.00	.00	105.33	118.35	121.75	125.35	129.17	133.23	137.55	142.16
ELEVATION	100.00	102.00	104.00	104.53	104.67	104.83	105.01	105.20	105.41	105.64

STORAGE	5.51	5.52	5.54	5.56	5.57	5.59	5.60	5.62
OUTFLOW	147.09	147.56	148.52	150.29	151.55	153.10	154.96	157.19
ELEVATION	105.90	105.91	105.92	105.94	105.96	105.97	105.98	106.00

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HYDROGRAPH AT STATION DET181

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	15.	1.8	102.3	*	1		1110	135	1.	1.6	102.0
1		0005	2	0.	.0	100.0	*	1		0540	69	15.	1.8	102.3	*	1		1115	136	1.	1.5	102.0
1		0010	3	0.	.0	100.0	*	1		0545	70	14.	1.8	102.3	*	1		1120	137	1.	1.5	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	14.	1.8	102.3	*	1		1125	138	0.	1.5	102.0
1		0020	5	0.	.0	100.0	*	1		0555	72	13.	1.8	102.2	*	1		1130	139	0.	1.5	102.0
1		0025	6	0.	.0	100.1	*	1		0600	73	12.	1.8	102.2	*	1		1135	140	0.	1.5	102.0
1		0030	7	0.	.1	100.1	*	1		0605	74	12.	1.8	102.2	*	1		1140	141	0.	1.5	102.0
1		0035	8	0.	.1	100.1	*	1		0610	75	11.	1.7	102.2	*	1		1145	142	0.	1.5	102.0
1		0040	9	0.	.1	100.1	*	1		0615	76	11.	1.7	102.2	*	1		1150	143	0.	1.5	102.0
1		0045	10	0.	.2	100.2	*	1		0620	77	10.	1.7	102.2	*	1		1155	144	0.	1.5	102.0
1		0050	11	0.	.2	100.3	*	1		0625	78	10.	1.7	102.2	*	1		1200	145	0.	1.5	102.0
1		0055	12	0.	.3	100.4	*	1		0630	79	9.	1.7	102.2	*	1		1205	146	0.	1.5	102.0
1		0100	13	0.	.4	100.5	*	1		0635	80	9.	1.7	102.2	*	1		1210	147	0.	1.5	102.0
1		0105	14	0.	.6	100.8	*	1		0640	81	8.	1.7	102.2	*	1		1215	148	0.	1.5	102.0
1		0110	15	0.	1.0	101.4	*	1		0645	82	8.	1.7	102.2	*	1		1220	149	0.	1.5	102.0
1		0115	16	10.	1.7	102.2	*	1		0650	83	8.	1.7	102.1	*	1		1225	150	0.	1.5	102.0
1		0120	17	50.	2.4	102.9	*	1		0655	84	7.	1.7	102.1	*	1		1230	151	0.	1.5	102.0
1		0125	18	82.	3.0	103.6	*	1		0700	85	7.	1.7	102.1	*	1		1235	152	0.	1.5	102.0
1		0130	19	104.	3.4	104.0	*	1		0705	86	6.	1.7	102.1	*	1		1240	153	0.	1.5	102.0
1		0135	20	111.	3.7	104.2	*	1		0710	87	6.	1.6	102.1	*	1		1245	154	0.	1.5	102.0
1		0140	21	116.	3.9	104.4	*	1		0715	88	6.	1.6	102.1	*	1		1250	155	0.	1.5	102.0
1		0145	22	119.	4.0	104.6	*	1		0720	89	5.	1.6	102.1	*	1		1255	156	0.	1.5	102.0
1		0150	23	122.	4.2	104.7	*	1		0725	90	5.	1.6	102.1	*	1		1300	157	0.	1.5	102.0
1		0155	24	123.	4.2	104.7	*	1		0730	91	5.	1.6	102.1	*	1		1305	158	0.	1.5	102.0
1		0200	25	124.	4.3	104.8	*	1		0735	92	5.	1.6	102.1	*	1		1310	159	0.	1.5	102.0
1		0205	26	124.	4.2	104.8	*	1		0740	93	4.	1.6	102.1	*	1		1315	160	0.	1.5	102.0
1		0210	27	122.	4.2	104.7	*	1		0745	94	4.	1.6	102.1	*	1		1320	161	0.	1.5	102.0
1		0215	28	121.	4.1	104.6	*	1		0750	95	4.	1.6	102.1	*	1		1325	162	0.	1.5	102.0
1		0220	29	118.	4.0	104.5	*	1		0755	96	4.	1.6	102.1	*	1		1330	163	0.	1.5	102.0
1		0225	30	115.	3.9	104.4	*	1		0800	97	3.	1.6	102.1	*	1		1335	164	0.	1.5	102.0
1		0230	31	112.	3.7	104.3	*	1		0805	98	3.	1.6	102.1	*	1		1340	165	0.	1.5	102.0
1		0235	32	108.	3.5	104.1	*	1		0810	99	3.	1.6	102.1	*	1		1345	166	0.	1.5	102.0
1		0240	33	102.	3.4	103.9	*	1		0815	100	3.	1.6	102.1	*	1		1350	167	0.	1.5	102.0
1		0245	34	92.	3.2	103.7	*	1		0820	101	3.	1.6	102.1	*	1		1355	168	0.	1.5	102.0
1		0250	35	84.	3.0	103.6	*	1		0825	102	3.	1.6	102.1	*	1		1400	169	0.	1.5	102.0
1		0255	36	77.	2.9	103.5	*	1		0830	103	3.	1.6	102.1	*	1		1405	170	0.	1.5	102.0
1		0300	37	71.	2.8	103.4	*	1		0835	104	3.	1.6	102.1	*	1		1410	171	0.	1.5	102.0
1		0305	38	66.	2.7	103.3	*	1		0840	105	3.	1.6	102.1	*	1		1415	172	0.	1.5	102.0
1		0310	39	62.	2.6	103.2	*	1		0845	106	3.	1.6	102.0	*	1		1420	173	0.	1.5	102.0
1		0315	40	58.	2.6	103.1	*	1		0850	107	2.	1.6	102.0	*	1		1425	174	0.	1.5	102.0
1		0320	41	55.	2.5	103.0	*	1		0855	108	2.	1.6	102.0	*	1		1430	175	0.	1.5	102.0
1		0325	42	51.	2.5	103.0	*	1		0900	109	2.	1.6	102.0	*	1		1435	176	0.	1.5	102.0
1		0330	43	48.	2.4	102.9	*	1		0905	110	2.	1.6	102.0	*	1		1440	177	0.	1.5	102.0
1		0335	44	46.	2.4	102.9	*	1		0910	111	2.	1.6	102.0	*	1		1445	178	0.	1.5	102.0
1		0340	45	43.	2.3	102.8	*	1		0915	112	2.	1.6	102.0	*	1		1450	179	0.	1.5	102.0
1		0345	46	41.	2.3	102.8	*	1		0920	113	2.	1.6	102.0	*	1		1455	180	0.	1.5	102.0
1		0350	47	39.	2.2	102.7	*	1		0925	114	2.	1.6	102.0	*	1		1500	181	0.	1.5	102.0
1		0355	48	37.	2.2	102.7	*	1		0930	115	2.	1.6	102.0	*	1		1505	182	0.	1.5	102.0
1		0400	49	35.	2.2	102.7	*	1		0935	116	2.	1.6	102.0	*	1		1510	183	0.	1.5	102.0
1		0405	50	33.	2.1	102.6	*	1		0940	117	2.	1.6	102.0	*	1		1515	184	0.	1.5	102.0
1		0410	51	31.	2.1	102.6	*	1		0945	118	1.	1.6	102.0	*	1		1520	185	0.	1.5	102.0
1		0415	52	30.	2.1	102.6	*	1		0950	119	1.	1.6	102.0	*	1		1525	186	0.	1.5	102.0
1		0420	53	28.	2.0	102.5	*	1		0955	120	1.	1.6	102.0	*	1		1530	187	0.	1.5	102.0
1		0425	54	27.	2.0	102.5	*	1		1000	121	1.	1.6	102.0	*	1		1535	188	0.	1.5	102.0
1		0430	55	26.	2.0	102.5	*	1		1005	122	1.	1.6	102.0	*	1		1540	189	0.	1.5	102.0
1		0435	56	24.	2.0	102.5	*	1		1010	123	1.	1.6	102.0	*	1		1545	190	0.	1.5	102.0
1		0440	57	23.	2.0	102.4	*	1		1015	124	1.	1.6	102.0	*	1		1550	191	0.	1.5	102.0
1		0445	58	22.	1.9	102.4	*	1		1020	125	1.	1.6	102.0	*	1		1555	192	0.	1.5	102.0

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 1    0450  59    22.    1.9   102.4 *  1    1025 126    1.    1.6   102.0 *  1    1600 193    0.    1.5   102.0
 1    0455  60    21.    1.9   102.4 *  1    1030 127    1.    1.6   102.0 *  1    1605 194    0.    1.5   102.0
 1    0500  61    20.    1.9   102.4 *  1    1035 128    1.    1.6   102.0 *  1    1610 195    0.    1.5   102.0
 1    0505  62    19.    1.9   102.4 *  1    1040 129    1.    1.6   102.0 *  1    1615 196    0.    1.5   102.0
 1    0510  63    18.    1.9   102.3 *  1    1045 130    1.    1.6   102.0 *  1    1620 197    0.    1.5   102.0
 1    0515  64    18.    1.9   102.3 *  1    1050 131    1.    1.6   102.0 *  1    1625 198    0.    1.5   102.0
 1    0520  65    17.    1.8   102.3 *  1    1055 132    1.    1.6   102.0 *  1    1630 199    0.    1.5   102.0
 1    0525  66    16.    1.8   102.3 *  1    1100 133    1.    1.6   102.0 *  1    1635 200    0.    1.5   102.0
 1    0530  67    16.    1.8   102.3 *  1    1105 134    1.    1.6   102.0 *
                                      *                                      *
*****************************************************************************************************************

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+    124.      2.00                 47.         18.         18.         18.
                        (INCHES)   1.208       1.252       1.252       1.252
                         (AC-FT)    23.         24.         24.         24.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
      4.       2.00                  2.          2.          2.          2.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
   104.76      2.00               102.95      102.23      102.23      102.23

                        CUMULATIVE AREA =     .36 SQ MI


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          *            *
 335 KK   *   SUB190   *          RUNOFF HG FROM SUB-BASIN 190
          *            *
          **************

             SUBBASIN RUNOFF DATA

 336 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .06  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 337 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

 338 UC        CLARK UNITGRAPH
                       TC         .27  TIME OF CONCENTRATION
                        R         .27  STORAGE COEFFICIENT

 339 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                        UNIT HYDROGRAPH PARAMETERS
                                  CLARK   TC=   .27 HR,      R=   .27 HR
                                 SNYDER   TP=   .21 HR,     CP=   .51

                                        UNIT HYDROGRAPH
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                                        19 END-OF-PERIOD ORDINATES
        20.      64.      83.      70.      52.      38.      28.      21.      15.      11.
         8.       6.       4.       3.       2.       2.       1.       1.       1.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB190

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    102.      1.33                 11.          4.          4.          4.
                         (INCHES)  1.743       1.743       1.743       1.743
                          (AC-FT)    5.          5.          5.          5.

                         CUMULATIVE AREA =     .06 SQ MI


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          *            *
 341 KK   *   RCH207   *          ROUTE HG SUB190 THRU REACH 207 (WEST); 68' STREET
          *            *
          **************

             HYDROGRAPH ROUTING DATA

 342 RK        KINEMATIC WAVE STREAM ROUTING
                        L      2440.  CHANNEL LENGTH
                        S      .0030  SLOPE
                        N       .015  CHANNEL ROUGHNESS COEFFICIENT
                       CA        .00  CONTRIBUTING AREA
                    SHAPE       DEEP  CHANNEL SHAPE
                       WD      68.00  BOTTOM WIDTH OR DIAMETER
                        Z        .00  SIDE SLOPE
                   NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                                COMPUTED KINEMATIC PARAMETERS
                                     VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

                 ELEMENT    ALPHA       M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                             PEAK                  CELERITY
                                                (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

                 MAIN         2.63      1.33      1.62    813.33    100.92    82.74       1.75      8.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5207E+01  EXCESS= .0000E+00 OUTFLOW= .5218E+01 BASIN STORAGE= .2098E-06 PERCENT ERROR=   -.2

                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN         2.63      1.33      5.00              98.82    80.00       1.74

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   RCH207

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     99.      1.33                 10.          4.          4.          4.
                         (INCHES)  1.742       1.742       1.742       1.742
                          (AC-FT)    5.          5.          5.          5.

                         CUMULATIVE AREA =     .06 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
343 KK    *   SUB200   *          RUNOFF HG FROM SUB-BASIN 200
          *            *
          **************

             SUBBASIN RUNOFF DATA

344 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .05  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

345 LG          GREEN AND AMPT LOSS RATE
                     STRTL         .15  STARTING LOSS
                       DTH         .28  MOISTURE DEFICIT
                      PSIF        3.40  WETTING FRONT SUCTION
                     XKSAT         .80  HYDRAULIC CONDUCTIVITY
                     RTIMP       37.00  PERCENT IMPERVIOUS AREA

346 UC          CLARK UNITGRAPH
                        TC         .30  TIME OF CONCENTRATION
                         R         .34  STORAGE COEFFICIENT

347 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .30 HR,      R=   .34 HR
                                  SNYDER   TP=   .23 HR,     CP=   .46

                                          UNIT HYDROGRAPH
                                   24 END-OF-PERIOD ORDINATES
              11.       43.       62.       57.       47.       36.       28.       22.       17.       14.
              11.        8.        7.        5.        4.        3.        2.        2.        1.        1.
               1.        1.        1.        0.

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   SUB200

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     80.      1.33                     9.          3.          3.          3.
                       (INCHES)     1.744       1.744       1.744       1.744
                        (AC-FT)        5.          5.          5.          5.

                      CUMULATIVE AREA =     .05 SQ MI


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          *            *
349 KK    *   SUM207   *          COMBINE HG FROM DET181, RCH207 (WEST) AND SUB200
          *            *
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350 HC          HYDROGRAPH COMBINATION
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                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

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                      HYDROGRAPH AT STATION   SUM207

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     254.      1.42                 66.         25.         25.         25.
                         (INCHES)   1.312       1.362       1.362       1.362
                          (AC-FT)    33.         34.         34.         34.

                         CUMULATIVE AREA =     .47 SQ MI


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           *            *
 351 KK    *   SUB210   *            RUNOFF HG FROM SUB-BASIN 210
           *            *
           **************

              SUBBASIN RUNOFF DATA

 352 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

  72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI           INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

 353 LG         GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

 354 UC         CLARK UNITGRAPH
                         TC         .17  TIME OF CONCENTRATION
                          R         .14  STORAGE COEFFICIENT

 355 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .17 HR,       R=   .14 HR
                                        SNYDER   TP=   .13 HR,      CP=   .54

                                                   UNIT HYDROGRAPH
                                              10 END-OF-PERIOD ORDINATES
              34.       62.       44.       24.       13.        7.        4.        2.        1.        1.

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   SUB210

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+      62.      1.25                  5.          2.          2.          2.
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                    (INCHES)     1.744       1.744       1.744       1.744
                     (AC-FT)       2.          2.          2.          2.

                    CUMULATIVE AREA =     .03 SQ MI


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          *            *
 357 KK   *   RCH227   *          ROUTE HG SUB210 THRU REACH 227; 10' GUNITE CHANNEL
          *            *
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             HYDROGRAPH ROUTING DATA

 358 RK        KINEMATIC WAVE STREAM ROUTING
                        L       560.  CHANNEL LENGTH
                        S      .0020  SLOPE
                        N       .016  CHANNEL ROUGHNESS COEFFICIENT
                       CA        .00  CONTRIBUTING AREA
                    SHAPE       TRAP  CHANNEL SHAPE
                       WD      10.00  BOTTOM WIDTH OR DIAMETER
                        Z        .50  SIDE SLOPE
                   NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                                COMPUTED KINEMATIC PARAMETERS
                                     VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

                 ELEMENT    ALPHA      M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                             PEAK                  CELERITY
                                                (MIN)     (FT)     (CFS)    (MIN)       (IN)      (FPS)

                 MAIN         1.11     1.49       .58    186.67    61.58    75.31       1.75      6.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2325E+01  EXCESS= .0000E+00 OUTFLOW= .2329E+01 BASIN STORAGE= .4183E-06 PERCENT ERROR=   -.2

                                  INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN         1.11     1.49      5.00              61.51    75.00       1.75

      ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   RCH227

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     62.       1.25                 5.          2.          2.          2.
                        (INCHES)   1.752       1.752       1.752       1.752
                         (AC-FT)     2.          2.          2.          2.

                        CUMULATIVE AREA =     .03 SQ MI


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          *            *
 359 KK   *   SUB220   *          RUNOFF HG FROM SUB-BASIN 220
          *            *
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             SUBBASIN RUNOFF DATA

 360 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .05  SUBBASIN AREA
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                PRECIPITATION DATA

 72 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI             INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

361 LG          GREEN AND AMPT LOSS RATE
                     STRTL        .15  STARTING LOSS
                       DTH        .28  MOISTURE DEFICIT
                      PSIF       3.40  WETTING FRONT SUCTION
                     XKSAT        .80  HYDRAULIC CONDUCTIVITY
                     RTIMP      37.00  PERCENT IMPERVIOUS AREA

362 UC          CLARK UNITGRAPH
                        TC        .33  TIME OF CONCENTRATION
                         R        .44  STORAGE COEFFICIENT

363 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                  ***

                                              UNIT HYDROGRAPH PARAMETERS
                                       CLARK   TC=   .33 HR,       R=   .44 HR
                                      SNYDER   TP=   .24 HR,      CP=   .38

                                                UNIT HYDROGRAPH
                                            30 END-OF-PERIOD ORDINATES
                 7.       30.       46.       45.       40.       33.       27.       22.       18.       15.
                13.       10.        9.        7.        6.        5.        4.        3.        3.        2.
                 2.        2.        1.        1.        1.        1.        1.        0.        0.        0.

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   SUB220

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                         (CFS)
+     63.      1.33                   9.          3.          3.          3.
                       (INCHES)    1.744       1.744       1.744       1.744
                        (AC-FT)       4.          4.          4.          4.

                       CUMULATIVE AREA =     .05 SQ MI


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          *            *
 365 KK   *   SUB225   *            RUNOFF HG FROM SUB-BASIN 225
          *            *
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             SUBBASIN RUNOFF DATA

 366 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .01  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB                STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI             INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

367 LG          GREEN AND AMPT LOSS RATE
                     STRTL        .15  STARTING LOSS
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                    DTH        .28  MOISTURE DEFICIT
                   PSIF       3.40  WETTING FRONT SUCTION
                  XKSAT        .80  HYDRAULIC CONDUCTIVITY
                  RTIMP      37.00  PERCENT IMPERVIOUS AREA

368 UC        CLARK UNITGRAPH
                     TC        .15  TIME OF CONCENTRATION
                      R        .16  STORAGE COEFFICIENT

369 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
               100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .15 HR,       R=   .16 HR
                                  SNYDER   TP=   .12 HR,      CP=   .52

                                          UNIT HYDROGRAPH
                                     11 END-OF-PERIOD ORDINATES
            18.      33.      24.      14.       8.       5.       3.       2.       1.       1.
             0.

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   SUB225

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                        (CFS)
+     34.      1.25                 3.          1.          1.          1.
                      (INCHES)    1.744       1.744       1.744       1.744
                       (AC-FT)      1.          1.          1.          1.

                      CUMULATIVE AREA =     .01 SQ MI


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          *            *
371 KK    *   SUM227   *            COMBINE HG FROM RCH227, SUB220 & SUB225
          *            *
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372 HC        HYDROGRAPH COMBINATION
                   ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   SUM227

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                        (CFS)
+    150.      1.25                16.          6.          6.          6.
                      (INCHES)    1.746       1.746       1.746       1.746
                       (AC-FT)      8.          8.          8.          8.

                      CUMULATIVE AREA =     .09 SQ MI


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373 KK    *   SUB230   *            RUNOFF HG FROM SUB-BASIN 230
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             SUBBASIN RUNOFF DATA

 374 BA        SUBBASIN CHARACTERISTICS
                    TAREA          .04  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 375 LG        GREEN AND AMPT LOSS RATE
                    STRTL          .22  STARTING LOSS
                      DTH          .30  MOISTURE DEFICIT
                     PSIF         2.50  WETTING FRONT SUCTION
                    XKSAT         1.16  HYDRAULIC CONDUCTIVITY
                    RTIMP        16.00  PERCENT IMPERVIOUS AREA

 376 UC        CLARK UNITGRAPH
                       TC          .45  TIME OF CONCENTRATION
                        R          .32  STORAGE COEFFICIENT

 377 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .45 HR,       R=   .32 HR
                                         SNYDER   TP=   .27 HR,      CP=   .50

                                                   UNIT HYDROGRAPH
                                                23 END-OF-PERIOD ORDINATES
                 5.       24.       43.       47.       42.       35.       28.       22.       17.       13.
                10.        7.        6.        4.        3.        3.        2.        2.        1.        1.
                 1.        1.        0.

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUB230

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.50, TOTAL EXCESS =    1.27

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     50.       1.42                  6.          2.          2.          2.
                         (INCHES)   1.267       1.267       1.267       1.267
                          (AC-FT)     3.          3.          3.          3.

                        CUMULATIVE AREA =     .04 SQ MI


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          *            *
 379 KK   *    SUM231  *            COMBINE HG FROM SUM207, SUM227 & SUB230
          *            *
          **************
                                    INFLOW INTO DETENTION BASIN 231

 381 HC        HYDROGRAPH COMBINATION
                    ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION SUM231

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
+		(CFS)				
+ 421.	1.42		88.	33.	33.	33.
		(INCHES)	1.366	1.411	1.411	1.411
		(AC-FT)	43.	45.	45.	45.

CUMULATIVE AREA = .60 SQ MI

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          *            *
382 KK    *   DET231   *          ROUTE HG SUM231 THRU DET BASIN 231; Wb = 250'; L = 800'
          *            *
          **************
                                  100-FOOT WIER USED FOR HIGH FLOWS AND 1-48" CMP

384 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          1  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

385 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC        .00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

386 SV            STORAGE         .0      9.6     20.1     31.5

387 SE          ELEVATION     100.00   102.00   104.00   106.00

388 SL          LOW-LEVEL OUTLET
                      ELEVL     102.00  ELEVATION AT CENTER OF OUTLET
                      CAREA      12.60  CROSS-SECTIONAL AREA
                       COQL        .37  COEFFICIENT
                       EXPL        .50  EXPONENT OF HEAD

389 SS          SPILLWAY
                       CREL     105.90  SPILLWAY CREST ELEVATION
                      SPWID     100.00  SPILLWAY WIDTH
                       COQW       2.60  WEIR COEFFICIENT
                       EXPW       1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	50.82	53.19	55.79	58.66	61.83	65.38	69.35	73.84
ELEVATION	100.00	102.00	103.85	104.02	104.23	104.46	104.74	105.06	105.44	105.90
OUTFLOW	73.90	74.05	74.32	74.76	75.39	76.28	77.44	78.92	80.76	83.00
ELEVATION	105.90	105.91	105.91	105.92	105.93	105.94	105.95	105.97	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	9.62	19.33	20.13	20.26	21.42	22.76	24.32	26.15	28.33
OUTFLOW	.00	.00	50.82	52.88	53.19	55.79	58.66	61.83	65.38	69.35
ELEVATION	100.00	102.00	103.85	104.00	104.02	104.23	104.46	104.74	105.06	105.44
STORAGE	30.95	31.02	31.12	31.18	31.25	31.33	31.42	31.52		
OUTFLOW	73.84	74.32	75.39	76.28	77.44	78.92	80.76	83.00		
ELEVATION	105.90	105.91	105.93	105.94	105.95	105.97	105.98	106.00		

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HYDROGRAPH AT STATION DET231

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	1		0535	68	56.	21.6	104.3	1		1110	135	8.	11.1	102.3
1		0005	2	0.	.0	100.0	1		0540	69	56.	21.3	104.2	1		1115	136	8.	11.1	102.3
1		0010	3	0.	.0	100.0	1		0545	70	55.	21.0	104.2	1		1120	137	7.	11.0	102.3
		0015	4	0.	.0	100.0	1		0550	71	54.	20.8	104.1	1		1125	138	7.	11.0	102.3
1		0020	5	0.	.1	100.0	1		0555	72	54.	20.5	104.1	1		1130	139	7.	11.0	102.3
1		0025	6	0.	.1	100.0	1		0600	73	53.	20.2	104.0	1		1135	140	7.	10.9	102.2
1		0030	7	0.	.1	100.0	1		0605	74	52.	19.9	104.0	1		1140	141	7.	10.9	102.2
1		0035	8	0.	.2	100.0	1		0610	75	52.	19.6	103.9	1		1145	142	6.	10.8	102.2
1		0040	9	0.	.3	100.1	1		0615	76	51.	19.4	103.9	1		1150	143	6.	10.8	102.2
1		0045	10	0.	.4	100.1	1		0620	77	50.	19.1	103.8	1		1155	144	6.	10.7	102.2
1		0050	11	0.	.6	100.1	1		0625	78	48.	18.8	103.8	1		1200	145	6.	10.7	102.2
1		0055	12	0.	.8	100.2	1		0630	79	47.	18.6	103.7	1		1205	146	6.	10.7	102.2
1		0100	13	0.	1.1	100.2	1		0635	80	45.	18.3	103.7	1		1210	147	5.	10.6	102.2
1		0105	14	0.	1.7	100.4	1		0640	81	44.	18.1	103.6	1		1215	148	5.	10.6	102.2
1		0110	15	0.	2.9	100.6	1		0645	82	43.	17.8	103.6	1		1220	149	5.	10.6	102.2
1		0115	16	0.	5.0	101.0	1		0650	83	42.	17.6	103.5	1		1225	150	5.	10.5	102.2
1		0120	17	0.	7.6	101.6	1		0655	84	40.	17.4	103.5	1		1230	151	5.	10.5	102.2
1		0125	18	5.	10.5	102.2	1		0700	85	39.	17.1	103.4	1		1235	152	4.	10.5	102.2
1		0130	19	19.	13.2	102.7	1		0705	86	38.	16.9	103.4	1		1240	153	4.	10.4	102.2
1		0135	20	31.	15.5	103.1	1		0710	87	37.	16.7	103.3	1		1245	154	4.	10.4	102.2
1		0140	21	41.	17.5	103.5	1		0715	88	36.	16.5	103.3	1		1250	155	4.	10.4	102.1
1		0145	22	50.	19.1	103.8	1		0720	89	35.	16.3	103.3	1		1255	156	4.	10.4	102.1
1		0150	23	54.	20.5	104.1	1		0725	90	34.	16.1	103.2	1		1300	157	4.	10.3	102.1
1		0155	24	56.	21.6	104.3	1		0730	91	33.	15.9	103.2	1		1305	158	4.	10.3	102.1
1		0200	25	58.	22.6	104.4	1		0735	92	32.	15.7	103.2	1		1310	159	4.	10.3	102.1
1		0205	26	60.	23.5	104.6	1		0740	93	31.	15.5	103.1	1		1315	160	3.	10.3	102.1
1		0210	27	62.	24.3	104.7	1		0745	94	30.	15.3	103.1	1		1320	161	3.	10.2	102.1
1		0215	28	63.	25.0	104.9	1		0750	95	29.	15.1	103.1	1		1325	162	3.	10.2	102.1
1		0220	29	64.	25.6	105.0	1		0755	96	28.	15.0	103.0	1		1330	163	3.	10.2	102.1
1		0225	30	65.	26.2	105.1	1		0800	97	27.	14.8	103.0	1		1335	164	3.	10.2	102.1
1		0230	31	66.	26.6	105.1	1		0805	98	26.	14.7	103.0	1		1340	165	3.	10.2	102.1
1		0235	32	67.	27.1	105.2	1		0810	99	26.	14.5	102.9	1		1345	166	3.	10.1	102.1
1		0240	33	68.	27.4	105.3	1		0815	100	25.	14.3	102.9	1		1350	167	3.	10.1	102.1
1		0245	34	68.	27.7	105.3	1		0820	101	24.	14.2	102.9	1		1355	168	3.	10.1	102.1
1		0250	35	68.	27.9	105.4	1		0825	102	23.	14.1	102.8	1		1400	169	2.	10.1	102.1
1		0255	36	69.	28.0	105.4	1		0830	103	23.	13.9	102.8	1		1405	170	2.	10.1	102.1
1		0300	37	69.	28.1	105.4	1		0835	104	22.	13.8	102.8	1		1410	171	2.	10.1	102.1
1		0305	38	69.	28.1	105.4	1		0840	105	21.	13.7	102.8	1		1415	172	2.	10.0	102.1
1		0310	39	69.	28.1	105.4	1		0845	106	20.	13.5	102.7	1		1420	173	2.	10.0	102.1
1		0315	40	69.	28.0	105.4	1		0850	107	20.	13.4	102.7	1		1425	174	2.	10.0	102.1
1		0320	41	69.	27.9	105.4	1		0855	108	19.	13.3	102.7	1		1430	175	2.	10.0	102.1
1		0325	42	68.	27.8	105.4	1		0900	109	19.	13.2	102.7	1		1435	176	2.	10.0	102.1
1		0330	43	68.	27.7	105.3	1		0905	110	18.	13.1	102.7	1		1440	177	2.	10.0	102.1
1		0335	44	68.	27.6	105.3	1		0910	111	17.	13.0	102.6	1		1445	178	2.	10.0	102.1
1		0340	45	68.	27.4	105.3	1		0915	112	17.	12.9	102.6	1		1450	179	2.	10.0	102.1
1		0345	46	67.	27.2	105.2	1		0920	113	16.	12.8	102.6	1		1455	180	2.	9.9	102.1
1		0350	47	67.	27.1	105.2	1		0925	114	16.	12.7	102.6	1		1500	181	2.	9.9	102.1
1		0355	48	67.	26.9	105.2	1		0930	115	15.	12.6	102.6	1		1505	182	2.	9.9	102.1
1		0400	49	66.	26.6	105.1	1		0935	116	15.	12.5	102.5	1		1510	183	2.	9.9	102.1
1		0405	50	66.	26.4	105.1	1		0940	117	14.	12.4	102.5	1		1515	184	1.	9.9	102.1
1		0410	51	65.	26.2	105.1	1		0945	118	14.	12.3	102.5	1		1520	185	1.	9.9	102.1
1		0415	52	65.	26.0	105.0	1		0950	119	14.	12.2	102.5	1		1525	186	1.	9.9	102.0
1		0420	53	65.	25.7	105.0	1		0955	120	13.	12.1	102.5	1		1530	187	1.	9.9	102.0
1		0425	54	64.	25.5	104.9	1		1000	121	13.	12.0	102.5	1		1535	188	1.	9.9	102.0
1		0430	55	64.	25.2	104.9	1		1005	122	12.	12.0	102.4	1		1540	189	1.	9.9	102.0
1		0435	56	63.	24.9	104.8	1		1010	123	12.	11.9	102.4	1		1545	190	1.	9.8	102.0
1		0440	57	63.	24.7	104.8	1		1015	124	11.	11.8	102.4	1		1550	191	1.	9.8	102.0
1		0445	58	62.	24.4	104.7	1		1020	125	11.	11.7	102.4	1		1555	192	1.	9.8	102.0
1		0450	59	61.	24.1	104.7	1		1025	126	11.	11.7	102.4	1		1600	193	1.	9.8	102.0
1		0455	60	61.	23.9	104.7	1		1030	127	10.	11.6	102.4	1		1605	194	1.	9.8	102.0
1		0500	61	60.	23.6	104.6	1		1035	128	10.	11.5	102.4	1		1610	195	1.	9.8	102.0
1		0505	62	60.	23.3	104.6	1		1040	129	10.	11.5	102.4	1		1615	196	1.	9.8	102.0
1		0510	63	59.	23.0	104.5	1		1045	130	9.	11.4	102.3	1		1620	197	1.	9.8	102.0
1		0515	64	59.	22.7	104.5	1		1050	131	9.	11.4	102.3	1		1625	198	1.	9.8	102.0
1		0520	65	58.	22.5	104.4	1		1055	132	9.	11.3	102.3	1		1630	199	1.	9.8	102.0
1		0525	66	57.	22.2	104.4	1		1100	133	9.	11.2	102.3	1		1635	200	1.	9.8	102.0
1		0530	67	57.	21.9	104.3	1		1105	134	8.	11.2	102.3							

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
		(CFS)				
+ 69.	3.08		57.	26.	26.	26.
		(INCHES)	.888	1.103	1.103	1.103
		(AC-FT)	28.	35.	35.	35.

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 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)      (HR)
      28.       3.08                  23.         15.         15.         15.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)      (HR)
    105.39      3.08                104.47      102.93      102.93      102.93

                        CUMULATIVE AREA =     .60 SQ MI


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            *            *
 390 KK     *    SUM241  *            COMBINE HG FROM RCH241 (WEST), DET231 & SUB76
            *            *
            **************

 391 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   SUM241

 PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                         (CFS)
+    1285.      2.00                290.        111.        111.        111.
                       (INCHES)    1.320       1.398       1.398       1.398
                        (AC-FT)    144.        152.        152.        152.

                        CUMULATIVE AREA =    2.05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 392 KK     *    RCH267  *            ROUTE HG SUM241 THRU REACH 267
            *            *
            **************

               HYDROGRAPH ROUTING DATA

 393 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        FLOW  TYPE OF INITIAL CONDITION
                      RSVRIC       -1.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 394 RC          NORMAL DEPTH CHANNEL
                         ANL        .030  LEFT OVERBANK N-VALUE
                        ANCH        .025  MAIN CHANNEL N-VALUE
                         ANR        .030  RIGHT OVERBANK N-VALUE
                       RLNTH        700.  REACH LENGTH
                         SEL       .0060  ENERGY SLOPE
                       ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 396 RY       ELEVATION    100.00     98.00     98.00     95.00     95.00     98.00     98.00    100.00
 395 RX       DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00

                                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA
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STORAGE	.00	.05	.10	.17	.24	.32	.41	.51	.62	.74
OUTFLOW	.00	5.17	17.13	35.21	59.55	90.43	128.20	173.23	225.92	286.64
ELEVATION	95.00	95.26	95.53	95.79	96.05	96.32	96.58	96.84	97.11	97.37
STORAGE	.87	1.00	1.26	1.59	1.94	2.30	2.68	3.07	3.47	3.89
OUTFLOW	355.77	433.69	539.99	687.35	862.02	1061.76	1285.54	1532.79	1803.21	2096.67
ELEVATION	97.63	97.89	98.16	98.42	98.68	98.95	99.21	99.47	99.74	100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 35. TO 2097.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RCH267

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1276.	2.00		290.	111.	111.	111.
		(INCHES)	1.320	1.398	1.398	1.398
		(AC-FT)	144.	152.	152.	152.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
3.	2.00	1.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
99.20	2.00	96.92	95.89	95.89	95.89

CUMULATIVE AREA = 2.05 SQ MI

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          **************
          *            *
397 KK    *   SUB250   *          RUNOFF HG FROM SUB-BASIN 250
          *            *
          **************

            SUBBASIN RUNOFF DATA

398 BA        SUBBASIN CHARACTERISTICS
                   TAREA        .02  SUBBASIN AREA

              PRECIPITATION DATA

 72 PB             STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI          INCREMENTAL PRECIPITATION PATTERN
                   .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                   .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                   .01      .00      .01      .01

399 LG        GREEN AND AMPT LOSS RATE
                   STRTL       .15  STARTING LOSS
                     DTH       .28  MOISTURE DEFICIT
                    PSIF      3.40  WETTING FRONT SUCTION
                   XKSAT       .80  HYDRAULIC CONDUCTIVITY
                   RTIMP     37.00  PERCENT IMPERVIOUS AREA

400 UC        CLARK UNITGRAPH
                      TC       .23  TIME OF CONCENTRATION
                       R       .33  STORAGE COEFFICIENT

401 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                     .0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
                  100.0
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***

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                                        UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .23 HR,       R=   .33 HR
                                  SNYDER   TP=   .19 HR,      CP=   .41

                                          UNIT HYDROGRAPH
                                     23 END-OF-PERIOD ORDINATES
          10.      26.      30.      25.      19.      15.      12.       9.       7.       6.
           4.       3.       3.       2.       2.       1.       1.       1.       1.       0.
           0.       0.       0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB250

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     38.      1.33                   4.          2.          2.          2.
                         (INCHES)   1.744       1.744       1.744       1.744
                          (AC-FT)     2.          2.          2.          2.

                         CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 403 KK   *   SUB260   *          RUNOFF HG FROM SUB-BASIN 260
          *            *
          **************

             SUBBASIN RUNOFF DATA

 404 BA        SUBBASIN CHARACTERISTICS
                    TAREA          .01  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                    .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                    .01      .00      .01      .01

 405 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

 406 UC        CLARK UNITGRAPH
                       TC         .15  TIME OF CONCENTRATION
                        R         .20  STORAGE COEFFICIENT

 407 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                  ***

                                        UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .15 HR,       R=   .20 HR
                                  SNYDER   TP=   .13 HR,      CP=   .47

                                          UNIT HYDROGRAPH
                                     14 END-OF-PERIOD ORDINATES
          14.      27.      21.      14.       9.       6.       4.       2.       2.       1.
           1.       0.       0.       0.

   ***          ***          ***          ***          ***
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                    HYDROGRAPH AT STATION   SUB260

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
   (CFS)       (HR)
                          (CFS)
      29.      1.25                2.          1.          1.          1.
                        (INCHES)  1.745       1.745       1.745       1.745
                         (AC-FT)  1.          1.          1.          1.

                        CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 409 KK     *   SUM267   *          COMBINE HG FROM RCH267, SUB250 & SUB260
            *            *
            **************

 410 HC         HYDROGRAPH COMBINATION
                     ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUM267

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
   (CFS)       (HR)
                          (CFS)
    1285.      2.00               296.        114.        114.        114.
                        (INCHES)  1.324       1.404       1.404       1.404
                         (AC-FT)  147.        156.        156.        156.

                        CUMULATIVE AREA =    2.08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 411 KK     *   RCH281   *          ROUTE HG SUM267 THRU REACH 281
            *            *
            **************

            HYDROGRAPH ROUTING DATA

 412 RS         STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC      -1.00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

 413 RC         NORMAL DEPTH CHANNEL
                       ANL       .030  LEFT OVERBANK N-VALUE
                      ANCH       .025  MAIN CHANNEL N-VALUE
                       ANR       .030  RIGHT OVERBANK N-VALUE
                     RLNTH      1180.  REACH LENGTH
                       SEL      .0040  ENERGY SLOPE
                     ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 415 RY       ELEVATION   100.00    98.00    98.00    95.00    95.00    98.00    98.00   100.00
 414 RX       DISTANCE    500.00   512.00   533.00   545.00   555.00   567.00   588.00   600.00

                                                          ***
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COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	.08	.17	.28	.41	.54	.70	.87	1.05	1.25
OUTFLOW	.00	4.22	13.98	28.75	48.62	73.83	104.67	141.44	184.46	234.04
ELEVATION	95.00	95.26	95.53	95.79	96.05	96.32	96.58	96.84	97.11	97.37
STORAGE	1.46	1.69	2.12	2.68	3.27	3.88	4.52	5.17	5.85	6.56
OUTFLOW	290.48	354.11	440.90	561.22	703.83	866.93	1049.64	1251.52	1472.31	1711.92
ELEVATION	97.63	97.89	98.16	98.42	98.68	98.95	99.21	99.47	99.74	100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 1050. TO 1712.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RCH281

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1285.	2.08		296.	114.	114.	114.
		(INCHES)	1.323	1.403	1.403	1.403
		(AC-FT)	147.	156.	156.	156.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
5.	2.08	1.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
99.51	2.08	97.13	96.00	96.00	96.00

CUMULATIVE AREA = 2.08 SQ MI

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              *            *
416 KK        *   SUB270   *          RUNOFF HG FROM SUB-BASIN 270
              *            *
              **************

                SUBBASIN RUNOFF DATA

417 BA            SUBBASIN CHARACTERISTICS
                       TAREA        .02  SUBBASIN AREA

                  PRECIPITATION DATA

 72 PB                 STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI              INCREMENTAL PRECIPITATION PATTERN
                       .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                       .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                       .01       .00       .01       .01

418 LG            GREEN AND AMPT LOSS RATE
                       STRTL        .22  STARTING LOSS
                         DTH        .29  MOISTURE DEFICIT
                        PSIF       2.65  WETTING FRONT SUCTION
                       XKSAT       1.10  HYDRAULIC CONDUCTIVITY
                       RTIMP      10.00  PERCENT IMPERVIOUS AREA

419 UC            CLARK UNITGRAPH
                          TC        .90  TIME OF CONCENTRATION
                           R        .95  STORAGE COEFFICIENT

420 UA            ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0
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                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .90 HR,       R=   .95 HR
                                        SNYDER   TP=   .58 HR,      CP=   .39

                                                   UNIT HYDROGRAPH
                                              66 END-OF-PERIOD ORDINATES
              0.       1.       3.       6.       9.      10.      11.      10.      10.      10.
              9.       9.       8.       7.       7.       6.       6.       5.       5.       4.
              4.       4.       3.       3.       3.       3.       2.       2.       2.       2.
              2.       2.       1.       1.       1.       1.       1.       1.       1.       1.
              1.       1.       1.       1.       0.       0.       0.       0.       0.       0.
              0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
              0.       0.       0.       0.       0.       0.

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   SUB270

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     12.       1.67                  3.          1.          1.          1.
                        (INCHES)    1.174       1.175       1.175       1.175
                         (AC-FT)      2.          2.          2.          2.

                        CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 422 KK   *   SUB280   *            RUNOFF HG FROM SUB-BASIN 280
          *            *
          **************

             SUBBASIN RUNOFF DATA

 423 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .02  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 424 LG         GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

 425 UC         CLARK UNITGRAPH
                       TC         .18  TIME OF CONCENTRATION
                        R         .22  STORAGE COEFFICIENT

 426 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .18 HR,       R=   .22 HR
                                        SNYDER   TP=   .14 HR,      CP=   .43
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                                        UNIT HYDROGRAPH
                                   15 END-OF-PERIOD ORDINATES
          21.      43.      38.      27.      18.      12.       9.       6.       4.       3.
           2.       1.       1.       1.       0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB280

  TOTAL RAINFALL =   2.77, TOTAL LOSS =   1.02, TOTAL EXCESS =   1.75

 PEAK FLOW    TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     16.58-HR
+  (CFS)      (HR)
                         (CFS)
+    50.      1.25                 4.          2.          2.          2.
                       (INCHES)  1.743       1.743       1.743       1.743
                        (AC-FT)    2.          2.          2.          2.

                       CUMULATIVE AREA =    .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 428 KK   *   SUM281   *          COMBINE HG FROM RCH281, SUB270 & SUB280
          *            *
          **************
                                 INFLOW INTO DETENTION BASIN 281

 430 HC        HYDROGRAPH COMBINATION
                     ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUM281

 PEAK FLOW    TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     16.58-HR
+  (CFS)      (HR)
                         (CFS)
+  1298.      2.08                303.        116.        116.        116.
                       (INCHES)  1.323       1.405       1.405       1.405
                        (AC-FT)  150.        159.        159.        159.

                       CUMULATIVE AREA =   2.13 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 431 KK   *   DET281   *          ROUTE HG SUM281 THRU DET BASIN 281; Wb = 100'; L  = 800'
          *            *
          **************
                                 100-FOOT WIER USED FOR HIGH FLOWS AND 4-48" CMP

 433 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

 434 RS        STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       STOR  TYPE OF INITIAL CONDITION
                    RSVRIC        .00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

 435 SV          STORAGE         .0       4.1       9.1      15.0
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436 SE          ELEVATION      100.00    102.00    104.00    106.00

437 SL          LOW-LEVEL OUTLET
                     ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
                     CAREA       50.30  CROSS-SECTIONAL AREA
                      COQL        .37  COEFFICIENT
                      EXPL        .50  EXPONENT OF HEAD

438 SS          SPILLWAY
                      CREL      103.50  SPILLWAY CREST ELEVATION
                     SPWID      100.00  SPILLWAY WIDTH
                      COQW        2.60  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	258.33	243.93	231.06	219.47	208.99	199.47	190.77	182.81
ELEVATION	100.00	102.00	105.00	104.67	104.40	104.16	103.96	103.79	103.63	103.50
OUTFLOW	195.10	216.64	254.22	312.10	394.56	505.88	650.36	832.34	1056.18	1326.26
ELEVATION	103.59	103.69	103.84	104.03	104.25	104.52	104.83	105.18	105.57	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	4.11	9.11	12.04	12.58	13.72	14.99
OUTFLOW	.00	.00	303.01	733.81	832.34	1056.18	1326.26
ELEVATION	100.00	102.00	104.00	105.00	105.18	105.57	106.00

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HYDROGRAPH AT STATION DET281

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	66.	5.2	102.4	*	1		1110	135	9.	4.3	102.1
1		0005	2	0.	.0	100.0	*	1		0540	69	64.	5.2	102.4	*	1		1115	136	9.	4.3	102.1
1		0010	3	0.	.0	100.0	*	1		0545	70	63.	5.2	102.4	*	1		1120	137	9.	4.3	102.1
1		0015	4	0.	.0	100.0	*	1		0550	71	62.	5.1	102.4	*	1		1125	138	8.	4.2	102.1
1		0020	5	0.	.0	100.0	*	1		0555	72	61.	5.1	102.4	*	1		1130	139	8.	4.2	102.1
1		0025	6	0.	.0	100.0	*	1		0600	73	60.	5.1	102.4	*	1		1135	140	8.	4.2	102.1
1		0030	7	0.	.1	100.0	*	1		0605	74	58.	5.1	102.4	*	1		1140	141	8.	4.2	102.1
1		0035	8	0.	.1	100.0	*	1		0610	75	57.	5.1	102.4	*	1		1145	142	7.	4.2	102.0
1		0040	9	0.	.1	100.1	*	1		0615	76	56.	5.0	102.4	*	1		1150	143	7.	4.2	102.0
1		0045	10	0.	.1	100.1	*	1		0620	77	55.	5.0	102.4	*	1		1155	144	7.	4.2	102.0
1		0050	11	0.	.2	100.1	*	1		0625	78	54.	5.0	102.4	*	1		1200	145	7.	4.2	102.0
1		0055	12	0.	.3	100.1	*	1		0630	79	53.	5.0	102.3	*	1		1205	146	6.	4.2	102.0
1		0100	13	0.	.4	100.2	*	1		0635	80	52.	5.0	102.3	*	1		1210	147	6.	4.2	102.0
1		0105	14	0.	.7	100.3	*	1		0640	81	50.	4.9	102.3	*	1		1215	148	6.	4.2	102.0
1		0110	15	0.	1.3	100.6	*	1		0645	82	49.	4.9	102.3	*	1		1220	149	6.	4.2	102.0
1		0115	16	0.	2.2	101.1	*	1		0650	83	48.	4.9	102.3	*	1		1225	150	6.	4.2	102.0
1		0120	17	0.	3.6	101.8	*	1		0655	84	46.	4.9	102.3	*	1		1230	151	5.	4.2	102.0
1		0125	18	76.	5.4	102.5	*	1		0700	85	45.	4.8	102.3	*	1		1235	152	5.	4.2	102.0
1		0130	19	175.	7.0	103.2	*	1		0705	86	43.	4.8	102.3	*	1		1240	153	5.	4.2	102.0
1		0135	20	263.	8.5	103.7	*	1		0710	87	42.	4.8	102.3	*	1		1245	154	5.	4.2	102.0
1		0140	21	383.	9.7	104.2	*	1		0715	88	41.	4.8	102.3	*	1		1250	155	5.	4.2	102.0
1		0145	22	530.	10.7	104.5	*	1		0720	89	40.	4.8	102.3	*	1		1255	156	5.	4.2	102.0
1		0150	23	695.	11.8	104.9	*	1		0725	90	38.	4.7	102.3	*	1		1300	157	5.	4.2	102.0
1		0155	24	926.	13.1	105.3	*	1		0730	91	37.	4.7	102.2	*	1		1305	158	4.	4.2	102.0
1		0200	25	1140.	14.1	105.7	*	1		0735	92	36.	4.7	102.2	*	1		1310	159	4.	4.2	102.0
1		0205	26	1257.	14.7	105.9	*	1		0740	93	35.	4.7	102.2	*	1		1315	160	4.	4.2	102.0
1		0210	27	1275.	14.7	105.9	*	1		0745	94	34.	4.7	102.2	*	1		1320	161	4.	4.2	102.0
1		0215	28	1226.	14.5	105.8	*	1		0750	95	33.	4.7	102.2	*	1		1325	162	4.	4.2	102.0
1		0220	29	1141.	14.1	105.7	*	1		0755	96	32.	4.6	102.2	*	1		1330	163	4.	4.2	102.0
1		0225	30	1044.	13.7	105.5	*	1		0800	97	31.	4.6	102.2	*	1		1335	164	4.	4.2	102.0
1		0230	31	949.	13.2	105.4	*	1		0805	98	30.	4.6	102.2	*	1		1340	165	4.	4.2	102.0
1		0235	32	856.	12.7	105.2	*	1		0810	99	29.	4.6	102.2	*	1		1345	166	3.	4.2	102.0
1		0240	33	774.	12.3	105.1	*	1		0815	100	28.	4.6	102.2	*	1		1350	167	3.	4.2	102.0
1		0245	34	703.	11.8	104.9	*	1		0820	101	27.	4.6	102.2	*	1		1355	168	3.	4.2	102.0
1		0250	35	638.	11.4	104.8	*	1		0825	102	27.	4.5	102.2	*	1		1400	169	3.	4.2	102.0
1		0255	36	574.	11.0	104.6	*	1		0830	103	26.	4.5	102.2	*	1		1405	170	3.	4.2	102.0
1		0300	37	511.	10.5	104.5	*	1		0835	104	25.	4.5	102.2	*	1		1410	171	3.	4.2	102.0
1		0305	38	449.	10.1	104.3	*	1		0840	105	24.	4.5	102.2	*	1		1415	172	3.	4.2	102.0
1		0310	39	391.	9.7	104.2	*	1		0845	106	23.	4.5	102.2	*	1		1420	173	3.	4.2	102.0
1		0315	40	341.	9.4	104.1	*	1		0850	107	23.	4.5	102.1	*	1		1425	174	3.	4.2	102.0

1	0320	41	302.	9.1	104.0	*	1	0855	108	22.	4.5	102.1	*	1	1430	175	3.	4.2	102.0
1	0325	42	286.	8.8	103.9	*	1	0900	109	21.	4.5	102.1	*	1	1435	176	2.	4.2	102.0
1	0330	43	267.	8.5	103.8	*	1	0905	110	21.	4.4	102.1	*	1	1440	177	2.	4.1	102.0
1	0335	44	248.	8.2	103.6	*	1	0910	111	20.	4.4	102.1	*	1	1445	178	2.	4.1	102.0
1	0340	45	229.	7.9	103.5	*	1	0915	112	19.	4.4	102.1	*	1	1450	179	2.	4.1	102.0
1	0345	46	211.	7.6	103.4	*	1	0920	113	19.	4.4	102.1	*	1	1455	180	2.	4.1	[illegible]
1	0350	47	195.	7.3	103.3	*	1	0925	114	18.	4.4	102.1	*	1	1500	181	2.	4.1	[illegible]
1	0355	48	180.	7.1	103.2	*	1	0930	115	18.	4.4	102.1	*	1	1505	182	2.	4.1	102.0
1	0400	49	166.	6.9	103.1	*	1	0935	116	17.	4.4	102.1	*	1	1510	183	2.	4.1	102.0
1	0405	50	154.	6.7	103.0	*	1	0940	117	17.	4.4	102.1	*	1	1515	184	2.	4.1	102.0
1	0410	51	144.	6.5	102.9	*	1	0945	118	16.	4.4	102.1	*	1	1520	185	2.	4.1	102.0
1	0415	52	134.	6.3	102.9	*	1	0950	119	16.	4.4	102.1	*	1	1525	186	2.	4.1	102.0
1	0420	53	126.	6.2	102.8	*	1	0955	120	15.	4.4	102.1	*	1	1530	187	2.	4.1	102.0
1	0425	54	118.	6.1	102.8	*	1	1000	121	15.	4.4	102.1	*	1	1535	188	2.	4.1	102.0
1	0430	55	112.	6.0	102.7	*	1	1005	122	14.	4.3	102.1	*	1	1540	189	2.	4.1	102.0
1	0435	56	106.	5.9	102.7	*	1	1010	123	14.	4.3	102.1	*	1	1545	190	2.	4.1	102.0
1	0440	57	101.	5.8	102.7	*	1	1015	124	13.	4.3	102.1	*	1	1550	191	1.	4.1	102.0
1	0445	58	96.	5.7	102.6	*	1	1020	125	13.	4.3	102.1	*	1	1555	192	1.	4.1	102.0
1	0450	59	92.	5.6	102.6	*	1	1025	126	12.	4.3	102.1	*	1	1600	193	1.	4.1	102.0
1	0455	60	88.	5.6	102.6	*	1	1030	127	12.	4.3	102.1	*	1	1605	194	1.	4.1	102.0
1	0500	61	84.	5.5	102.6	*	1	1035	128	12.	4.3	102.1	*	1	1610	195	1.	4.1	102.0
1	0505	62	80.	5.4	102.5	*	1	1040	129	11.	4.3	102.1	*	1	1615	196	1.	4.1	102.0
1	0510	63	77.	5.4	102.5	*	1	1045	130	11.	4.3	102.1	*	1	1620	197	1.	4.1	102.0
1	0515	64	74.	5.3	102.5	*	1	1050	131	11.	4.3	102.1	*	1	1625	198	1.	4.1	102.0
1	0520	65	72.	5.3	102.5	*	1	1055	132	10.	4.3	102.1	*	1	1630	199	1.	4.1	102.0
1	0525	66	69.	5.3	102.5	*	1	1100	133	10.	4.3	102.1	*	1	1635	200	1.	4.1	102.0
1	0530	67	68.	5.2	102.4	*	1	1105	134	10.	4.3	102.1	*						
						*							*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1275.	2.17		296.	113.	113.	113.
		(INCHES)	1.294	1.368	1.368	1.368
		(AC-FT)	147.	155.	155.	155.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
15.	2.17	8.	5.	5.	5.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
105.92	2.17	103.35	102.39	102.39	102.39

CUMULATIVE AREA = 2.13 SQ MI

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              **************
              *            *
439 KK        *   RCH441   *          ROUTE HG DET281 THRU REACH 441 (WEST)
              *            *
              **************

                 HYDROGRAPH ROUTING DATA

440 RS             STORAGE ROUTING
                        NSTPS          1  NUMBER OF SUBREACHES
                         ITYP       FLOW  TYPE OF INITIAL CONDITION
                        RSVRIC      -1.00  INITIAL CONDITION
                             X        .00 WORKING R AND D COEFFICIENT

441 RC             NORMAL DEPTH CHANNEL
                          ANL       .030  LEFT OVERBANK N-VALUE
                         ANCH       .025  MAIN CHANNEL N-VALUE
                          ANR       .030  RIGHT OVERBANK N-VALUE
                        RLNTH       580.  REACH LENGTH
                          SEL      .0040  ENERGY SLOPE
                        ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
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443 RY        ELEVATION    100.00     98.00     98.00     95.00     95.00     98.00     98.00    100.00
442 RX        DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .04       .08       .14       .20       .27       .34       .43       .52       .61
          OUTFLOW        .00      4.22     13.98     28.75     48.62     73.83    104.67    141.44    184.46    234.04
        ELEVATION      95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

          STORAGE        .72       .83      1.04      1.32      1.61      1.91      2.22      2.54      2.88      3.22
          OUTFLOW     290.48    354.11    440.90    561.22    703.83    866.93   1049.64   1251.52   1472.31   1711.92
        ELEVATION      97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       29. TO     1712.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   RCH441

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+   1277.      2.17                 296.        113.        113.        113.
                        (INCHES)   1.294       1.368       1.368       1.368
                         (AC-FT)    147.        155.        155.        155.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
       3.      2.17                   1.          0.          0.          0.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
   (FEET)      (HR)
   99.50       2.17                 97.13       95.99       95.99       95.99

                        CUMULATIVE AREA =    2.13 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 444 KK     *   SUB290   *            RUNOFF HG FROM SUB-BASIN 290
            *            *
            **************
                                 ************ BEGIN NEW BRANCH *************

              SUBBASIN RUNOFF DATA

 446 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .02  SUBBASIN AREA

                PRECIPITATION DATA

  72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI           INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

 447 LG         GREEN AND AMPT LOSS RATE
                      STRTL         .22  STARTING LOSS
                        DTH         .29  MOISTURE DEFICIT
                       PSIF        2.65  WETTING FRONT SUCTION
                      XKSAT        1.10  HYDRAULIC CONDUCTIVITY
                      RTIMP       10.00  PERCENT IMPERVIOUS AREA

 448 UC         CLARK UNITGRAPH
                         TC         .40  TIME OF CONCENTRATION
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                    R          .44  STORAGE COEFFICIENT

449 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                   .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                100.0

                                                  ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .40 HR,       R=   .44 HR
                                       SNYDER   TP=   .26 HR,      CP=   .39

                                              UNIT HYDROGRAPH
                                        30 END-OF-PERIOD ORDINATES
            2.       11.       19.       20.       18.       16.       13.       11.        9.        7.
            6.        5.        4.        3.        3.        2.        2.        2.        1.        1.
            1.        1.        1.        1.        0.        0.        0.        0.        0.        0.

    ***           ***           ***           ***           ***

                    HYDROGRAPH AT STATION   SUB290

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     21.      1.42                 3.          1.          1.          1.
                       (INCHES)   1.175       1.175       1.175       1.175
                        (AC-FT)      1.          1.          1.          1.

                       CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
451 KK    *   SUB300   *          RUNOFF HG FROM SUB-BASIN 300
          *            *
          **************

             SUBBASIN RUNOFF DATA

452 BA         SUBBASIN CHARACTERISTICS
                     TAREA         .02  SUBBASIN AREA

               PRECIPITATION DATA

 72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI           INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

453 LG         GREEN AND AMPT LOSS RATE
                     STRTL         .15  STARTING LOSS
                       DTH         .28  MOISTURE DEFICIT
                      PSIF        3.40  WETTING FRONT SUCTION
                     XKSAT         .80  HYDRAULIC CONDUCTIVITY
                     RTIMP       37.00  PERCENT IMPERVIOUS AREA

454 UC         CLARK UNITGRAPH
                        TC         .17  TIME OF CONCENTRATION
                         R         .21  STORAGE COEFFICIENT

455 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                   .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                100.0

                                                  ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .17 HR,       R=   .21 HR
                                       SNYDER   TP=   .14 HR,      CP=   .45
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                                        UNIT HYDROGRAPH
                                    15 END-OF-PERIOD ORDINATES
          21.      41.      33.      22.      15.      10.       7.       5.       3.       2.
           1.       1.       1.       0.       0.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUB300

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     45.      1.25                 4.          1.          1.          1.
                       (INCHES)   1.745       1.745       1.745       1.745
                        (AC-FT)     2.          2.          2.          2.

                      CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 457 KK   *   SUM301   *            COMBINE HG FROM SUB290 & SUB300
          *            *
          **************
                                    INFLOW INTO DETENTION BASIN 301

 459 HC         HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUM301

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     61.      1.25                 7.          2.          2.          2.
                       (INCHES)   1.460       1.460       1.460       1.460
                        (AC-FT)     3.          3.          3.          3.

                      CUMULATIVE AREA =     .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 460 KK   *   DET301   *            ROUTE HG SUM301 THRU DET BASIN 301; Wb = 100'; L  = 200'
          *            *
          **************
                                    100-FOOT WIER USED FOR HIGH FLOWS AND 1-18" CMP

 462 KO         OUTPUT CONTROL VARIABLES
                      IPRNT          1  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

 463 RS         STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC        .00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT
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464 SV          STORAGE          .0       1.0       2.3       3.8

465 SE        ELEVATION       100.00    102.00    104.00    106.00

466 SL        LOW-LEVEL OUTLET
                   ELEVL       102.00  ELEVATION AT CENTER OF OUTLET
                   CAREA         1.80  CROSS-SECTIONAL AREA
                    COQL          .37  COEFFICIENT
                    EXPL          .50  EXPONENT OF HEAD

467 SS        SPILLWAY
                    CREL       105.90  SPILLWAY CREST ELEVATION
                   SPWID       100.00  SPILLWAY WIDTH
                    COQW         2.60  WEIR COEFFICIENT
                    EXPW         1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	4.62	5.02	5.50	6.08	6.80	7.72	8.91	10.55
ELEVATION	100.00	102.00	102.75	102.88	103.06	103.30	103.62	104.09	104.78	105.90
OUTFLOW	10.56	10.63	10.80	11.12	11.64	12.41	13.47	14.88	16.67	18.90
ELEVATION	105.90	105.90	105.91	105.92	105.93	105.94	105.95	105.96	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.03	1.50	1.58	1.69	1.84	2.04	2.28	2.34	2.86
OUTFLOW	.00	.00	4.62	5.02	5.50	6.08	6.80	7.55	7.72	8.91
ELEVATION	100.00	102.00	102.75	102.88	103.06	103.30	103.62	104.00	104.09	104.78
STORAGE	3.68	3.69	3.70	3.71	3.72	3.74	3.75			
OUTFLOW	10.55	11.12	12.41	13.47	14.88	16.67	18.90			
ELEVATION	105.90	105.92	105.94	105.95	105.96	105.98	106.00			

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HYDROGRAPH AT STATION DET301

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	2.	1.2	102.3	*	1		1110	135	0.	1.0	102.0
1		0005	2	0.	.0	100.0	*	1		0540	69	2.	1.2	102.3	*	1		1115	136	0.	1.0	102.0
1		0010	3	0.	.0	100.0	*	1		0545	70	2.	1.2	102.3	*	1		1120	137	0.	1.0	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	1.	1.2	102.2	*	1		1125	138	0.	1.0	102.0
1		0020	5	0.	.0	100.0	*	1		0555	72	1.	1.2	102.2	*	1		1130	139	0.	1.0	102.0
1		0025	6	0.	.0	100.0	*	1		0600	73	1.	1.2	102.2	*	1		1135	140	0.	1.0	102.0
1		0030	7	0.	.0	100.1	*	1		0605	74	1.	1.2	102.2	*	1		1140	141	0.	1.0	102.0
1		0035	8	0.	.0	100.1	*	1		0610	75	1.	1.1	102.2	*	1		1145	142	0.	1.0	102.0
1		0040	9	0.	.1	100.1	*	1		0615	76	1.	1.1	102.2	*	1		1150	143	0.	1.0	102.0
1		0045	10	0.	.1	100.1	*	1		0620	77	1.	1.1	102.2	*	1		1155	144	0.	1.0	102.0
1		0050	11	0.	.1	100.2	*	1		0625	78	1.	1.1	102.1	*	1		1200	145	0.	1.0	102.0
1		0055	12	0.	.1	100.3	*	1		0630	79	1.	1.1	102.1	*	1		1205	146	0.	1.0	102.0
1		0100	13	0.	.2	100.4	*	1		0635	80	1.	1.1	102.1	*	1		1210	147	0.	1.0	102.0
1		0105	14	0.	.3	100.6	*	1		0640	81	1.	1.1	102.1	*	1		1215	148	0.	1.0	102.0
1		0110	15	0.	.6	101.1	*	1		0645	82	1.	1.1	102.1	*	1		1220	149	0.	1.0	102.0
1		0115	16	0.	1.0	101.9	*	1		0650	83	1.	1.1	102.1	*	1		1225	150	0.	1.0	102.0
1		0120	17	3.	1.4	102.6	*	1		0655	84	1.	1.1	102.1	*	1		1230	151	0.	1.0	102.0
1		0125	18	6.	1.7	103.1	*	1		0700	85	1.	1.1	102.1	*	1		1235	152	0.	1.0	102.0
1		0130	19	7.	2.0	103.6	*	1		0705	86	1.	1.1	102.1	*	1		1240	153	0.	1.0	102.0
1		0135	20	7.	2.2	103.9	*	1		0710	87	0.	1.1	102.1	*	1		1245	154	0.	1.0	102.0
1		0140	21	8.	2.3	104.1	*	1		0715	88	0.	1.1	102.1	*	1		1250	155	0.	1.0	102.0
1		0145	22	8.	2.4	104.2	*	1		0720	89	0.	1.1	102.1	*	1		1255	156	0.	1.0	102.0
1		0150	23	8.	2.5	104.3	*	1		0725	90	0.	1.1	102.1	*	1		1300	157	0.	1.0	102.0
1		0155	24	8.	2.5	104.4	*	1		0730	91	0.	1.1	102.1	*	1		1305	158	0.	1.0	102.0
1		0200	25	8.	2.6	104.4	*	1		0735	92	0.	1.1	102.1	*	1		1310	159	0.	1.0	102.0
1		0205	26	8.	2.6	104.4	*	1		0740	93	0.	1.1	102.1	*	1		1315	160	0.	1.0	102.0
1		0210	27	8.	2.6	104.4	*	1		0745	94	0.	1.1	102.1	*	1		1320	161	0.	1.0	102.0
1		0215	28	8.	2.5	104.4	*	1		0750	95	0.	1.1	102.0	*	1		1325	162	0.	1.0	102.0
1		0220	29	8.	2.5	104.3	*	1		0755	96	0.	1.1	102.0	*	1		1330	163	0.	1.0	10[illegible]
1		0225	30	8.	2.5	104.3	*	1		0800	97	0.	1.1	102.0	*	1		1335	164	0.	1.0	10[illegible]
1		0230	31	8.	2.5	104.2	*	1		0805	98	0.	1.1	102.0	*	1		1340	165	0.	1.0	102.0
1		0235	32.	8.	2.4	104.2	*	1		0810	99	0.	1.1	102.0	*	1		1345	166	0.	1.0	102.0
1		0240	33	8.	2.4	104.1	*	1		0815	100	0.	1.1	102.0	*	1		1350	167	0.	1.0	102.0
1		0245	34	8.	2.3	104.1	*	1		0820	101	0.	1.0	102.0	*	1		1355	168	0.	1.0	102.0
1		0250	35	8.	2.3	104.0	*	1		0825	102	0.	1.0	102.0	*	1		1400	169	0.	1.0	102.0

1	0255	36	7.	2.2	103.9 *	1	0830	103	0.	1.0	102.0 *	1	1405	170	0.	1.0	102.0
1	0300	37	7.	2.2	103.9 *	1	0835	104	0.	1.0	102.0 *	1	1410	171	0.	1.0	102.0
1	0305	38	7.	2.1	103.8 *	1	0840	105	0.	1.0	102.0 *	1	1415	172	0.	1.0	102.0
1	0310	39	7.	2.1	103.7 *	1	0845	106	0.	1.0	102.0 *	1	1420	173	0.	1.0	102.0
1	0315	40	7.	2.1	103.6 *	1	0850	107	0.	1.0	102.0 *	1	1425	174	0.	1.0	102.0
1	0320	41	7.	2.0	103.6 *	1	0855	108	0.	1.0	102.0 *	1	1430	175	0.	1.0	102.0
	0325	42	7.	2.0	103.5 *	1	0900	109	0.	1.0	102.0 *	1	1435	176	0.	1.0	102.0
1	0330	43	6.	1.9	103.4 *	1	0905	110	0.	1.0	102.0 *	1	1440	177	0.	1.0	102.0
1	0335	44	6.	1.9	103.4 *	1	0910	111	0.	1.0	102.0 *	1	1445	178	0.	1.0	102.0
1	0340	45	6.	1.8	103.3 *	1	0915	112	0.	1.0	102.0 *	1	1450	179	0.	1.0	102.0
1	0345	46	6.	1.8	103.2 *	1	0920	113	0.	1.0	102.0 *	1	1455	180	0.	1.0	102.0
1	0350	47	6.	1.8	103.2 *	1	0925	114	0.	1.0	102.0 *	1	1500	181	0.	1.0	102.0
1	0355	48	6.	1.7	103.1 *	1	0930	115	0.	1.0	102.0 *	1	1505	182	0.	1.0	102.0
1	0400	49	5.	1.7	103.0 *	1	0935	116	0.	1.0	102.0 *	1	1510	183	0.	1.0	102.0
1	0405	50	5.	1.6	103.0 *	1	0940	117	0.	1.0	102.0 *	1	1515	184	0.	1.0	102.0
1	0410	51	5.	1.6	102.9 *	1	0945	118	0.	1.0	102.0 *	1	1520	185	0.	1.0	102.0
1	0415	52	5.	1.6	102.9 *	1	0950	119	0.	1.0	102.0 *	1	1525	186	0.	1.0	102.0
1	0420	53	5.	1.5	102.8 *	1	0955	120	0.	1.0	102.0 *	1	1530	187	0.	1.0	102.0
1	0425	54	5.	1.5	102.8 *	1	1000	121	0.	1.0	102.0 *	1	1535	188	0.	1.0	102.0
1	0430	55	4.	1.5	102.7 *	1	1005	122	0.	1.0	102.0 *	1	1540	189	0.	1.0	102.0
1	0435	56	4.	1.4	102.7 *	1	1010	123	0.	1.0	102.0 *	1	1545	190	0.	1.0	102.0
1	0440	57	4.	1.4	102.6 *	1	1015	124	0.	1.0	102.0 *	1	1550	191	0.	1.0	102.0
1	0445	58	4.	1.4	102.6 *	1	1020	125	0.	1.0	102.0 *	1	1555	192	0.	1.0	102.0
1	0450	59	3.	1.4	102.5 *	1	1025	126	0.	1.0	102.0 *	1	1600	193	0.	1.0	102.0
1	0455	60	3.	1.3	102.5 *	1	1030	127	0.	1.0	102.0 *	1	1605	194	0.	1.0	102.0
1	0500	61	3.	1.3	102.5 *	1	1035	128	0.	1.0	102.0 *	1	1610	195	0.	1.0	102.0
1	0505	62	3.	1.3	102.4 *	1	1040	129	0.	1.0	102.0 *	1	1615	196	0.	1.0	102.0
1	0510	63	3.	1.3	102.4 *	1	1045	130	0.	1.0	102.0 *	1	1620	197	0.	1.0	102.0
1	0515	64	2.	1.3	102.4 *	1	1050	131	0.	1.0	102.0 *	1	1625	198	0.	1.0	102.0
1	0520	65	2.	1.3	102.4 *	1	1055	132	0.	1.0	102.0 *	1	1630	199	0.	1.0	102.0
1	0525	66	2.	1.2	102.3 *	1	1100	133	0.	1.0	102.0 *	1	1635	200	0.	1.0	102.0
1	0530	67	2.	1.2	102.3 *	1	1105	134	0.	1.0	102.0 *						
					*						*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
8.	2.08		4.	2.	2.	2.
		(INCHES)	.979	1.000	1.000	1.000
		(AC-FT)	2.	2.	2.	2.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
3.	2.08	2.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
104.40	2.08	103.02	102.24	102.24	102.24

CUMULATIVE AREA = .04 SQ MI

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              *            *
468 KK        *    RCH349  *          ROUTE HG DET301 THRU REACH 349 (WEST)
              *            *
              **************

                 HYDROGRAPH ROUTING DATA

469 RS             STORAGE ROUTING
                        NSTPS          1  NUMBER OF SUBREACHES
                         ITYP       FLOW  TYPE OF INITIAL CONDITION
                        RSVRIC      -1.00  INITIAL CONDITION
                             X        .00 WORKING R AND D COEFFICIENT

470 RC             NORMAL DEPTH CHANNEL
                          ANL       .030  LEFT OVERBANK N-VALUE
                         ANCH       .025  MAIN CHANNEL N-VALUE
                          ANR       .030  RIGHT OVERBANK N-VALUE
                        RLNTH      1800.  REACH LENGTH
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                    SEL        .0040  ENERGY SLOPE
                  ELMAX           .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
472 RY      ELEVATION   100.00    99.00    99.00    96.00    96.00    99.00    99.00   100.00
471 RX      DISTANCE    500.00   508.00   508.00   520.00   530.00   542.00   542.00   550.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00      .09      .20      .33      .47      .62      .79      .97     1.16     1.38
          OUTFLOW        .00     2.89     9.47    19.29    32.31    48.62    68.35    91.64   118.65   149.53
        ELEVATION      96.00    96.21    96.42    96.63    96.84    97.05    97.26    97.47    97.68    97.89

          STORAGE       1.60     1.84     2.10     2.37     2.65     2.96     3.29     3.65     4.04     4.46
          OUTFLOW     184.46   223.58   267.05   315.04   367.71   434.87   510.93   593.28   682.35   778.52
        ELEVATION      98.11    98.32    98.53    98.74    98.95    99.16    99.37    99.58    99.79   100.00

    ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   RCH349

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                          (CFS)
+      8.      2.42                4.          2.          2.          2.
                        (INCHES)   .971       1.000       1.000       1.000
                         (AC-FT)     2.          2.          2.          2.

 PEAK STORAGE  TIME                       MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
      0.       2.25                0.          0.          0.          0.

 PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    96.38      2.42               96.24      96.09       96.09       96.09

                       CUMULATIVE AREA =     .04 SQ MI


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          *            *
473 KK    *   SUB310   *            RUNOFF HG FROM SUB-BASIN 310
          *            *
          **************

            SUBBASIN RUNOFF DATA

474 BA        SUBBASIN CHARACTERISTICS
                   TAREA         .03  SUBBASIN AREA

              PRECIPITATION DATA

 72 PB              STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI          INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

475 LG        GREEN AND AMPT LOSS RATE
                   STRTL        .22  STARTING LOSS
                     DTH        .29  MOISTURE DEFICIT
                    PSIF       2.65  WETTING FRONT SUCTION
                   XKSAT       1.10  HYDRAULIC CONDUCTIVITY
                   RTIMP      10.00  PERCENT IMPERVIOUS AREA

476 UC        CLARK UNITGRAPH
                      TC        .60  TIME OF CONCENTRATION
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                    R          .73  STORAGE COEFFICIENT

477 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
               100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .60 HR,       R=   .73 HR
                                    SNYDER   TP=   .41 HR,      CP=   .38

                                          UNIT HYDROGRAPH
                                     50 END-OF-PERIOD ORDINATES
             1.       4.      10.      15.      16.      16.      15.      14.      13.      11.
            10.       9.       8.       7.       6.       6.       5.       5.       4.       4.
             3.       3.       3.       2.       2.       2.       2.       1.       1.       1.
             1.       1.       1.       1.       1.       1.       1.       0.       0.       0.
             0.       0.       0.       0.       0.       0.       0.       0.       0.       0.

    ***          ***          ***          ***          ***

                 HYDROGRAPH AT STATION   SUB310

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     18.      1.50                 3.          1.          1.          1.
                        (INCHES)  1.175       1.175       1.175       1.175
                         (AC-FT)    2.          2.          2.          2.

                        CUMULATIVE AREA =     .03 SQ MI


** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
479 KK    *   SUB320   *          RUNOFF HG FROM SUB-BASIN 320
          *            *
          **************

             SUBBASIN RUNOFF DATA

480 BA        SUBBASIN CHARACTERISTICS
                   TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 72 PB             STORM         2.77  BASIN TOTAL PRECIPITATION

 73 PI          INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

481 LG        GREEN AND AMPT LOSS RATE
                   STRTL         .15  STARTING LOSS
                     DTH         .28  MOISTURE DEFICIT
                    PSIF        3.40  WETTING FRONT SUCTION
                   XKSAT         .80  HYDRAULIC CONDUCTIVITY
                   RTIMP       37.00  PERCENT IMPERVIOUS AREA

482 UC        CLARK UNITGRAPH
                      TC         .22  TIME OF CONCENTRATION
                       R         .34  STORAGE COEFFICIENT

483 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
               100.0

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                                          UNIT HYDROGRAPH PARAMETERS
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                                        CLARK   TC=   .22 HR,       R=   .34 HR
                                       SNYDER   TP=   .17 HR,      CP=   .36

                                                UNIT HYDROGRAPH
                                            23 END-OF-PERIOD ORDINATES
              7.       18.       19.       16.       12.       10.        8.        6.        5.        4.
              3.        2.        2.        1.        1.        1.        1.        1.        0.        0.
              0.        0.        0.

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   SUB320

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     24.       1.33                   3.          1.          1.          1.
                        (INCHES)     1.743       1.743       1.743       1.743
                         (AC-FT)       1.          1.          1.          1.

                        CUMULATIVE AREA =     .01 SQ MI


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            *            *
  485 KK    *   SUB330   *            RUNOFF HG FROM SUB-BASIN 330
            *            *
            **************

               SUBBASIN RUNOFF DATA

  486 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .03  SUBBASIN AREA

                 PRECIPITATION DATA

   72 PB              STORM        2.77  BASIN TOTAL PRECIPITATION

   73 PI            INCREMENTAL PRECIPITATION PATTERN
                       .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                       .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                       .01       .00       .01       .01

  487 LG         GREEN AND AMPT LOSS RATE
                      STRTL         .25  STARTING LOSS
                        DTH         .30  MOISTURE DEFICIT
                       PSIF        2.40  WETTING FRONT SUCTION
                      XKSAT        1.20  HYDRAULIC CONDUCTIVITY
                      RTIMP        1.00  PERCENT IMPERVIOUS AREA

  488 UC         CLARK UNITGRAPH
                         TC         .53  TIME OF CONCENTRATION
                          R        1.47  STORAGE COEFFICIENT

  489 UA         ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .53 HR,       R=  1.47 HR
                                       SNYDER   TP=   .47 HR,      CP=   .26

                                                UNIT HYDROGRAPH
                                            97 END-OF-PERIOD ORDINATES
              1.        3.        6.        9.        9.       10.        9.        9.        8.        8.
              8.        7.        7.        6.        6.        6.        5.        5.        5.        5.
              4.        4.        4.        4.        3.        3.        3.        3.        3.        3.
              2.        2.        2.        2.        2.        2.        2.        2.        2.        1.
              1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
              1.        1.        1.        1.        1.        1.        1.        1.        0.        0.
```

```
          0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
          0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
          0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
          0.       0.       0.       0.       0.       0.       0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB330

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.79, TOTAL EXCESS =     .98

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+      9.      1.58                 3.          1.          1.          1.
                        (INCHES)    .962        .978        .978        .978
                         (AC-FT)     1.          1.          1.          1.

                        CUMULATIVE AREA =     .03 SQ MI


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          *            *
 491 KK   *     SUBC   *          RUNOFF HG FROM SUB-BASIN C
          *            *
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            SUBBASIN RUNOFF DATA

 492 BA       SUBBASIN CHARACTERISTICS
                   TAREA          .19  SUBBASIN AREA

              PRECIPITATION DATA

  72 PB            STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI         INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

 493 LG       GREEN AND AMPT LOSS RATE
                   STRTL          .25  STARTING LOSS
                     DTH          .25  MOISTURE DEFICIT
                    PSIF         6.05  WETTING FRONT SUCTION
                   XKSAT          .20  HYDRAULIC CONDUCTIVITY
                   RTIMP         1.00  PERCENT IMPERVIOUS AREA

 494 UC       CLARK UNITGRAPH
                      TC          .70  TIME OF CONCENTRATION
                       R          .51  STORAGE COEFFICIENT

 495 UA       ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                     .0       3.0       5.0       8.0      12.0      20.0      43.0      75.0      90.0      96.0
                  100.0

                                                  ***

                                              UNIT HYDROGRAPH PARAMETERS
                                       CLARK   TC=   .70 HR,       R=   .51 HR
                                      SNYDER   TP=   .59 HR,      CP=   .73

                                                UNIT HYDROGRAPH
                                           38 END-OF-PERIOD ORDINATES
          4.       10.       17.       28.       60.      118.      158.      158.      143.      124.
        105.       89.       75.       64.       54.       46.       39.       33.       28.       24.
         20.       17.       15.       12.       10.        9.        8.        6.        5.        5.
          4.        3.        3.        2.        2.        2.        1.        1.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION     SUBC

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.14, TOTAL EXCESS =    1.63
```

```
 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    230.      1.75                  34.         12.         12.         12.
                        (INCHES)    1.619       1.619       1.619       1.619
                         (AC-FT)     17.         17.         17.         17.

                        CUMULATIVE AREA =     .19 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 497 KK     *   SUM337   *            COMBINE HG FROM SUB330 & SUBC
            *            *
            **************

 498 HC         HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   SUM337

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    239.      1.67                  37.         13.         13.         13.
                        (INCHES)    1.538       1.541       1.541       1.541
                         (AC-FT)     18.         18.         18.         18.

                        CUMULATIVE AREA =     .22 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 499 KK     *   RCH347   *            ROUTE HG SUM337 THRU REACH 347
            *            *
            **************

            HYDROGRAPH ROUTING DATA

 500 RS         STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        FLOW  TYPE OF INITIAL CONDITION
                     RSVRIC       -1.00  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 501 RC         NORMAL DEPTH CHANNEL
                        ANL        .030  LEFT OVERBANK N-VALUE
                       ANCH        .025  MAIN CHANNEL N-VALUE
                        ANR        .030  RIGHT OVERBANK N-VALUE
                      RLNTH       2020.  REACH LENGTH
                        SEL       .0040  ENERGY SLOPE
                      ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 503 RY       ELEVATION    100.00     98.00     98.00     95.00     95.00     98.00     98.00    100.00
 502 RX       DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00

                                                          ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .13       .30       .48       .69       .93      1.19      1.48      1.80      2.14
```

OUTFLOW	.00	4.22	13.98	28.75	48.62	73.83	104.67	141.44	184.46	234.04
ELEVATION	95.00	95.26	95.53	95.79	96.05	96.32	96.58	96.84	97.11	97.37
STORAGE	2.50	2.90	3.62	4.59	5.60	6.65	7.73	8.86	10.02	11.22
OUTFLOW	290.48	354.11	440.90	561.22	703.83	866.93	1049.64	1251.52	1472.31	1711.92
ELEVATION	97.63	97.89	98.16	98.42	98.68	98.95	99.21	99.47	99.74	100.00

*** *** *** *** ***

HYDROGRAPH AT STATION RCH347

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 228.	1.83		37.	13.	13.	13.
		(INCHES)	1.538	1.541	1.541	1.541
		(AC-FT)	18.	18.	18.	18.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
2.	1.83	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
97.33	1.83	95.60	95.22	95.22	95.22

CUMULATIVE AREA = .22 SQ MI

*** ***

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              **************
              *            *
 .04 KK       *     SUBD   *          RUNOFF HG FROM SUB-BASIN D
              *            *
              **************
```

SUBBASIN RUNOFF DATA

```
505 BA        SUBBASIN CHARACTERISTICS
                   TAREA        .23  SUBBASIN AREA

              PRECIPITATION DATA

 72 PB             STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI          INCREMENTAL PRECIPITATION PATTERN
                   .01      .01      .01      .01      .00      .01      .03      .03      .04      .04
                   .06      .09      .27      .14      .12      .04      .03      .02      .01      .01
                   .01      .00      .01      .01

506 LG        GREEN AND AMPT LOSS RATE
                   STRTL        .25  STARTING LOSS
                     DTH        .28  MOISTURE DEFICIT
                    PSIF       4.34  WETTING FRONT SUCTION
                   XKSAT        .26  HYDRAULIC CONDUCTIVITY
                   RTIMP       1.00  PERCENT IMPERVIOUS AREA

507 UC        CLARK UNITGRAPH
                      TC        .62  TIME OF CONCENTRATION
                       R        .41  STORAGE COEFFICIENT

508 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
                   100.0
```

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= .62 HR, R= .41 HR

SNYDER TP= .52 HR, CP= .78

UNIT HYDROGRAPH

```
                                        31 END-OF-PERIOD ORDINATES
          6.      16.      27.      58.     135.     210.     221.     195.     163.     133.
        109.      89.      73.      59.      48.      40.      32.      26.      22.      18.
         14.      12.      10.       8.       6.       5.       4.       3.       3.       2.
          2.

  ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION     SUBD

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.19, TOTAL EXCESS =    1.58

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    304.      1.67                38.         14.         14.         14.
                        (INCHES)   1.576       1.576       1.576       1.576
                         (AC-FT)    19.         19.         19.         19.

                        CUMULATIVE AREA =     .23 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 510 KK   *   SUB340   *          RUNOFF HG FROM SUB-BASIN 340
          *            *
          **************

             SUBBASIN RUNOFF DATA

 511 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 512 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .25  STARTING LOSS
                      DTH         .30  MOISTURE DEFICIT
                     PSIF        2.40  WETTING FRONT SUCTION
                    XKSAT        1.20  HYDRAULIC CONDUCTIVITY
                    RTIMP        1.00  PERCENT IMPERVIOUS AREA

 513 UC        CLARK UNITGRAPH
                       TC         .23  TIME OF CONCENTRATION
                        R         .37  STORAGE COEFFICIENT

 514 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                        UNIT HYDROGRAPH PARAMETERS
                                  CLARK   TC=   .23 HR,       R=   .37 HR
                                 SNYDER   TP=   .20 HR,      CP=   .39

                                            UNIT HYDROGRAPH
                                        25 END-OF-PERIOD ORDINATES
          3.       8.      10.       8.       7.       5.       4.       3.       3.       2.
          2.       1.       1.       1.       1.       1.       0.       0.       0.       0.
          0.       0.       0.       0.       0.

  ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB340

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.79, TOTAL EXCESS =     .98
```

```
 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
     8.       1.33                   1.          0.          0.          0.
                         (INCHES)   .978        .978        .978        .978
                          (AC-FT)    0.          0.          0.          0.

                         CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 516 KK     *    SUM347  *            COMBINE HG FROM RCH347, SUBD & SUB340
            *            *
            **************

 517 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   SUM347

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    505.      1.67                  76.         28.         28.         28.
                         (INCHES)  1.546       1.548       1.548       1.548
                          (AC-FT)    38.         38.         38.         38.

                         CUMULATIVE AREA =     .46 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 518 KK     *    RCH349  *            ROUTE HG SUM347 THRU REACH 349 (NORTH); GUNITE CHANNEL
            *            *
            **************

               HYDROGRAPH ROUTING DATA

 519 RK          KINEMATIC WAVE STREAM ROUTING
                            L        440.  CHANNEL LENGTH
                            S       .0070  SLOPE
                            N        .016  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .00  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD       20.00  BOTTOM WIDTH OR DIAMETER
                            Z         .50  SIDE SLOPE
                       NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS

                                                          ***
                                   COMPUTED KINEMATIC PARAMETERS
                                        VARIABLE TIME STEP
                                      (DT SHOWN IS A MINIMUM)

                 ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                  CELERITY
                                                   (MIN)     (FT)     (CFS)    (MIN)       (IN)      (FPS)

                 MAIN         1.31      1.56        .16    146.67    504.97   100.33       1.55     17.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3774E+02  EXCESS= .0000E+00 OUTFLOW= .3774E+02 BASIN STORAGE= .1583E-05 PERCENT ERROR=    .0
```

```
                                    INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN          1.31      1.56      5.00            503.78    105.00      1.55

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   RCH349

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     504.      1.75                 76.         28.         28.         28.
                        (INCHES)    1.548       1.550       1.550       1.550
                         (AC-FT)     38.         38.         38.         38.

                        CUMULATIVE AREA =     .46 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  520 KK    *   SUM349   *            COMBINE HG FROM RCH349 (WEST & NORTH), SUB310 & SUB320
            *            *
            **************
                                      INFLOW INTO DETENTION BASIN 349

  522 HC          HYDROGRAPH COMBINATION
                        ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   SUM349

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     535.      1.67                 87.         31.         31.         31.
                        (INCHES)    1.487       1.494       1.494       1.494
                         (AC-FT)     43.         43.         43.         43.

                        CUMULATIVE AREA =     .54 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  523 KK    *   DET349   *            ROUTE HG SUM349 THRU DET BASIN 349; Wb = 100'; L  = 600'
            *            *
            **************
                                      100-FOOT WIER USED FOR HIGH FLOWS AND 4-48" CMP

  525 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

               HYDROGRAPH ROUTING DATA

  526 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC         .00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

  527 SV            STORAGE          .0       3.1       6.8      11.2
```

```
528 SE          ELEVATION      100.00    102.00    104.00    106.00

529 SL          LOW-LEVEL OUTLET
                     ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
                     CAREA       50.30  CROSS-SECTIONAL AREA
                      COQL        .37  COEFFICIENT
                      EXPL        .50  EXPONENT OF HEAD

530 SS          SPILLWAY
                      CREL      105.00  SPILLWAY CREST ELEVATION
                     SPWID      100.00  SPILLWAY WIDTH
                      COQW        2.60  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD
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***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	272.42	270.35	268.30	266.29	264.31	262.35	260.42	258.53
ELEVATION	100.00	102.00	105.33	105.28	105.23	105.18	105.14	105.09	105.04	105.00
OUTFLOW	262.30	268.32	278.56	294.09	315.99	345.33	383.19	430.63	488.71	558.52
ELEVATION	105.04	105.08	105.14	105.22	105.31	105.41	105.54	105.68	105.83	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	3.09	6.83	9.77	9.95	10.22	10.53	10.87	11.24
OUTFLOW	.00	.00	211.09	321.99	345.33	383.19	430.63	488.71	558.52
ELEVATION	100.00	102.00	104.00	105.33	105.41	105.54	105.68	105.83	106.00

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HYDROGRAPH AT STATION DET349

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	1		0535	68	4.	3.2	102.0	1		1110	135	0.	3.1	102.0
1		0005	2	0.	.0	100.0	1		0540	69	4.	3.2	102.0	1		1115	136	0.	3.1	102.0
1		0010	3	0.	.0	100.0	1		0545	70	4.	3.2	102.0	1		1120	137	0.	3.1	102.0
1		0015	4	0.	.0	100.0	1		0550	71	3.	3.1	102.0	1		1125	138	0.	3.1	102.0
1		0020	5	0.	.0	100.0	1		0555	72	3.	3.1	102.0	1		1130	139	0.	3.1	102.0
1		0025	6	0.	.0	100.0	1		0600	73	3.	3.1	102.0	1		1135	140	0.	3.1	102.0
1		0030	7	0.	.0	100.0	1		0605	74	3.	3.1	102.0	1		1140	141	0.	3.1	102.0
1		0035	8	0.	.0	100.0	1		0610	75	3.	3.1	102.0	1		1145	142	0.	3.1	102.0
1		0040	9	0.	.0	100.0	1		0615	76	2.	3.1	102.0	1		1150	143	0.	3.1	102.0
1		0045	10	0.	.0	100.0	1		0620	77	2.	3.1	102.0	1		1155	144	0.	3.1	102.0
1		0050	11	0.	.1	100.0	1		0625	78	2.	3.1	102.0	1		1200	145	0.	3.1	102.0
1		0055	12	0.	.1	100.1	1		0630	79	2.	3.1	102.0	1		1205	146	0.	3.1	102.0
1		0100	13	0.	.1	100.1	1		0635	80	2.	3.1	102.0	1		1210	147	0.	3.1	102.0
1		0105	14	0.	.2	100.1	1		0640	81	2.	3.1	102.0	1		1215	148	0.	3.1	102.0
1		0110	15	0.	.5	100.3	1		0645	82	2.	3.1	102.0	1		1220	149	0.	3.1	102.0
1		0115	16	0.	1.0	100.6	1		0650	83	2.	3.1	102.0	1		1225	150	0.	3.1	102.0
1		0120	17	0.	1.8	101.1	1		0655	84	2.	3.1	102.0	1		1230	151	0.	3.1	102.0
1		0125	18	3.	3.1	102.0	1		0700	85	1.	3.1	102.0	1		1235	152	0.	3.1	102.0
1		0130	19	104.	4.9	103.0	1		0705	86	1.	3.1	102.0	1		1240	153	0.	3.1	102.0
1		0135	20	209.	6.8	104.0	1		0710	87	1.	3.1	102.0	1		1245	154	0.	3.1	102.0
1		0140	21	278.	8.6	104.8	1		0715	88	1.	3.1	102.0	1		1250	155	0.	3.1	102.0
1		0145	22	364.	10.1	105.5	1		0720	89	1.	3.1	102.0	1		1255	156	0.	3.1	102.0
1		0150	23	470.	10.8	105.8	1		0725	90	1.	3.1	102.0	1		1300	157	0.	3.1	102.0
1		0155	24	469.	10.8	105.8	1		0730	91	1.	3.1	102.0	1		1305	158	0.	3.1	102.0
1		0200	25	427.	10.5	105.7	1		0735	92	1.	3.1	102.0	1		1310	159	0.	3.1	102.0
1		0205	26	378.	10.2	105.5	1		0740	93	1.	3.1	102.0	1		1315	160	0.	3.1	102.0
1		0210	27	331.	9.8	105.4	1		0745	94	1.	3.1	102.0	1		1320	161	0.	3.1	102.0
1		0215	28	309.	9.4	105.2	1		0750	95	1.	3.1	102.0	1		1325	162	0.	3.1	102.0
1		0220	29	288.	8.9	104.9	1		0755	96	1.	3.1	102.0	1		1330	163	0.	3.1	102.0
1		0225	30	265.	8.3	104.6	1		0800	97	1.	3.1	102.0	1		1335	164	0.	3.1	102.0
1		0230	31	241.	7.6	104.4	1		0805	98	1.	3.1	102.0	1		1340	165	0.	3.1	102.0
1		0235	32	217.	7.0	104.1	1		0810	99	1.	3.1	102.0	1		1345	166	0.	3.1	102.0
1		0240	33	186.	6.4	103.8	1		0815	100	1.	3.1	102.0	1		1350	167	0.	3.1	102.0
1		0245	34	158.	5.9	103.5	1		0820	101	1.	3.1	102.0	1		1355	168	0.	3.1	102.0
1		0250	35	135.	5.5	103.3	1		0825	102	0.	3.1	102.0	1		1400	169	0.	3.1	102.0
1		0255	36	115.	5.1	103.1	1		0830	103	0.	3.1	102.0	1		1405	170	0.	3.1	102.0
1		0300	37	99.	4.8	102.9	1		0835	104	0.	3.1	102.0	1		1410	171	0.	3.1	102.0
1		0305	38	85.	4.6	102.8	1		0840	105	0.	3.1	102.0	1		1415	172	0.	3.1	102.0
1		0310	39	73.	4.4	102.7	1		0845	106	0.	3.1	102.0	1		1420	173	0.	3.1	102.0
1		0315	40	63.	4.2	102.6	1		0850	107	0.	3.1	102.0	1		1425	174	0.	3.1	102.0
1		0320	41	55.	4.1	102.5	1		0855	108	0.	3.1	102.0	1		1430	175	0.	3.1	102.0

1	0325	42	48.	3.9	102.5	*	1	0900	109	0.	3.1	102.0	*	1	1435	176	0.	3.1	102.0
1	0330	43	42.	3.8	102.4	*	1	0905	110	0.	3.1	102.0	*	1	1440	177	0.	3.1	102.0
1	0335	44	37.	3.7	102.4	*	1	0910	111	0.	3.1	102.0	*	1	1445	178	0.	3.1	102.0
1	0340	45	32.	3.7	102.3	*	1	0915	112	0.	3.1	102.0	*	1	1450	179	0.	3.1	102.0
1	0345	46	28.	3.6	102.3	*	1	0920	113	0.	3.1	102.0	*	1	1455	180	0.	3.1	102.0
1	0350	47	25.	3.5	102.2	*	1	0925	114	0.	3.1	102.0	*	1	1500	181	0.	3.1	[illegible]
1	0355	48	22.	3.5	102.2	*	1	0930	115	0.	3.1	102.0	*	1	1505	182	0.	3.1	[illegible]
1	0400	49	20.	3.4	102.2	*	1	0935	116	0.	3.1	102.0	*	1	1510	183	0.	3.1	102.0
1	0405	50	18.	3.4	102.2	*	1	0940	117	0.	3.1	102.0	*	1	1515	184	0.	3.1	102.0
1	0410	51	16.	3.4	102.2	*	1	0945	118	0.	3.1	102.0	*	1	1520	185	0.	3.1	102.0
1	0415	52	14.	3.3	102.1	*	1	0950	119	0.	3.1	102.0	*	1	1525	186	0.	3.1	102.0
1	0420	53	13.	3.3	102.1	*	1	0955	120	0.	3.1	102.0	*	1	1530	187	0.	3.1	102.0
1	0425	54	12.	3.3	102.1	*	1	1000	121	0.	3.1	102.0	*	1	1535	188	0.	3.1	102.0
1	0430	55	11.	3.3	102.1	*	1	1005	122	0.	3.1	102.0	*	1	1540	189	0.	3.1	102.0
1	0435	56	10.	3.3	102.1	*	1	1010	123	0.	3.1	102.0	*	1	1545	190	0.	3.1	102.0
1	0440	57	9.	3.3	102.1	*	1	1015	124	0.	3.1	102.0	*	1	1550	191	0.	3.1	102.0
1	0445	58	9.	3.2	102.1	*	1	1020	125	0.	3.1	102.0	*	1	1555	192	0.	3.1	102.0
1	0450	59	8.	3.2	102.1	*	1	1025	126	0.	3.1	102.0	*	1	1600	193	0.	3.1	102.0
1	0455	60	7.	3.2	102.1	*	1	1030	127	0.	3.1	102.0	*	1	1605	194	0.	3.1	102.0
1	0500	61	7.	3.2	102.1	*	1	1035	128	0.	3.1	102.0	*	1	1610	195	0.	3.1	102.0
1	0505	62	6.	3.2	102.1	*	1	1040	129	0.	3.1	102.0	*	1	1615	196	0.	3.1	102.0
1	0510	63	6.	3.2	102.1	*	1	1045	130	0.	3.1	102.0	*	1	1620	197	0.	3.1	102.0
1	0515	64	5.	3.2	102.1	*	1	1050	131	0.	3.1	102.0	*	1	1625	198	0.	3.1	102.0
1	0520	65	5.	3.2	102.0	*	1	1055	132	0.	3.1	102.0	*	1	1630	199	0.	3.1	102.0
1	0525	66	5.	3.2	102.0	*	1	1100	133	0.	3.1	102.0	*	1	1635	200	0.	3.1	102.0
1	0530	67	4.	3.2	102.0	*	1	1105	134	0.	3.1	102.0	*						
						*							*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 470.	1.83		80.	29.	29.	29.
		(INCHES)	1.383	1.387	1.387	1.387
		(AC-FT)	40.	40.	40.	40.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
11.	1.83	5.	3.	3.	3.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
105.78	1.83	102.75	102.12	102.12	102.12

CUMULATIVE AREA = .54 SQ MI

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         ***************
         *             *
531 KK   *   RCH377    *         ROUTE HG DET349 THRU REACH 377
         *             *
         ***************
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HYDROGRAPH ROUTING DATA

532 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	FLOW	TYPE OF INITIAL CONDITION
RSVRIC	-1.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

533 RC NORMAL DEPTH CHANNEL

ANL	.030	LEFT OVERBANK N-VALUE
ANCH	.025	MAIN CHANNEL N-VALUE
ANR	.030	RIGHT OVERBANK N-VALUE
RLNTH	900.	REACH LENGTH
SEL	.0040	ENERGY SLOPE
ELMAX	.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK --- +		------ MAIN CHANNEL ------- +			--- RIGHT OVERBANK ---	
535 RY	ELEVATION	100.00	98.00	98.00	95.00	95.00	98.00	98.00	100.00

```
534 RX       DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00
                                                          ***

                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .06       .13       .21       .31       .41       .53       .66       .80       .95
          OUTFLOW       .00      4.22     13.98     28.75     48.62     73.83    104.67    141.44    184.46    234.04
        ELEVATION     95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37

          STORAGE      1.12      1.29      1.61      2.05      2.50      2.96      3.45      3.95      4.46      5.00
          OUTFLOW    290.48    354.11    440.90    561.22    703.83    866.93   1049.64   1251.52   1472.31   1711.92
        ELEVATION     97.63     97.89     98.16     98.42     98.68     98.95     99.21     99.47     99.74    100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      141. TO     1712.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   RCH377

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                            (CFS)
+    468.      1.92                 80.         29.         29.         29.
                         (INCHES)  1.382       1.387       1.387       1.387
                          (AC-FT)  40.         40.         40.         40.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
       2.      1.92                  0.          0.          0.          0.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    98.22      1.92                95.96       95.35       95.35       95.35

                        CUMULATIVE AREA =     .54 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 536 KK     *   SUB350   *          RUNOFF HG FROM SUB-BASIN 350
            *            *
            **************

              SUBBASIN RUNOFF DATA

 537 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  72 PB               STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI           INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                      .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                      .01       .00       .01       .01

 538 LG         GREEN AND AMPT LOSS RATE
                      STRTL         .22  STARTING LOSS
                        DTH         .29  MOISTURE DEFICIT
                       PSIF        2.65  WETTING FRONT SUCTION
                      XKSAT        1.10  HYDRAULIC CONDUCTIVITY
                      RTIMP       10.00  PERCENT IMPERVIOUS AREA

 539 UC         CLARK UNITGRAPH
                         TC         .32  TIME OF CONCENTRATION
                          R         .31  STORAGE COEFFICIENT
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540 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                     .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                  100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .32 HR,       R=   .31 HR
                                         SNYDER   TP=   .23 HR,      CP=   .49

                                                UNIT HYDROGRAPH
                                          22 END-OF-PERIOD ORDINATES
                 3.       12.       17.       16.       13.       10.        7.        6.        4.        3.
                 2.        2.        1.        1.        1.        1.        0.        0.        0.        0.
                 0.        0.

     ***          ***          ***          ***          ***

                      HYDROGRAPH AT STATION   SUB350

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.59, TOTAL EXCESS =    1.18

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                                  (CFS)
+     17.       1.33                   2.          1.          1.          1.
                                (INCHES)     1.176       1.176       1.176       1.176
                                 (AC-FT)        1.          1.          1.          1.

                                CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
542 KK    *   SUB360   *          RUNOFF HG FROM SUB-BASIN 360
          *            *
          **************

             SUBBASIN RUNOFF DATA

543 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB                STORM         2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                     .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                     .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                     .01       .00       .01       .01

544 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .15  STARTING LOSS
                        DTH         .28  MOISTURE DEFICIT
                       PSIF        3.40  WETTING FRONT SUCTION
                      XKSAT         .80  HYDRAULIC CONDUCTIVITY
                      RTIMP       37.00  PERCENT IMPERVIOUS AREA

545 UC          CLARK UNITGRAPH
                         TC         .18  TIME OF CONCENTRATION
                          R         .24  STORAGE COEFFICIENT

546 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                     .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                  100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .18 HR,       R=   .24 HR
                                         SNYDER   TP=   .14 HR,      CP=   .41

                                                UNIT HYDROGRAPH
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                                                  17 END-OF-PERIOD ORDINATES
            12.      25.      23.      16.      12.       8.       6.       4.       3.       2.
             1.       1.       1.       1.       0.       0.       0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB360

  TOTAL RAINFALL =   2.77, TOTAL LOSS =   1.02, TOTAL EXCESS =   1.75

 PEAK FLOW    TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR      24-HR      72-HR    16.58-HR
+  (CFS)      (HR)
                         (CFS)
+    30.      1.25                 3.         1.         1.         1.
                       (INCHES)  1.745      1.745      1.745      1.745
                        (AC-FT)    1.         1.         1.         1.

                       CUMULATIVE AREA =    .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 548 KK   *   SUB370   *          RUNOFF HG FROM SUB-BASIN 370
          *            *
          **************

            SUBBASIN RUNOFF DATA

 549 BA       SUBBASIN CHARACTERISTICS
                   TAREA          .03  SUBBASIN AREA

              PRECIPITATION DATA

  72 PB            STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI         INCREMENTAL PRECIPITATION PATTERN
                   .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                   .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                   .01       .00       .01       .01

 550 LG       GREEN AND AMPT LOSS RATE
                   STRTL         .15  STARTING LOSS
                     DTH         .28  MOISTURE DEFICIT
                    PSIF        3.40  WETTING FRONT SUCTION
                   XKSAT         .80  HYDRAULIC CONDUCTIVITY
                   RTIMP       37.00  PERCENT IMPERVIOUS AREA

 551 UC       CLARK UNITGRAPH
                      TC         .25  TIME OF CONCENTRATION
                       R         .31  STORAGE COEFFICIENT

 552 UA       ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                     .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                  100.0

                                                  ***

                                                  UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=   .25 HR,       R=   .31 HR
                                          SNYDER   TP=   .20 HR,      CP=   .47

                                                      UNIT HYDROGRAPH
                                                  21 END-OF-PERIOD ORDINATES
            11.      31.      39.      33.      25.      19.      14.      11.       8.       6.
             5.       4.       3.       2.       2.       1.       1.       1.       1.       0.
             0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB370

  TOTAL RAINFALL =   2.77, TOTAL LOSS =   1.02, TOTAL EXCESS =   1.75

 PEAK FLOW    TIME                        MAXIMUM AVERAGE FLOW
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                                        6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     48.       1.33                     5.          2.          2.          2.
                        (INCHES)     1.743       1.743       1.743       1.743
                         (AC-FT)        3.          3.          3.          3.

                         CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 554 KK     *    SUM377  *            COMBINE HG FROM RCH377, SUB350, SUB360 & SUB370
            *            *
            **************

 555 HC          HYDROGRAPH COMBINATION
                       ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   SUM377

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    486.       1.92                    90.         33.         33.         33.
                        (INCHES)     1.398       1.408       1.408       1.408
                         (AC-FT)       45.         45.         45.         45.

                         CUMULATIVE AREA =     .60 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
 556 KK     *    RCH407  *            ROUTE HG SUM377 THRU REACH 407
            *            *
            **************

               HYDROGRAPH ROUTING DATA

 557 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        FLOW  TYPE OF INITIAL CONDITION
                       RSVRIC       -1.00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

 558 RC          NORMAL DEPTH CHANNEL
                         ANL        .030  LEFT OVERBANK N-VALUE
                        ANCH        .025  MAIN CHANNEL N-VALUE
                         ANR        .030  RIGHT OVERBANK N-VALUE
                       RLNTH       1820.  REACH LENGTH
                         SEL       .0040  ENERGY SLOPE
                       ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                        CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 560 RY       ELEVATION    100.00     98.00     98.00     95.00     95.00     98.00     98.00    100.00
 559 RX       DISTANCE     500.00    512.00    533.00    545.00    555.00    567.00    588.00    600.00

                                                                  ***

                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .12       .27       .43       .62       .84      1.08      1.34      1.62      1.93
          OUTFLOW        .00      4.22     13.98     28.75     48.62     73.83    104.67    141.44    184.46    234.04
        ELEVATION      95.00     95.26     95.53     95.79     96.05     96.32     96.58     96.84     97.11     97.37
```

STORAGE	2.26	2.61	3.27	4.14	5.05	5.99	6.97	7.98	9.03	10.11
OUTFLOW	290.48	354.11	440.90	561.22	703.83	866.93	1049.64	1251.52	1472.31	1711.92
ELEVATION	97.63	97.89	98.16	98.42	98.68	98.95	99.21	99.47	99.74	100.00

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***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   RCH407

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                            (CFS)
+     458.     2.00                   90.         33.         33.         33.
                          (INCHES)  1.397       1.408       1.408       1.408
                           (AC-FT)    44.         45.         45.         45.

 PEAK STORAGE  TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)     (HR)
       3.      2.00                    1.          0.          0.          0.

 PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+   (FEET)     (HR)
    98.19      2.00                  96.09       95.41       95.41       95.41

                         CUMULATIVE AREA =     .60 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
 561 KK   *   SUB380   *            RUNOFF HG FROM SUB-BASIN 380
          *            *
          **************

             SUBBASIN RUNOFF DATA

 562 BA        SUBBASIN CHARACTERISTICS
                    TAREA          .05  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM         2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 563 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .13  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       59.00  PERCENT IMPERVIOUS AREA

 564 UC        CLARK UNITGRAPH
                       TC         .30  TIME OF CONCENTRATION
                        R         .35  STORAGE COEFFICIENT

 565 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .30 HR,       R=   .35 HR
                                    SNYDER   TP=   .23 HR,      CP=   .45

                                          UNIT HYDROGRAPH
                                     24 END-OF-PERIOD ORDINATES
            12.       44.       64.       58.       48.       38.       30.       23.       18.       14.
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          11.       9.       7.       6.       4.       3.       3.       2.       2.       1.
           1.       1.       1.       1.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUB380

  TOTAL RAINFALL =    2.77, TOTAL LOSS =     .66, TOTAL EXCESS =    2.11

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                         (CFS)
+     93.      1.33                  12.         4.          4.          4.
                       (INCHES)    2.100       2.100       2.100       2.100
                        (AC-FT)       6.          6.          6.          6.

                       CUMULATIVE AREA =     .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
 567 KK   *   SUB390   *            RUNOFF HG FROM SUB-BASIN 390
          *            *
          **************

             SUBBASIN RUNOFF DATA

 568 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .03  SUBBASIN AREA

               PRECIPITATION DATA

  72 PB             STORM        2.77  BASIN TOTAL PRECIPITATION

  73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

 569 LG        GREEN AND AMPT LOSS RATE
                    STRTL         .15  STARTING LOSS
                      DTH         .28  MOISTURE DEFICIT
                     PSIF        3.40  WETTING FRONT SUCTION
                    XKSAT         .80  HYDRAULIC CONDUCTIVITY
                    RTIMP       37.00  PERCENT IMPERVIOUS AREA

 570 UC        CLARK UNITGRAPH
                       TC         .27  TIME OF CONCENTRATION
                        R         .47  STORAGE COEFFICIENT

 571 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                   ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .27 HR,       R=   .47 HR
                                       SNYDER   TP=   .23 HR,      CP=   .37

                                                UNIT HYDROGRAPH
                                           32 END-OF-PERIOD ORDINATES
          6.       20.       28.       26.       22.       19.       16.       13.       11.        9.
          8.        6.        5.        4.        4.        3.        3.        2.        2.        2.
          1.        1.        1.        1.        1.        1.        0.        0.        0.        0.
          0.        0.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SUB390

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
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                                    6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     38.       1.33                 5.          2.          2.          2.
                        (INCHES)    1.744       1.744       1.744       1.744
                         (AC-FT)      3.          3.          3.          3.

                        CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
 573 KK     *   SUM401   *            COMBINE HG FROM SUB380, SUB390
            *            *
            **************
                                      INFLOW INTO DETENTION BASIN 401

 575 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***

     ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   SUM401

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    131.       1.33                17.          6.          6.          6.
                        (INCHES)    1.975       1.975       1.975       1.975
                         (AC-FT)      8.          8.          8.          8.

                        CUMULATIVE AREA =     .08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 576 KK     *   DET401   *            ROUTE HG SUM401 THRU DET BASIN 401; Wb = 150'; L = 400'
            *            *
            **************
                                      100-FOOT WIER USED FOR HIGH FLOWS AND 1-36" CMP

 578 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

               HYDROGRAPH ROUTING DATA

 579 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        STOR  TYPE OF INITIAL CONDITION
                      RSVRIC         .00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 580 SV            STORAGE          .0       2.1       4.6       7.5

 581 SE          ELEVATION      100.00    102.00    104.00    106.00

 582 SL          LOW-LEVEL OUTLET
                       ELEVL      102.00  ELEVATION AT CENTER OF OUTLET
                       CAREA        7.10  CROSS-SECTIONAL AREA
                        COQL         .37  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 583 SS          SPILLWAY
                        CREL      105.90  SPILLWAY CREST ELEVATION
                       SPWID      100.00  SPILLWAY WIDTH
```

COQW	2.60	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	25.10	26.61	28.31	30.24	32.46	35.03	38.03	41.61
ELEVATION	100.00	102.00	103.42	103.59	103.81	104.06	104.37	104.76	105.26	105.90
OUTFLOW	41.64	41.74	41.96	42.34	42.92	43.74	44.86	46.30	48.12	50.36
ELEVATION	105.90	105.91	105.91	105.92	105.93	105.94	105.95	105.97	105.98	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	2.06	3.83	4.05	4.31	4.55	4.64	5.10	5.67	6.40
OUTFLOW	.00	.00	25.10	26.61	28.31	29.80	30.24	32.46	35.03	38.03
ELEVATION	100.00	102.00	103.42	103.59	103.81	104.00	104.06	104.37	104.76	105.26
STORAGE	7.34	7.36	7.38	7.40	7.42	7.44	7.46	7.49		
OUTFLOW	41.61	41.96	42.92	43.74	44.86	46.30	48.12	50.36		
ELEVATION	105.90	105.91	105.93	105.94	105.95	105.97	105.98	106.00		

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HYDROGRAPH AT STATION DET401

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	1.	2.2	102.1	*	1		1110	135	0.	2.1	102.0
1		0005	2	0.	.0	100.0	*	1		0540	69	1.	2.2	102.1	*	1		1115	136	0.	2.1	102.0
1		0010	3	0.	.0	100.0	*	1		0545	70	1.	2.1	102.1	*	1		1120	137	0.	2.1	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	1.	2.1	102.1	*	1		1125	138	0.	2.1	102.0
1		0020	5	0.	.0	100.0	*	1		0555	72	1.	2.1	102.1	*	1		1130	139	0.	2.1	102.0
1		0025	6	0.	.1	100.1	*	1		0600	73	1.	2.1	102.1	*	1		1135	140	0.	2.1	102.0
1		0030	7	0.	.1	100.1	*	1		0605	74	1.	2.1	102.0	*	1		1140	141	0.	2.1	102.0
1		0035	8	0.	.1	100.1	*	1		0610	75	1.	2.1	102.0	*	1		1145	142	0.	2.1	[illegible]
1		0040	9	0.	.2	100.1	*	1		0615	76	1.	2.1	102.0	*	1		1150	143	0.	2.1	102.0
1		0045	10	0.	.2	100.2	*	1		0620	77	1.	2.1	102.0	*	1		1155	144	0.	2.1	102.0
1		0050	11	0.	.3	100.3	*	1		0625	78	1.	2.1	102.0	*	1		1200	145	0.	2.1	102.0
1		0055	12	0.	.4	100.4	*	1		0630	79	0.	2.1	102.0	*	1		1205	146	0.	2.1	102.0
1		0100	13	0.	.6	100.5	*	1		0635	80	0.	2.1	102.0	*	1		1210	147	0.	2.1	102.0
1		0105	14	0.	.8	100.8	*	1		0640	81	0.	2.1	102.0	*	1		1215	148	0.	2.1	102.0
1		0110	15	0.	1.2	101.2	*	1		0645	82	0.	2.1	102.0	*	1		1220	149	0.	2.1	102.0
1		0115	16	0.	1.9	101.9	*	1		0650	83	0.	2.1	102.0	*	1		1225	150	0.	2.1	102.0
1		0120	17	10.	2.8	102.6	*	1		0655	84	0.	2.1	102.0	*	1		1230	151	0.	2.1	102.0
1		0125	18	21.	3.5	103.2	*	1		0700	85	0.	2.1	102.0	*	1		1235	152	0.	2.1	102.0
1		0130	19	27.	4.2	103.7	*	1		0705	86	0.	2.1	102.0	*	1		1240	153	0.	2.1	102.0
1		0135	20	30.	4.7	104.1	*	1		0710	87	0.	2.1	102.0	*	1		1245	154	0.	2.1	102.0
1		0140	21	32.	5.0	104.3	*	1		0715	88	0.	2.1	102.0	*	1		1250	155	0.	2.1	102.0
1		0145	22	33.	5.3	104.5	*	1		0720	89	0.	2.1	102.0	*	1		1255	156	0.	2.1	102.0
1		0150	23	34.	5.5	104.6	*	1		0725	90	0.	2.1	102.0	*	1		1300	157	0.	2.1	102.0
1		0155	24	34.	5.5	104.7	*	1		0730	91	0.	2.1	102.0	*	1		1305	158	0.	2.1	102.0
1		0200	25	35.	5.6	104.7	*	1		0735	92	0.	2.1	102.0	*	1		1310	159	0.	2.1	102.0
1		0205	26	35.	5.6	104.7	*	1		0740	93	0.	2.1	102.0	*	1		1315	160	0.	2.1	102.0
1		0210	27	34.	5.5	104.7	*	1		0745	94	0.	2.1	102.0	*	1		1320	161	0.	2.1	102.0
1		0215	28	34.	5.4	104.6	*	1		0750	95	0.	2.1	102.0	*	1		1325	162	0.	2.1	102.0
1		0220	29	34.	5.3	104.5	*	1		0755	96	0.	2.1	102.0	*	1		1330	163	0.	2.1	102.0
1		0225	30	33.	5.2	104.4	*	1		0800	97	0.	2.1	102.0	*	1		1335	164	0.	2.1	102.0
1		0230	31	32.	5.1	104.3	*	1		0805	98	0.	2.1	102.0	*	1		1340	165	0.	2.1	102.0
1		0235	32	32.	4.9	104.2	*	1		0810	99	0.	2.1	102.0	*	1		1345	166	0.	2.1	102.0
1		0240	33	31.	4.7	104.1	*	1		0815	100	0.	2.1	102.0	*	1		1350	167	0.	2.1	102.0
1		0245	34	30.	4.6	104.0	*	1		0820	101	0.	2.1	102.0	*	1		1355	168	0.	2.1	102.0
1		0250	35	29.	4.4	103.9	*	1		0825	102	0.	2.1	102.0	*	1		1400	169	0.	2.1	102.0
1		0255	36	28.	4.2	103.8	*	1		0830	103	0.	2.1	102.0	*	1		1405	170	0.	2.1	102.0
1		0300	37	27.	4.1	103.6	*	1		0835	104	0.	2.1	102.0	*	1		1410	171	0.	2.1	102.0
1		0305	38	26.	3.9	103.5	*	1		0840	105	0.	2.1	102.0	*	1		1415	172	0.	2.1	102.0
1		0310	39	24.	3.8	103.4	*	1		0845	106	0.	2.1	102.0	*	1		1420	173	0.	2.1	102.0
1		0315	40	22.	3.6	103.2	*	1		0850	107	0.	2.1	102.0	*	1		1425	174	0.	2.1	102.0
1		0320	41	20.	3.5	103.1	*	1		0855	108	0.	2.1	102.0	*	1		1430	175	0.	2.1	102.0
1		0325	42	18.	3.3	103.0	*	1		0900	109	0.	2.1	102.0	*	1		1435	176	0.	2.1	[illegible]
1		0330	43	17.	3.2	102.9	*	1		0905	110	0.	2.1	102.0	*	1		1440	177	0.	2.1	[illegible]
1		0335	44	15.	3.1	102.9	*	1		0910	111	0.	2.1	102.0	*	1		1445	178	0.	2.1	102.0
1		0340	45	14.	3.0	102.8	*	1		0915	112	0.	2.1	102.0	*	1		1450	179	0.	2.1	102.0
1		0345	46	12.	2.9	102.7	*	1		0920	113	0.	2.1	102.0	*	1		1455	180	0.	2.1	102.0
1		0350	47	11.	2.9	102.6	*	1		0925	114	0.	2.1	102.0	*	1		1500	181	0.	2.1	102.0
1		0355	48	10.	2.8	102.6	*	1		0930	115	0.	2.1	102.0	*	1		1505	182	0.	2.1	102.0

1	0400	49	9.	2.7	102.5	*	1	0935	116	0.	2.1	102.0	*	1	1510	183	0.	2.1	102.0
1	0405	50	8.	2.7	102.5	*	1	0940	117	0.	2.1	102.0	*	1	1515	184	0.	2.1	102.0
1	0410	51	8.	2.6	102.4	*	1	0945	118	0.	2.1	102.0	*	1	1520	185	0.	2.1	102.0
1	0415	52	7.	2.5	102.4	*	1	0950	119	0.	2.1	102.0	*	1	1525	186	0.	2.1	102.0
1	0420	53	6.	2.5	102.4	*	1	0955	120	0.	2.1	102.0	*	1	1530	187	0.	2.1	102.0
1	0425	54	6.	2.5	102.3	*	1	1000	121	0.	2.1	102.0	*	1	1535	188	0.	2.1	102.0
	0430	55	5.	2.4	102.3	*	1	1005	122	0.	2.1	102.0	*	1	1540	189	0.	2.1	102.0
1	0435	56	5.	2.4	102.3	*	1	1010	123	0.	2.1	102.0	*	1	1545	190	0.	2.1	102.0
1	0440	57	4.	2.4	102.2	*	1	1015	124	0.	2.1	102.0	*	1	1550	191	0.	2.1	102.0
1	0445	58	4.	2.3	102.2	*	1	1020	125	0.	2.1	102.0	*	1	1555	192	0.	2.1	102.0
1	0450	59	4.	2.3	102.2	*	1	1025	126	0.	2.1	102.0	*	1	1600	193	0.	2.1	102.0
1	0455	60	3.	2.3	102.2	*	1	1030	127	0.	2.1	102.0	*	1	1605	194	0.	2.1	102.0
1	0500	61	3.	2.3	102.2	*	1	1035	128	0.	2.1	102.0	*	1	1610	195	0.	2.1	102.0
1	0505	62	3.	2.2	102.1	*	1	1040	129	0.	2.1	102.0	*	1	1615	196	0.	2.1	102.0
1	0510	63	2.	2.2	102.1	*	1	1045	130	0.	2.1	102.0	*	1	1620	197	0.	2.1	102.0
1	0515	64	2.	2.2	102.1	*	1	1050	131	0.	2.1	102.0	*	1	1625	198	0.	2.1	102.0
1	0520	65	2.	2.2	102.1	*	1	1055	132	0.	2.1	102.0	*	1	1630	199	0.	2.1	102.0
1	0525	66	2.	2.2	102.1	*	1	1100	133	0.	2.1	102.0	*	1	1635	200	0.	2.1	102.0
1	0530	67	2.	2.2	102.1	*	1	1105	134	0.	2.1	102.0	*						
						*							*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 35.	2.00		13.	5.	5.	5.
		(INCHES)	1.489	1.493	1.493	1.493
		(AC-FT)	6.	6.	6.	6.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
6.	2.00	3.	2.	2.	2.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
104.70	2.00	102.85	102.18	102.18	102.18

CUMULATIVE AREA = .08 SQ MI

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              *            *
584 KK        *   SUB400   *          RUNOFF HG FROM SUB-BASIN 400
              *            *
              **************

                 SUBBASIN RUNOFF DATA

585 BA             SUBBASIN CHARACTERISTICS
                        TAREA         .06  SUBBASIN AREA

                   PRECIPITATION DATA

 72 PB                  STORM        2.77  BASIN TOTAL PRECIPITATION

 73 PI               INCREMENTAL PRECIPITATION PATTERN
                        .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                        .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                        .01       .00       .01       .01

586 LG             GREEN AND AMPT LOSS RATE
                        STRTL         .19  STARTING LOSS
                          DTH         .30  MOISTURE DEFICIT
                         PSIF        2.55  WETTING FRONT SUCTION
                        XKSAT        1.14  HYDRAULIC CONDUCTIVITY
                        RTIMP        6.40  PERCENT IMPERVIOUS AREA

587 UC             CLARK UNITGRAPH
                           TC         .63  TIME OF CONCENTRATION
                            R         .47  STORAGE COEFFICIENT

588 UA             ACCUMULATED-AREA VS. TIME,  11 ORDINATES
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                .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
              100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .63 HR,       R=   .47 HR
                                  SNYDER   TP=   .36 HR,      CP=   .45

                                          UNIT HYDROGRAPH
                                   34 END-OF-PERIOD ORDINATES
          3.       12.       30.       44.       46.       44.       41.       36.       31.       26.
         22.       18.       15.       13.       11.        9.        8.        6.        5.        4.
          4.        3.        3.        2.        2.        2.        1.        1.        1.        1.
          1.        1.        0.        0.

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUB400

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.65, TOTAL EXCESS =    1.12

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     48.      1.50                 7.          3.          3.          3.
                        (INCHES)   1.113       1.113       1.113       1.113
                         (AC-FT)   3.          3.          3.          3.

                       CUMULATIVE AREA =     .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 590 KK   *   SUM407   *          COMBINE HG FROM SUB400, RCH407 & DET401
          *            *
          **************

 591 HC         HYDROGRAPH COMBINATION
                     ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE
                                                  ***

   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   SUM407

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+    515.      2.00                109.         40.         40.         40.
                        (INCHES)   1.384       1.394       1.394       1.394
                         (AC-FT)   54.         55.         55.         55.

                       CUMULATIVE AREA =     .74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 592 KK   *   RCH441   *          ROUTE HG SUM407 THRU REACH 441 (NORTH)
          *            *
          **************

             HYDROGRAPH ROUTING DATA

 593 RS         STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
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                    RSVRIC       -1.00  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

594 RC          NORMAL DEPTH CHANNEL
                       ANL        .030  LEFT OVERBANK N-VALUE
                      ANCH        .025  MAIN CHANNEL N-VALUE
                       ANR        .030  RIGHT OVERBANK N-VALUE
                     RLNTH       1160.  REACH LENGTH
                       SEL       .0060  ENERGY SLOPE
                     ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
596 RY        ELEVATION   100.00    98.00    98.00    95.00    95.00    98.00    98.00   100.00
595 RX        DISTANCE    500.00   512.00   533.00   545.00   555.00   567.00   588.00   600.00

                                                        ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00      .08      .17      .28      .40      .53      .69      .85     1.03     1.23
          OUTFLOW       .00     5.17    17.13    35.21    59.55    90.43   128.20   173.23   225.92   286.64
        ELEVATION     95.00    95.26    95.53    95.79    96.05    96.32    96.58    96.84    97.11    97.37

          STORAGE      1.44     1.66     2.08     2.64     3.22     3.82     4.44     5.09     5.75     6.44
          OUTFLOW    355.77   433.69   539.99   687.35   862.02  1061.76  1285.54  1532.79  1803.21  2096.67
        ELEVATION     97.63    97.89    98.16    98.42    98.68    98.95    99.21    99.47    99.74   100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      173. TO     2097.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   RCH441

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
  (CFS)        (HR)
                          (CFS)
+   507.       2.08                  109.        40.         40.         40.
                         (INCHES)   1.384      1.394       1.394       1.394
                         (AC-FT)     54.        55.         55.         55.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+ (AC-FT)      (HR)
     2.        2.08                    1.         0.          0.          0.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     16.58-HR
+  (FEET)      (HR)
   98.08       2.08                  96.11      95.41       95.41       95.41

                        CUMULATIVE AREA =     .74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
597 KK      *   SUB410   *            RUNOFF HG FROM SUB-BASIN 410
            *            *
            **************

              SUBBASIN RUNOFF DATA

598 BA          SUBBASIN CHARACTERISTICS
                      TAREA        .06  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB                STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                      .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
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                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

599 LG          GREEN AND AMPT LOSS RATE
                     STRTL        .15  STARTING LOSS
                       DTH        .28  MOISTURE DEFICIT
                      PSIF       3.40  WETTING FRONT SUCTION
                     XKSAT        .80  HYDRAULIC CONDUCTIVITY
                     RTIMP      37.00  PERCENT IMPERVIOUS AREA

600 UC          CLARK UNITGRAPH
                        TC        .23  TIME OF CONCENTRATION
                         R        .24  STORAGE COEFFICIENT

601 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                    100.0

                                                  ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .23 HR,       R=   .24 HR
                                        SNYDER   TP=   .17 HR,      CP=   .45

                                                UNIT HYDROGRAPH
                                            17 END-OF-PERIOD ORDINATES
              32.       80.       88.       68.       48.       34.       24.       17.       12.        8.
               6.        4.        3.        2.        1.        1.        1.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   SUB410

    TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+     108.      1.25                11.          4.          4.          4.
                         (INCHES)  1.744       1.744       1.744       1.744
                          (AC-FT)     5.          5.          5.          5.

                         CUMULATIVE AREA =     .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
603 KK      *   SUB425   *            RUNOFF HG FROM SUB-BASIN 425
            *            *
            **************

               SUBBASIN RUNOFF DATA

604 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .03  SUBBASIN AREA

                PRECIPITATION DATA

 72 PB               STORM       2.77  BASIN TOTAL PRECIPITATION

 73 PI            INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

605 LG          GREEN AND AMPT LOSS RATE
                     STRTL        .15  STARTING LOSS
                       DTH        .28  MOISTURE DEFICIT
                      PSIF       3.40  WETTING FRONT SUCTION
                     XKSAT        .80  HYDRAULIC CONDUCTIVITY
                     RTIMP      37.00  PERCENT IMPERVIOUS AREA

606 UC          ..CLARK UNITGRAPH
                        TC        .45  TIME OF CONCENTRATION
```

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                    R          .76  STORAGE COEFFICIENT

607 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
               100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .45 HR,       R=   .76 HR
                                    SNYDER   TP=   .33 HR,      CP=   .32

                                          UNIT HYDROGRAPH
                                     51 END-OF-PERIOD ORDINATES
          2.        8.       15.       18.       18.       17.       15.       14.       12.       11.
         10.        9.        8.        7.        6.        6.        5.        5.        4.        4.
          3.        3.        3.        2.        2.        2.        2.        2.        1.        1.
          1.        1.        1.        1.        1.        1.        1.        1.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.

   ***          ***          ***          ***          ***

                  HYDROGRAPH AT STATION   SUB425

   TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.02, TOTAL EXCESS =    1.75

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                             (CFS)
+     27.       1.50                5.          2.          2.          2.
                           (INCHES)     1.743       1.743       1.743       1.743
                            (AC-FT)       3.          3.          3.          3.

                           CUMULATIVE AREA =     .03 SQ MI


* *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
609 KK    *   SUB440   *          RUNOFF HG FROM SUB-BASIN 440
          *            *
          **************

             SUBBASIN RUNOFF DATA

610 BA        SUBBASIN CHARACTERISTICS
                   TAREA          .04  SUBBASIN AREA

              PRECIPITATION DATA

 72 PB             STORM         2.77  BASIN TOTAL PRECIPITATION

 73 PI          INCREMENTAL PRECIPITATION PATTERN
                    .01       .01       .01       .01       .00       .01       .03       .03       .04       .04
                    .06       .09       .27       .14       .12       .04       .03       .02       .01       .01
                    .01       .00       .01       .01

611 LG        GREEN AND AMPT LOSS RATE
                   STRTL          .19  STARTING LOSS
                     DTH          .30  MOISTURE DEFICIT
                    PSIF         2.55  WETTING FRONT SUCTION
                   XKSAT         1.14  HYDRAULIC CONDUCTIVITY
                   RTIMP         6.40  PERCENT IMPERVIOUS AREA

612 UC        CLARK UNITGRAPH
                      TC          .57  TIME OF CONCENTRATION
                       R          .62  STORAGE COEFFICIENT

613 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
               100.0

                                                  ***
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                                    UNIT HYDROGRAPH PARAMETERS
                              CLARK   TC=   .57 HR,       R=   .62 HR
                             SNYDER   TP=   .37 HR,      CP=   .40

                                         UNIT HYDROGRAPH
                                   43 END-OF-PERIOD ORDINATES
            2.      6.     16.     23.     24.     23.     22.     20.     17.     15.
           13.     11.     10.      9.      8.      7.      6.      5.      4.      4.
            3.      3.      3.      2.      2.      2.      2.      1.      1.      1.
            1.      1.      1.      1.      1.      0.      0.      0.      0.      0.
            0.      0.      0.

   ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   SUB440

  TOTAL RAINFALL =    2.77, TOTAL LOSS =    1.65, TOTAL EXCESS =    1.12

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+     25.      1.50                    4.          2.          2.          2.
                         (INCHES)   1.113       1.113       1.113       1.113
                          (AC-FT)     2.          2.          2.          2.

                         CUMULATIVE AREA =     .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 615 KK   *   SUM441   *          COMBINE HG FROM RCH441 (WEST & NORTH), SUB410, SUB425 & SUB440
          *            *
          **************
                                   INFLOW INTO DETENTION BASIN 441

 617 HC          HYDROGRAPH COMBINATION
                       ICOMP          5  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***

   ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   SUM441

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+  (CFS)       (HR)
                          (CFS)
+   1789.      2.17                  422.        160.        160.        160.
                         (INCHES)   1.316       1.382       1.382       1.382
                          (AC-FT)   209.        220.        220.        220.

                         CUMULATIVE AREA =    2.98 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 618 KK   *   DET441   *          ROUTE HG SUM401 THRU DET BASIN 441; Wb = 150'; L = 1000'
          *            *
          **************
                                   100-FOOT WIER USED FOR HIGH FLOWS AND 6-48" CMP
                                   ****** OUTFLOW EXITS AT SE CORNER OF EXPANSION AREA ******

 621 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          1  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

                 HYDROGRAPH ROUTING DATA
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622 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       STOR  TYPE OF INITIAL CONDITION
                    RSVRIC        .00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

623 SV            STORAGE         .0      7.4      16.0      25.6

624 SE          ELEVATION     100.00    102.00    104.00    106.00

625 SL          LOW-LEVEL OUTLET
                     ELEVL     102.00  ELEVATION AT CENTER OF OUTLET
                     CAREA      75.40  CROSS-SECTIONAL AREA
                      COQL        .37  COEFFICIENT
                      EXPL        .50  EXPONENT OF HEAD

626 SS          SPILLWAY
                      CREL     103.00  SPILLWAY CREST ELEVATION
                     SPWID     100.00  SPILLWAY WIDTH
                      COQW       2.60  WEIR COEFFICIENT
                      EXPW       1.50  EXPONENT OF HEAD
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***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	403.18	361.74	328.02	300.05	276.48	256.34	238.93	223.74
ELEVATION	100.00	102.00	105.25	104.61	104.15	103.80	103.53	103.31	103.14	103.00
OUTFLOW	264.54	307.85	372.97	464.06	585.36	741.19	935.93	1174.04	1460.05	1798.48
ELEVATION	103.19	103.33	103.52	103.75	104.02	104.33	104.69	105.08	105.52	106.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	7.44	15.98	21.99	23.31	25.62
OUTFLOW	.00	.00	576.42	1279.06	1460.05	1798.48
ELEVATION	100.00	102.00	104.00	105.25	105.52	106.00

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HYDROGRAPH AT STATION DET441

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	100.0	*	1		0535	68	80.	8.6	102.3	*	1		1110	135	10.	7.6	102.0
1		0005	2	0.	.0	100.0	*	1		0540	69	77.	8.6	102.3	*	1		1115	136	10.	7.6	102.0
1		0010	3	0.	.0	100.0	*	1		0545	70	75.	8.5	102.3	*	1		1120	137	10.	7.6	102.0
1		0015	4	0.	.0	100.0	*	1		0550	71	73.	8.5	102.3	*	1		1125	138	9.	7.6	102.0
1		0020	5	0.	.0	100.0	*	1		0555	72	71.	8.5	102.2	*	1		1130	139	9.	7.6	102.0
1		0025	6	0.	.1	100.0	*	1		0600	73	69.	8.5	102.2	*	1		1135	140	9.	7.6	102.0
1		0030	7	0.	.1	100.0	*	1		0605	74	67.	8.4	102.2	*	1		1140	141	8.	7.6	102.0
1		0035	8	0.	.1	100.0	*	1		0610	75	66.	8.4	102.2	*	1		1145	142	8.	7.6	102.0
1		0040	9	0.	.2	100.0	*	1		0615	76	64.	8.4	102.2	*	1		1150	143	8.	7.6	102.0
1		0045	10	0.	.2	100.1	*	1		0620	77	63.	8.4	102.2	*	1		1155	144	8.	7.6	102.0
1		0050	11	0.	.3	100.1	*	1		0625	78	62.	8.4	102.2	*	1		1200	145	7.	7.5	102.0
1		0055	12	0.	.4	100.1	*	1		0630	79	60.	8.3	102.2	*	1		1205	146	7.	7.5	102.0
1		0100	13	0.	.6	100.2	*	1		0635	80	59.	8.3	102.2	*	1		1210	147	7.	7.5	102.0
1		0105	14	0.	.9	100.2	*	1		0640	81	58.	8.3	102.2	*	1		1215	148	7.	7.5	102.0
1		0110	15	0.	1.5	100.4	*	1		0645	82	56.	8.3	102.2	*	1		1220	149	6.	7.5	102.0
1		0115	16	0.	2.7	100.7	*	1		0650	83	55.	8.2	102.2	*	1		1225	150	6.	7.5	102.0
1		0120	17	0.	4.2	101.1	*	1		0655	84	53.	8.2	102.2	*	1		1230	151	6.	7.5	102.0
1		0125	18	0.	6.1	101.6	*	1		0700	85	52.	8.2	102.2	*	1		1235	152	6.	7.5	102.0
1		0130	19	62.	8.4	102.2	*	1		0705	86	50.	8.2	102.2	*	1		1240	153	6.	7.5	102.0
1		0135	20	215.	10.6	102.7	*	1		0710	87	48.	8.2	102.2	*	1		1245	154	5.	7.5	102.0
1		0140	21	360.	12.8	103.2	*	1		0715	88	47.	8.1	102.2	*	1		1250	155	5.	7.5	102.0
1		0145	22	516.	15.1	103.8	*	1		0720	89	46.	8.1	102.2	*	1		1255	156	5.	7.5	102.0
1		0150	23	755.	17.5	104.3	*	1		0725	90	44.	8.1	102.2	*	1		1300	157	5.	7.5	102.0
1		0155	24	1033.	19.9	104.8	*	1		0730	91	43.	8.1	102.1	*	1		1305	158	5.	7.5	102.0
1		0200	25	1305.	22.2	105.3	*	1		0735	92	41.	8.1	102.1	*	1		1310	159	5.	7.5	102.0
1		0205	26	1567.	24.0	105.7	*	1		0740	93	40.	8.0	102.1	*	1		1315	160	5.	7.5	102.0
1		0210	27	1713.	25.0	105.9	*	1		0745	94	39.	8.0	102.1	*	1		1320	161	4.	7.5	102.0
1		0215	28	1737.	25.2	105.9	*	1		0750	95	38.	8.0	102.1	*	1		1325	162	4.	7.5	102.0
1		0220	29	1673.	24.8	105.8	*	1		0755	96	36.	8.0	102.1	*	1		1330	163	4.	7.5	102.0
1		0225	30	1563.	24.0	105.7	*	1		0800	97	35.	8.0	102.1	*	1		1335	164	4.	7.5	102.0
1		0230	31	1439.	23.2	105.5	*	1		0805	98	34.	7.9	102.1	*	1		1340	165	4.	7.5	102.0
1		0235	32	1320.	22.3	105.3	*	1		0810	99	33.	7.9	102.1	*	1		1345	166	4.	7.5	102.0

1	0240	33	1210.	21.4	105.1 *	1	0815	100	32.	7.9	102.1 *	1	1350	167	4.	7.5	102.0
1	0245	34	1106.	20.5	104.9 *	1	0820	101	31.	7.9	102.1 *	1	1355	168	4.	7.5	102.0
1	0250	35	1005.	19.6	104.8 *	1	0825	102	30.	7.9	102.1 *	1	1400	169	4.	7.5	102.0
1	0255	36	909.	18.8	104.6 *	1	0830	103	29.	7.9	102.1 *	1	1405	170	3.	7.5	102.0
1	0300	37	817.	18.0	104.4 *	1	0835	104	28.	7.9	102.1 *	1	1410	171	3.	7.5	102.0
1	0305	38	730.	17.3	104.3 *	1	0840	105	27.	7.8	102.1 *	1	1415	172	3.	7.5	[illegible]
1	0310	39	647.	16.6	104.1 *	1	0845	106	26.	7.8	102.1 *	1	1420	173	3.	7.5	[illegible]
1	0315	40	572.	15.9	104.0 *	1	0850	107	25.	7.8	102.1 *	1	1425	174	3.	7.5	102.0
1	0320	41	525.	15.2	103.8 *	1	0855	108	25.	7.8	102.1 *	1	1430	175	3.	7.5	102.0
1	0325	42	477.	14.5	103.7 *	1	0900	109	24.	7.8	102.1 *	1	1435	176	3.	7.5	102.0
1	0330	43	436.	13.9	103.5 *	1	0905	110	23.	7.8	102.1 *	1	1440	177	3.	7.5	102.0
1	0335	44	400.	13.4	103.4 *	1	0910	111	22.	7.8	102.1 *	1	1445	178	3.	7.5	102.0
1	0340	45	367.	12.9	103.3 *	1	0915	112	22.	7.8	102.1 *	1	1450	179	3.	7.5	102.0
1	0345	46	336.	12.4	103.2 *	1	0920	113	21.	7.7	102.1 *	1	1455	180	2.	7.5	102.0
1	0350	47	308.	12.0	103.1 *	1	0925	114	20.	7.7	102.1 *	1	1500	181	2.	7.5	102.0
1	0355	48	283.	11.6	103.0 *	1	0930	115	20.	7.7	102.1 *	1	1505	182	2.	7.5	102.0
1	0400	49	259.	11.3	102.9 *	1	0935	116	19.	7.7	102.1 *	1	1510	183	2.	7.5	102.0
1	0405	50	238.	11.0	102.8 *	1	0940	117	18.	7.7	102.1 *	1	1515	184	2.	7.5	102.0
1	0410	51	219.	10.7	102.8 *	1	0945	118	18.	7.7	102.1 *	1	1520	185	2.	7.5	102.0
1	0415	52	202.	10.4	102.7 *	1	0950	119	17.	7.7	102.1 *	1	1525	186	2.	7.5	102.0
1	0420	53	186.	10.2	102.6 *	1	0955	120	17.	7.7	102.1 *	1	1530	187	2.	7.5	102.0
1	0425	54	173.	10.0	102.6 *	1	1000	121	16.	7.7	102.1 *	1	1535	188	2.	7.5	102.0
1	0430	55	160.	9.8	102.6 *	1	1005	122	16.	7.7	102.1 *	1	1540	189	2.	7.5	102.0
1	0435	56	150.	9.7	102.5 *	1	1010	123	15.	7.7	102.1 *	1	1545	190	2.	7.5	102.0
1	0440	57	140.	9.5	102.5 *	1	1015	124	15.	7.7	102.1 *	1	1550	191	2.	7.5	102.0
1	0445	58	132.	9.4	102.5 *	1	1020	125	14.	7.7	102.0 *	1	1555	192	2.	7.5	102.0
1	0450	59	124.	9.3	102.4 *	1	1025	126	14.	7.6	102.0 *	1	1600	193	2.	7.5	102.0
1	0455	60	117.	9.2	102.4 *	1	1030	127	13.	7.6	102.0 *	1	1605	194	1.	7.5	102.0
1	0500	61	111.	9.1	102.4 *	1	1035	128	13.	7.6	102.0 *	1	1610	195	1.	7.5	102.0
1	0505	62	105.	9.0	102.4 *	1	1040	129	13.	7.6	102.0 *	1	1615	196	1.	7.5	102.0
1	0510	63	100.	8.9	102.3 *	1	1045	130	12.	7.6	102.0 *	1	1620	197	1.	7.5	102.0
1	0515	64	95.	8.9	102.3 *	1	1050	131	12.	7.6	102.0 *	1	1625	198	1.	7.5	102.0
1	0520	65	91.	8.8	102.3 *	1	1055	132	11.	7.6	102.0 *	1	1630	199	1.	7.5	102.0
1	0525	66	87.	8.7	102.3 *	1	1100	133	11.	7.6	102.0 *	1	1635	200	1.	7.5	102.0
1	0530	67	83.	8.7	102.3 *	1	1105	134	11.	7.6	102.0 *						
					*						*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1737.	2.25		410.	155.	155.	155.
		(INCHES)	1.278	1.335	1.335	1.335
		(AC-FT)	203.	213.	213.	213.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
25.	2.25	13.	9.	9.	9.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
105.91	2.25	103.16	102.29	102.29	102.29

CUMULATIVE AREA = 2.98 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	SUBB1	251.	1.58	26.	10.	10.	.17		
+	ROUTED TO	RCH21	250.	1.58	26.	10.	10.	.17		
+	HYDROGRAPH AT	SUB10	43.	1.25	4.	1.	1.	.02		
+	HYDROGRAPH AT	SUB20	12.	1.42	2.	1.	1.	.01		
	3 COMBINED AT									

+		SUM21	274.	1.58	32.	11.	11.	.20	
	ROUTED TO								
+		DET21	133.	1.92	26.	10.	10.	.20	
+									105.19 1.92
	ROUTED TO								
+		RCH51	133.	1.92	26.	10.	10.	.20	
+									96.68 1.92
	HYDROGRAPH AT								
+		SUB30	31.	1.25	3.	1.	1.	.02	
	HYDROGRAPH AT								
+		SUB40	30.	1.25	3.	1.	1.	.02	
	3 COMBINED AT								
+		SUM51	143.	1.92	33.	12.	12.	.23	
	ROUTED TO								
+		RCH71	142.	2.00	33.	12.	12.	.23	
+									96.74 2.00
	HYDROGRAPH AT								
+		SUBA	915.	1.92	149.	54.	54.	.87	
	HYDROGRAPH AT								
+		SUBB2	159.	1.75	28.	10.	10.	.18	
	2 COMBINED AT								
+		SUM7	1055.	1.92	177.	64.	64.	1.05	
	ROUTED TO								
+		RCH71	1054.	1.92	177.	64.	64.	1.05	
	HYDROGRAPH AT								
+		SUB50	17.	1.50	3.	1.	1.	.02	
	HYDROGRAPH AT								
		SUB60	59.	1.33	7.	3.	3.	.04	
	HYDROGRAPH AT								
+		SUB70	60.	1.25	6.	2.	2.	.03	
	5 COMBINED AT								
+		SUM71	1230.	1.92	225.	81.	81.	1.37	
	ROUTED TO								
+		RCH77	1203.	2.00	225.	81.	81.	1.37	
+									99.24 2.00
	HYDROGRAPH AT								
+		SUB75	37.	1.33	5.	2.	2.	.02	
	2 COMBINED AT								
+		SUM77	1212.	2.00	230.	83.	83.	1.39	
	ROUTED TO								
+		RCH241	1205.	2.00	230.	83.	83.	1.39	
+									99.41 2.00
	HYDROGRAPH AT								
+		SUB76	23.	1.75	7.	3.	3.	.06	
	HYDROGRAPH AT								
+		SUB80	66.	1.33	7.	3.	3.	.04	
	HYDROGRAPH AT								
+		SUB90	82.	1.42	11.	4.	4.	.06	
	2 COMBINED AT								
+		SUM91	147.	1.33	18.	6.	6.	.09	
	ROUTED TO								
		DET91	20.	2.25	13.	5.	5.	.09	
									105.64 2.25
	ROUTED TO								
+		RCH137	20.	2.42	13.	5.	5.	.09	
+									96.64 2.42

	HYDROGRAPH AT								
+		SUB100	11.	1.83	3.	1.	1.	.03	
	HYDROGRAPH AT								
+		SUB110	52.	1.25	4.	1.	1.	.02	
	HYDROGRAPH AT								
+		SUB130	43.	1.33	5.	2.	2.	.03	
	2 COMBINED AT								
+		SUM131	93.	1.25	9.	3.	3.	.05	
	ROUTED TO								
+		DET131	19.	1.83	7.	3.	3.	.05	
+									105.23 1.83
	3 COMBINED AT								
+		SUM137	47.	2.00	23.	9.	9.	.17	
	ROUTED TO								
+		RCH147	47.	2.08	23.	9.	9.	.17	
+									97.03 2.08
	HYDROGRAPH AT								
+		SUB140	42.	1.17	3.	1.	1.	.02	
	ROUTED TO								
+		DET141	3.	1.67	1.	0.	0.	.02	
+									102.52 1.67
	2 COMBINED AT								
+		SUM147	50.	2.00	24.	9.	9.	.19	
	ROUTED TO								
+		RCH167	50.	2.08	24.	9.	9.	.19	
+									97.06 2.08
	HYDROGRAPH AT								
+		SUB150	37.	1.25	3.	1.	1.	.02	
	HYDROGRAPH AT								
+		SUB160	83.	1.25	7.	3.	3.	.04	
	2 COMBINED AT								
+		SUM161	120.	1.25	10.	4.	4.	.06	
	ROUTED TO								
+		DET161	39.	1.58	8.	3.	3.	.06	
+									105.35 1.58
	2 COMBINED AT								
+		SUM167	83.	1.92	32.	12.	12.	.24	
	ROUTED TO								
+		RCH181	83.	2.00	32.	12.	12.	.24	
+									97.32 2.00
	HYDROGRAPH AT								
+		SUB170	98.	1.33	10.	4.	4.	.05	
	HYDROGRAPH AT								
+		SUB175	34.	1.58	8.	3.	3.	.06	
	HYDROGRAPH AT								
+		SUB180	8.	1.33	1.	0.	0.	.01	
	4 COMBINED AT								
+		SUM181	151.	1.42	50.	19.	19.	.36	
	ROUTED TO								
+		DET181	124.	2.00	47.	18.	18.	.36	
+									104.76 2.00
	HYDROGRAPH AT								
+		SUB190	102.	1.33	11.	4.	4.	.06	
	ROUTED TO								
+		RCH207	99.	1.33	10.	4.	4.	.06	

	HYDROGRAPH AT								
+		SUB200	80.	1.33	9.	3.	3.	.05	
	3 COMBINED AT								
+		SUM207	254.	1.42	66.	25.	25.	.47	
	HYDROGRAPH AT								
+		SUB210	62.	1.25	5.	2.	2.	.03	
	ROUTED TO								
+		RCH227	62.	1.25	5.	2.	2.	.03	
	HYDROGRAPH AT								
+		SUB220	63.	1.33	9.	3.	3.	.05	
	HYDROGRAPH AT								
+		SUB225	34.	1.25	3.	1.	1.	.01	
	3 COMBINED AT								
+		SUM227	150.	1.25	16.	6.	6.	.09	
	HYDROGRAPH AT								
+		SUB230	50.	1.42	6.	2.	2.	.04	
	3 COMBINED AT								
+		SUM231	421.	1.42	88.	33.	33.	.60	
	ROUTED TO								
+		DET231	69.	3.08	57.	26.	26.	.60	
+									105.39 3.08
	3 COMBINED AT								
+		SUM241	1285.	2.00	290.	111.	111.	2.05	
	ROUTED TO								
+		RCH267	1276.	2.00	290.	111.	111.	2.05	
+									99.20 2.00
	HYDROGRAPH AT								
		SUB250	38.	1.33	4.	2.	2.	.02	
	HYDROGRAPH AT								
+		SUB260	29.	1.25	2.	1.	1.	.01	
	3 COMBINED AT								
+		SUM267	1285.	2.00	296.	114.	114.	2.08	
	ROUTED TO								
+		RCH281	1285.	2.08	296.	114.	114.	2.08	
+									99.51 2.08
	HYDROGRAPH AT								
+		SUB270	12.	1.67	3.	1.	1.	.02	
	HYDROGRAPH AT								
+		SUB280	50.	1.25	4.	2.	2.	.02	
	3 COMBINED AT								
+		SUM281	1298.	2.08	303.	116.	116.	2.13	
	ROUTED TO								
+		DET281	1275.	2.17	296.	113.	113.	2.13	
+									105.92 2.17
	ROUTED TO								
+		RCH441	1277.	2.17	296.	113.	113.	2.13	
+									99.50 2.17
	HYDROGRAPH AT								
+		SUB290	21.	1.42	3.	1.	1.	.02	
	HYDROGRAPH AT								
+		SUB300	45.	1.25	4.	1.	1.	.02	
	2 COMBINED AT								
+		SUM301	61.	1.25	7.	2.	2.	.04	
	ROUTED TO								
+		DET301	8.	2.08	4.	2.	2.	.04	
+									104.40 2.08

	ROUTED TO								
+		RCH349	8.	2.42	4.	2.	2.	.04	
+									96.38 2.42
	HYDROGRAPH AT								
+		SUB310	18.	1.50	3.	1.	1.	.03	
	HYDROGRAPH AT								
+		SUB320	24.	1.33	3.	1.	1.	.01	
	HYDROGRAPH AT								
+		SUB330	9.	1.58	3.	1.	1.	.03	
	HYDROGRAPH AT								
+		SUBC	230.	1.75	34.	12.	12.	.19	
	2 COMBINED AT								
+		SUM337	239.	1.67	37.	13.	13.	.22	
	ROUTED TO								
+		RCH347	228.	1.83	37.	13.	13.	.22	
+									97.33 1.83
	HYDROGRAPH AT								
+		SUBD	304.	1.67	38.	14.	14.	.23	
	HYDROGRAPH AT								
+		SUB340	8.	1.33	1.	0.	0.	.01	
	3 COMBINED AT								
+		SUM347	505.	1.67	76.	28.	28.	.46	
	ROUTED TO								
+		RCH349	504.	1.75	76.	28.	28.	.46	
	4 COMBINED AT								
+		SUM349	535.	1.67	87.	31.	31.	.54	
	ROUTED TO								
+		DET349	470.	1.83	80.	29.	29.	.54	
+									105.78 1.83
	ROUTED TO								
+		RCH377	468.	1.92	80.	29.	29.	.54	
+									98.22 1.92
	HYDROGRAPH AT								
+		SUB350	17.	1.33	2.	1.	1.	.01	
	HYDROGRAPH AT								
+		SUB360	30.	1.25	3.	1.	1.	.01	
	HYDROGRAPH AT								
+		SUB370	48.	1.33	5.	2.	2.	.03	
	4 COMBINED AT								
+		SUM377	486.	1.92	90.	33.	33.	.60	
	ROUTED TO								
+		RCH407	458.	2.00	90.	33.	33.	.60	
+									98.19 2.00
	HYDROGRAPH AT								
+		SUB380	93.	1.33	12.	4.	4.	.05	
	HYDROGRAPH AT								
+		SUB390	38.	1.33	5.	2.	2.	.03	
	2 COMBINED AT								
+		SUM401	131.	1.33	17.	6.	6.	.08	
	ROUTED TO								
+		DET401	35.	2.00	13.	5.	5.	.08	
+									104.70 2.00
	HYDROGRAPH AT								
+		SUB400	48.	1.50	7.	3.	3.	.06	
	3 COMBINED AT								

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+                    SUM407      515.   2.00       109.       40.       40.       .74
        ROUTED TO
+                    RCH441      507.   2.08       109.       40.       40.       .74
+                                                                                          98.08       2.08
        HYDROGRAPH AT
+                    SUB410      108.   1.25        11.        4.        4.       .06
        HYDROGRAPH AT
+                    SUB425       27.   1.50         5.        2.        2.       .03
        HYDROGRAPH AT
+                    SUB440       25.   1.50         4.        2.        2.       .04
        5 COMBINED AT
+                    SUM441     1789.   2.17       422.      160.      160.      2.98
        ROUTED TO
+                    DET441     1737.   2.25       410.      155.      155.      2.98
+                                                                                         105.91       2.25
1
```

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
RCH21	MANE	.47	250.51	95.76	1.45	5.00	249.69	95.00	1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1306E+02 EXCESS= .0000E+00 OUTFLOW= .1307E+02 BASIN STORAGE= .3862E-05 PERCENT ERROR= -.1

RCH71	MANE	.50	1054.13	115.30	1.57	5.00	1053.66	115.00	1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8764E+02 EXCESS= .0000E+00 OUTFLOW= .8766E+02 BASIN STORAGE= .2712E-04 PERCENT ERROR= .0

RCH207	MANE	1.62	100.92	82.74	1.75	5.00	98.82	80.00	1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5207E+01 EXCESS= .0000E+00 OUTFLOW= .5218E+01 BASIN STORAGE= .2098E-06 PERCENT ERROR= -.2

RCH227	MANE	.58	61.58	75.31	1.75	5.00	61.51	75.00	1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2325E+01 EXCESS= .0000E+00 OUTFLOW= .2329E+01 BASIN STORAGE= .4183E-06 PERCENT ERROR= -.2

RCH349	MANE	.16	504.97	100.33	1.55	5.00	503.78	105.00	1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3774E+02 EXCESS= .0000E+00 OUTFLOW= .3774E+02 BASIN STORAGE= .1583E-05 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*          SEPTEMBER 1990              *
*           VERSION 4.0                *
*                                      *
  RUN DATE  01/10/1992  TIME  15:37:38 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
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```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

  1           ID
  2           ID        SUN CITY WEST EXPANSION
  3           ID        STANLEY CONSULTANTS JOB # 11028   DATE: 10 JAN 92
  4           ID        HEC-1 MODEL 11028N (DESIGN COND ONSITE)
  5           ID
  6           ID        ****** 11028N SAME AS 11028M EXCEPT NO OFFSITE CONTRIBUTION *****
  7           ID
  8           ID        CLARK UNIT HYDROGRAPH
  9           ID
 10           ID        2-HR STORM DISTRIBUTION (FCDMC HYDROLOGIC DESIGN MANUAL; TABLE 2.2)
 11           ID              P100 = 2.77"
 12           ID
 13           ID        NO AREAL REDUCTION FACTOR  (TYPICAL FOR ALL AREAS)
 14           ID
 15           ID        COMPUTATION TIME INTERVAL 5 MINUTES.
 16           ID
 17           ID        GREEN-AMPT LOSS RATES FOR ONSITE DEVELOPED CONDITIONS ARE AREA-WEIGHTED
 18           ID              FROM TABLE  2   OF THE CONCEPTUAL MASTER DRAINAGE REPORT.
 19           ID              BASIC LOSS RATES AND PERCENT IMPERVIOUS (FOR DEVELOPED CONDITION)
 20           ID              SELECTED TO PRODUCE RAINFALL EXCESS SIMILAR TO CORRESPONDING
 21           ID              RATIONAL RUNOFF COEFFICIENT FOR PARTICULAR LAND USE.
 22           ID
 23           ID        TIME OF CONCENTRATION AND STORAGE COEFFICIENT R ARE BASED ON RESULTS
 24           ID              FROM MCUHP1 WITH LENGTHS AND SLOPES ESTIMATED FROM PRELIMINARY
 25           ID              LOT LAYOUTS AND GRADING.
 26           ID
 27           ID        Kb BASED ON HYDRO MANUAL FIGURE/TABLE 3.1  (m=-0.025, b=.15 for exist)
 28           ID                                                   (m=-0.00625, b=.04 for urban)
 29           ID
 30           ID        TIME-AREA RELATION FROM TABLE 5.2:
 31           ID              ONSITE AREAS USE AN URBAN TIME-AREA UA RECORD
 32           ID
 33           ID        HYDROGRAPH ROUTING THROUGH STREET REACHES USES KENEMATIC WAVE
 34           ID              RECTANGULAR CHANNEL WITH WIDTH OF 68 FEET AND "n"=0.015
 35           ID
 36           ID        HYDROGRAPH ROUTING THROUGH GUNITE-LINED, TRAPEZOIDAL CHANNEL ASSUMES:
 37           ID              Wbase = 10'(MIN), 20'(MAX); Side Slope = .5:1 (H\V); n = .016
 38           ID
 39           ID        HYDROGRAPH ROUTING THROUGH GOLF COURSE CHANNELS ASSUMES:
 40           ID              MODIFIED PULS ROUTING, 100 FOOT TOTAL TOPWIDTH
 41           ID              LOW FLOW CHANNEL IS 10' BOTTOM WIDTH, SS=4:1, MANNING n = 0.025
 42           ID              (UNLESS SPECIFIED OTHERWISE)
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 43          ID              OVERBANK WIDTHS VARY AND HAVE SS=6:1, MANNING n = 0.030
 44          ID              CHANNEL SLOPE RANGES FROM 0.003 TO 0.006 FEET PER FEET
 45          ID              NSTPS (ON RS RECORD) = LENGTH \ (VEL * 300 SEC)
 46          ID              (VEL ASSUMED @ 5 FPS, TIME INTERVAL 5 MINUTES)
 47          ID
 48          ID        CULVERTS ARE ASSUMED TO NOT INFLUENCE CHANNEL ROUTING
 49          ID
 50          ID        HYDROGRAPH ROUTING THROUGH DETENTION BASINS ASSUMES:
 51          ID              TRAPEZOIDAL, LEVEL BOTTOM, 6:1 SIDESLOPES
 52          ID              BOTTOM WIDTHS RANGE FROM 50' TO 250' (100' TYPICAL)
 53          ID              BASIN OUTLETS ASSUME PIPE WITH INLET CONTROL.
 54          ID              PIPE SIZE RANGES FROM SINGLE 18" CMP TO 4 - 48" CMP
 55          ID              LOW-FLOWS ASSUME ORFICE EQUATION:
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 56          ID              Q = C * A(pipe) * H(above FL)^0.5
 57          ID              WHERE C IS ORIFICE COEFFICIENT ESTIMATED TO BE 0.37
 58          ID              (GIVES FLOWS SIMILAR TO RESULTS OF BPR INLET CONTROL CURVES)
 59          ID              WIERS ARE USED IN COMBINATION WITH PIPES
             *DIAGRAM
 60          IT       5                    200
 61          IO       5

 62          KK   SUB10        RUNOFF HG FROM SUB-BASIN 10
 63          BA   0.020
 64          IN       5
 65          PB   2.770
 66          PC    .000    .011    .018    .023    .028    .032    .046    .071    .100    .137
 67          PC    .176    .232    .327    .601    .743    .863    .901    .930    .954    .962
 68          PC    .970    .979    .982    .992   1.000
 69          LG     .15    .280     3.4     .80      37
 70          UC    .183    .208
 71          UA       0       5      16      30      65      77      84      90      94      97
 72          UA     100

 73          KK   SUB20        RUNOFF HG FROM SUB-BASIN 20
 74          BA    .012
 75          LG    .225    .295    2.65    1.10      10
 76          UC    .400    .422
 77          UA       0       5      16      30      65      77      84      90      94      97
 78          UA     100

 79          KK   SUM21        COMBINE HG FROM SUB10 & SUB20
 80          KM                INFLOW INTO DETENTION BASIN 21
 81          HC       2

 82          KK   DET21        ROUTE HG SUM21 THRU DET BASIN 21; Wb = 100'; L = 500'
 83          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-48" CMP
 84          RS       1    STOR
 85          SV       0    2.57    5.69    9.37
 86          SE     100     102     104     106
 87          SL     102    25.1     .37      .5
 88          SS   105.9     100     2.6     1.5

 89          KK   RCH51        ROUTE HG DET21 THRU REACH 51
 90          RS       5    FLOW      -1
 91          RC     .03    .025     .03    1400    .005
 92          RX     500     512     533     545     555     567     588     600
 93          RY     100      98      98      95      95      98      98     100

 94          KK   SUB30        RUNOFF HG FROM SUB-BASIN 30
 95          BA    .017
 96          LG    .150     .28     3.4     .80      37
 97          UC    .200    .286
 98          UA       0       5      16      30      65      77      84      90      94      97
 99          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

100          KK   SUB40        RUNOFF HG FROM SUB-BASIN 40
101          BA    .016
102          LG    .150     .28     3.4     .80      37
103          UC    .183    .273
104          UA       0       5      16      30      65      77      84      90      94      97
105          UA     100
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106          KK   SUM51        COMBINE HG FROM RCH51, SUB30 & SUB40
107          HC       3

108          KK   RCH71        ROUTE HG SUM51 THRU REACH 71
109          RS       1    FLOW      -1
110          RC     .03    .025     .03    1400    .005
111          RX     500     512     533     545     555     567     588     600
112          RY     100      98      98      95      95      98      98     100

113          KK   SUB50        RUNOFF HG FROM SUB-BASIN 50
114          BA    .022
115          LG    .225    .295    2.65    1.10      10
116          UC    .517    .602
117          UA       0       5      16      30      65      77      84      90      94      97
118          UA     100

119          KK   SUB60        RUNOFF HG FROM SUB-BASIN 60
120          BA    .036
121          LG     .14     .28     3.4     .80      43
122          UC    .267    .361
123          UA       0       5      16      30      65      77      84      90      94      97
124          UA     100

125          KK   SUB70        RUNOFF HG FROM SUB-BASIN 70
126          BA    .030
127          LG     .15     .28     3.4     .80      37
128          UC    .217    .233
129          UA       0       5      16      30      65      77      84      90      94      97
130          UA     100

131          KK   SUM71        COMBINE HG FROM SUB60 & SUB70
132          HC       4

133          KK   RCH77        ROUTE HG SUM71 THRU REACH 77
134          RS       1    FLOW      -1
135          RC     .03    .025     .03    1900    .005
136          RX     500     512     533     545     555     567     588     600
137          RY     100      98      98      95      95      98      98     100

138          KK   SUB75        RUNOFF HG FROM SUB-BASIN 75
139          BA    .024
140          LG     .15     .28     3.4     .80      37
141          UC    .250    .382
142          UA       0       5      16      30      65      77      84      90      94      97
143          UA     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

144          KK   SUM77        COMBINE HG FROM RCH77 AND SUB75
145          HC       2

146          KK  RCH241        ROUTE HG SUM77 THRU REACH 241 (WEST)
147          RS       1    FLOW      -1
148          RC     .03    .025     .03    1480    .004
149          RX     500     512     533     545     555     567     588     600
150          RY     100      98      98      95      95      98      98     100

151          KK   SUB76        RUNOFF HG FROM SUB-BASIN 76
152          BA    .056
153          LG    .225    .295    2.65    1.10      10
154          UC    .917   1.256
155          UA       0       5      16      30      65      77      84      90      94      97
156          UA     100

157          KK   SUB80        RUNOFF HG FROM SUB-BASIN 80
158          KM        ***** BEGIN NEW BRANCH ********
159          BA    .037
160          LG    .150     .28     3.4     .80      37
161          UC    .233    .277
162          UA       0       5      16      30      65      77      84      90      94      97
163          UA     100

164          KK   SUB90        RUNOFF HG FROM SUB-BASIN 90
165          BA    .058
166          LG    .150     .28     3.4     .80      37
167          UC    .383    .397
168          UA       0       5      16      30      65      77      84      90      94      97
169          UA     100
```

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170          KK   SUM91        COMBINE HG FROM SUB80 AND SUB90
171          KM                INFLOW INTO DETENTION BASIN 91
172          HC       2

173          KK   DET91        ROUTE HG SUM91 THRU DET BASIN 91; Wb = 100'; L =400'
174          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-18" CMP
175          RS       1    STOR
176          SV       0    2.06    4.55    7.49
177          SE     100     102     104     106
178          SL     102     3.5     .37      .5
179          SS   105.9     100     2.6     1.5

180          KK  RCH137        ROUTE HG DET91 THRU REACH 137   50-FOOT CHANNEL
181          RS       1    FLOW      -1
182          RC     .03    .025     .03    1660    .004
183          RX     500     508     508     520     530     542     542     550
184          RY     100      99      99      96      96      99      99     100
1                                          HEC-1 INPUT                                                    PAGE  5

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


185          KK  SUB100        RUNOFF HG FROM SUB-BASIN 100
186          BA    .027
187          LG    .225   .295    2.65    1.10      10
188          UC   1.033  1.283
189          UA       0       5      16      30      65      77      84      90      94      97
190          UA     100

191          KK  SUB110        RUNOFF HG FROM SUB-BASIN 110
192          BA    .022
193          LG    .150    .28     3.4     .80      37
194          UC    .167   .168
195          UA       0       5      16      30      65      77      84      90      94      97
196          UA     100

197          KK  SUB130        RUNOFF HG FROM SUB-BASIN 130
198          BA    .026
199          LG    .150    .28     3.4     .80      37
200          UC    .250   .330
201          UA       0       5      16      30      65      77      84      90      94      97
202          UA     100

203          KK  SUM131        COMBINE HG FROM SUB110 AND SUB130
204          KM                INFLOW INTO DETENTION BASIN 131
205          HC       2

206          KK  DET131        ROUTE HG SUM131 THRU DET BASIN 131; Wb = 100'; L  = 200'
207          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-18" CMP
208          RS       1    STOR
209          SV       0    1.03    2.28    3.75
210          SE     100     102     104     106
211          SL     102     3.5     .37      .5
212          SS   105.9     100     2.6     1.5

213          KK  SUM137        COMBINE HG FROM RCH137, DET131 AND SUB100
214          HC       3

215          KK  RCH147        ROUTE HG SUM137 THRU REACH 147, 50-FOOT CHANNEL
216          RS       1    FLOW      -1
217          RC     .03    .025     .03     600    .004
218          RX     500     508     508     520     530     542     542     550
219          RY     100      99      99      96      96      99      99     100

220          KK  SUB140        RUNOFF HG FROM SUB-BASIN 140
221          KM                INFLOW INTO DETENTION BASIN 141
222          BA    .016
223          LG    .150    .28     3.4     .80      37
224          UC    .133   .127
225          UA       0       5      16      30      65      77      84      90      94      97
226          UA     100
1                                          HEC-1 INPUT                                                    PAGE  6

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


227          KK  DET141        ROUTE HG SUB140 THRU DET BASIN 141; Wb = 50'; L = 200'
228          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-18" CMP
229          RS       1    STOR
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230          SV       0    1.03    2.28    3.75
231          SE     100     102     104     106
232          SL     102     1.8     .37      .5
233          SS   105.9     100     2.6     1.5

234          KK  SUM147        COMBINE HG FROM RCH147 & DET141
235          HC       2

236          KK  RCH167        ROUTE HG SUM147 THRU REACH 167
237          RS       1    FLOW      -1
238          RC     .03    .025     .03    1280    .004
239          RX     500     508     508     520     530     542     542     550
240          RY     100      99      99      96      96      99      99     100

241          KK  SUB150        RUNOFF HG FROM SUB-BASIN 150
242          BA    .017
243          LG    .150     .28     3.4     .80      37
244          UC    .167    .203
245          UA       0       5      16      30      65      77      84      90      94      97
246          UA     100

247          KK  SUB160        RUNOFF HG FROM SUB-BASIN 160
248          BA    .039
249          LG    .150     .28     3.4     .80      37
250          UC    .200    .207
251          UA       0       5      16      30      65      77      84      90      94      97
252          UA     100

253          KK  SUM161        COMBINE HG FROM SUB150 & SUB160
254          KM                INFLOW INTO DETENTION BASIN 161
255          HC       2

256          KK  DET161        ROUTE HG SUM161 THRU DET BASIN 161; Wb = 100'; L  = 200'
257          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-36" CMP
258          RS       1    STOR
259          SV       0    1.03    2.28    3.75
260          SE     100     102     104     106
261          SL     102     7.1     .37      .5
262          SS   105.9     100     2.6     1.5

263          KK  SUM167        COMBINE HG FROM RCH167 & DET161
264          HC       2

265          KK  RCH181        ROUTE HG SUM147 THRU REACH 181, 50-FOOT CHANNEL
266          RS       1    FLOW      -1
267          RC     .03    .025     .03    1460    .005
268          RX     500     508     508     520     530     542     542     550
269          RY     100      99      99      96      96      99      99     100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

270          KK  SUB170        RUNOFF HG FROM SUB-BASIN 170
271          BA    .053
272          LG    .150     .28     3.4     .80      37
273          UC    .250    .259
274          UA       0       5      16      30      65      77      84      90      94      97
275          UA     100

276          KK  SUB175        RUNOFF HG FROM SUB-BASIN 175
277          BA    .063
278          LG    .230    .296     2.6    1.12     8.2
279          UC    .750    .887
280          UA       0       5      16      30      65      77      84      90      94      97
281          UA     100

282          KK  SUB180        RUNOFF HG FROM SUB-BASIN 180
283          BA    .006
284          LG    .150     .28     3.4     .80      37
285          UC    .267    .506
286          UA       0       5      16      30      65      77      84      90      94      97
287          UA     100

288          KK  SUM181        COMBINE HG FROM RCH181, SUB170, SUB175 AND SUB180
289          KM                INFLOW INTO DETENTION BASIN 181
290          HC       4

291          KK  DET181        ROUTE HG SUM181 THRU DET BASIN 181; Wb = 100'; L  = 300'
292          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 2-48" CMP
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293          RS       1    STOR
294          SV       0    1.54    3.42    5.62
295          SE     100     102     104     106
296          SL     102    25.1     .37      .5
297          SS   105.9     100     2.6     1.5

298          KK  SUB190        RUNOFF HG FROM SUB-BASIN 190
299          BA    .056
300          LG    .150     .28     3.4     .80      37
301          UC    .267    .273
302          UA       0       5      16      30      65      77      84      90      94      97
303          UA     100

304          KK  RCH207        ROUTE HG SUB190 THRU REACH 207 (WEST); 68' STREET
305          RK    2440    .003    .015            DEEP      68

306          KK  SUB200        RUNOFF HG FROM SUB-BASIN 200
307          BA    .050
308          LG     .15     .28     3.4     .80      37
309          UC    .300    .341
310          UA       0       5      16      30      65      77      84      90      94      97
311          UA     100
1                                          HEC-1 INPUT                                          PAGE  8

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


312          KK  SUM207        COMBINE HG FROM DET181, RCH207 (WEST) AND SUB200
313          HC       3

314          KK  SUB210        RUNOFF HG FROM SUB-BASIN 210
315          BA    .025
316          LG     .15     .28     3.4     .80      37
317          UC    .167    .143
318          UA       0       5      16      30      65      77      84      90      94      97
319          UA     100

320          KK  RCH227        ROUTE HG SUB210 THRU REACH 227; 10' GUNITE CHANNEL
321          RK     560    .002    .016            TRAP      10      .5

322          KK  SUB220        RUNOFF HG FROM SUB-BASIN 220
323          BA    .046
324          LG     .15     .28     3.4     .80      37
325          UC    .333    .436
326          UA       0       5      16      30      65      77      84      90      94      97
327          UA     100

328          KK  SUB225        RUNOFF HG FROM SUB-BASIN 225
329          BA    .014
330          LG     .15     .28     3.4     .80      37
331          UC    .150    .157
332          UA       0       5      16      30      65      77      84      90      94      97
333          UA     100

334          KK  SUM227        COMBINE HG FROM RCH227, SUB220 & SUB225
335          HC       3

336          KK  SUB230        RUNOFF HG FROM SUB-BASIN 230
337          BA    .041
338          LG     .22    .298     2.5    1.16      16
339          UC    .450    .317
340          UA       0       5      16      30      65      77      84      90      94      97
341          UA     100

342          KK  SUM231        COMBINE HG FROM SUM207, SUM227 & SUB230
343          KM                INFLOW INTO DETENTION BASIN 231
344          HC       3

345          KK  DET231        ROUTE HG SUM231 THRU DET BASIN 231; Wb = 250'; L = 800'
346          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-48" CMP
347          RS       1    STOR
348          SV       0    9.62   20.13   31.52
349          SE     100     102     104     106
350          SL     102    12.6     .37      .5
351          SS   105.9     100     2.6     1.5
1                                          HEC-1 INPUT                                          PAGE  9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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352          KK  SUM241        COMBINE HG FROM RCH241 (WEST), DET231 & SUB76
353          HC       3

354          KK  RCH267        ROUTE HG SUM241 THRU REACH 267
355          RS       1    FLOW      -1
356          RC     .03    .025     .03     700    .006
357          RX     500     512     533     545     555     567     588     600
358          RY     100      98      98      95      95      98      98     100

359          KK  SUB250        RUNOFF HG FROM SUB-BASIN 250
360          BA    .023
361          LG     .15     .28     3.4     .80      37
362          UC    .233    .333
363          UA       0       5      16      30      65      77      84      90      94      97
364          UA     100

365          KK  SUB260        RUNOFF HG FROM SUB-BASIN 260
366          BA    .013
367          LG     .15     .28     3.4     .80      37
368          UC    .150    .198
369          UA       0       5      16      30      65      77      84      90      94      97
370          UA     100

371          KK  SUM267        COMBINE HG FROM RCH267, SUB250 & SUB260
372          HC       3

373          KK  RCH281        ROUTE HG SUM267 THRU REACH 281
374          RS       1    FLOW      -1
375          RC     .03    .025     .03    1180    .004
376          RX     500     512     533     545     555     567     588     600
377          RY     100      98      98      95      95      98      98     100

378          KK  SUB270        RUNOFF HG FROM SUB-BASIN 270
379          BA    .024
380          LG    .225    .295    2.65    1.10      10
381          UC    .900    .953
382          UA       0       5      16      30      65      77      84      90      94      97
383          UA     100

384          KK  SUB280        RUNOFF HG FROM SUB-BASIN 280
385          BA    .024
386          LG    .150     .28     3.4     .80      37
387          UC    .183    .222
388          UA       0       5      16      30      65      77      84      90      94      97
389          UA     100

390          KK  SUM281        COMBINE HG FROM RCH281, SUB270 & SUB280
391          KM                INFLOW INTO DETENTION BASIN 281
392          HC       3
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

393          KK  DET281        ROUTE HG SUM281 THRU DET BASIN 281; Wb = 100'; L  = 800'
394          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 4-48" CMP
395          RS       1    STOR
396          SV       0    4.11    9.11   14.99
397          SE     100     102     104     106
398          SL     102    50.3     .37      .5
399          SS   103.5     100     2.6     1.5

400          KK  RCH441        ROUTE HG DET281 THRU REACH 441 (WEST)
401          RS       1    FLOW      -1
402          RC     .03    .025     .03     580    .004
403          RX     500     512     533     545     555     567     588     600
404          RY     100      98      98      95      95      98      98     100

405          KK  SUB290        RUNOFF HG FROM SUB-BASIN 290
406          KM          ************ BEGIN NEW BRANCH *************
407          BA    .021
408          LG    .225    .295    2.65    1.10      10
409          UC    .400    .437
410          UA       0       5      16      30      65      77      84      90      94      97
411          UA     100

412          KK  SUB300        RUNOFF HG FROM SUB-BASIN 300
413          BA    .021
414          LG    .150     .28     3.4     .80      37
415          UC    .167    .211
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416          UA      0      5     16     30     65     77     84     90     94     97
417          UA    100

418          KK  SUM301        COMBINE HG FROM SUB290 & SUB300
419          KM                INFLOW INTO DETENTION BASIN 301
420          HC      2

421          KK  DET301        ROUTE HG SUM301 THRU DET BASIN 301; Wb = 100'; L  = 200'
422          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-18" CMP
423          RS      1    STOR
424          SV      0    1.03   2.28   3.75
425          SE    100     102    104    106
426          SL    102     1.8    .37     .5
427          SS  105.9     100    2.6    1.5

428          KK  RCH349        ROUTE HG DET301 THRU REACH 349 (WEST)
429          RS      1    FLOW     -1
430          RC    .03    .025    .03   1800   .004
431          RX    500     508    508    520    530    542    542    550
432          RY    100      99     99     96     96     99     99    100

433          KK  SUB310        RUNOFF HG FROM SUB-BASIN 310
434          BA   .027
435          LG   .225    .295   2.65   1.10     10
436          UC   .600    .726
437          UA      0       5     16     30     65     77     84     90     94     97
438          UA    100
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

439          KK  SUB320        RUNOFF HG FROM SUB-BASIN 320
440          BA   .015
441          LG   .150     .28    3.4    .80     37
442          UC   .217    .342
443          UA      0       5     16     30     65     77     84     90     94     97
444          UA    100

445          KK  SUB330        RUNOFF HG FROM SUB-BASIN 330
446          BA   .027
447          LG    .25     .30    2.4   1.20      1
448          UC   .533   1.470
449          UA      0       5     16     30     65     77     84     90     94     97
450          UA    100

451          KK  RCH347        ROUTE HG SUB330 THRU REACH 347
452          RS      1    FLOW     -1
453          RC    .03    .025    .03   2020   .004
454          RX    500     512    533    545    555    567    588    600
455          RY    100      98     98     95     95     98     98    100

456          KK  SUB340        RUNOFF HG FROM SUB-BASIN 340
457          BA   .008
458          LG    .25     .30    2.4   1.20      1
459          UC   .233    .371
460          UA      0       5     16     30     65     77     84     90     94     97
461          UA    100

462          KK  SUM347        COMBINE HG FROM RCH347 AND SUB340
463          HC      2

464          KK  SUM349        COMBINE HG FROM RCH349, SUM347, SUB310 & SUB320
465          KM                INFLOW INTO DETENTION BASIN 349
466          HC      4

467          KK  DET349        ROUTE HG SUM349 THRU DET BASIN 349; Wb = 100'; L  = 600'
468          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 4-48" CMP
469          RS      1    STOR
470          SV      0    3.09   6.83  11.24
471          SE    100     102    104    106
472          SL    102    50.3    .37     .5
473          SS  105.0     100    2.6    1.5

474          KK  RCH377        ROUTE HG DET349 THRU REACH 377
475          RS      1    FLOW     -1
476          RC    .03    .025    .03    900   .004
477          RX    500     512    533    545    555    567    588    600
478          RY    100      98     98     95     95     98     98    100
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479          KK  SUB350        RUNOFF HG FROM SUB-BASIN 350
480          BA    .013
481          LG    .225    .295    2.65    1.10      10
482          UC    .317    .309
483          UA       0       5      16      30      65      77      84      90      94      97
484          UA     100
                                          HEC-1 INPUT                                          PAGE 12

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


485          KK  SUB360        RUNOFF HG FROM SUB-BASIN 360
486          BA    .015
487          LG    .150     .28     3.4     .80      37
488          UC    .183    .243
489          UA       0       5      16      30      65      77      84      90      94      97
490          UA     100

491          KK  SUB370        RUNOFF HG FROM SUB-BASIN 370
492          BA    .028
493          LG    .150     .28     3.4     .80      37
494          UC    .250    .305
495          UA       0       5      16      30      65      77      84      90      94      97
496          UA     100

497          KK  SUM377        COMBINE HG FROM RCH377, SUB350, SUB360 & SUB370
498          HC       4

499          KK  RCH407        ROUTE HG SUM377 THRU REACH 407
500          RS       1    FLOW      -1
501          RC     .03    .025     .03    1820    .004
502          RX     500     512     533     545     555     567     588     600
503          RY     100      98      98      95      95      98      98     100

504          KK  SUB380        RUNOFF HG FROM SUB-BASIN 380
505          BA    .052
506          LG     .13     .28    3.40     .80      59
507          UC    .300    .349
508          UA       0       5      16      30      65      77      84      90      94      97
509          UA     100

510          KK  SUB390        RUNOFF HG FROM SUB-BASIN 390
511          BA    .028
512          LG     .15     .28     3.4     .80      37
513          UC    .267    .471
514          UA       0       5      16      30      65      77      84      90      94      97
515          UA     100

516          KK  SUM401        COMBINE HG FROM SUB380, SUB390
517          KM                INFLOW INTO DETENTION BASIN 401
518          HC       2

519          KK  DET401        ROUTE HG SUM401 THRU DET BASIN 401; Wb = 150'; L = 400'
520          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 1-36" CMP
521          RS       1    STOR
522          SV       0    2.06    4.55    7.49
523          SE     100     102     104     106
524          SL     102     7.1     .37      .5
525          SS   105.9     100     2.6     1.5
1                                         HEC-1 INPUT                                          PAGE 13

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


526          KK  SUB400        RUNOFF HG FROM SUB-BASIN 400
527          BA    .058
528          LG    .192    .297    2.55    1.14     6.4
529          UC    .633    .473
530          UA       0       5      16      30      65      77      84      90      94      97
531          UA     100

532          KK  SUM407        COMBINE HG FROM SUB400, RCH407 & DET401
533          HC       3

534          KK  RCH441        ROUTE HG SUM407 THRU REACH 441 (NORTH)
535          RS       1    FLOW      -1
536          RC     .03    .025     .03    1160    .006
537          RX     500     512     533     545     555     567     588     600
538          RY     100      98      98      95      95      98      98     100
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539          KK  SUB410        RUNOFF HG FROM SUB-BASIN 410
540          BA    .056
541          LG     .15     .28     3.4     .80      37
542          UC    .233    .242
543          UA       0       5      16      30      65      77      84      90      94      97
544          UA     100

545          KK  SUB425        RUNOFF HG FROM SUB-BASIN 425
546          BA    .029
547          LG     .15     .28     3.4      .8      37
548          UC    .450    .759
549          UA       0       5      16      30      65      77      84      90      94      97
550          UA     100

551          KK  SUB440        RUNOFF HG FROM SUB-BASIN 440
552          BA    .035
553          LG    .192    .297    2.55    1.14     6.4
554          UC    .567    .622
555          UA       0       5      16      30      65      77      84      90      94      97
556          UA     100

557          KK  SUM441        COMBINE HG FROM RCH441 (WEST & NORTH), SUB410, SUB425 & SUB440
558          KM                INFLOW INTO DETENTION BASIN 441
559          HC       5

560          KK  DET441        ROUTE HG SUM401 THRU DET BASIN 441; Wb = 150'; L = 1000'
561          KM                100-FOOT WIER USED FOR HIGH FLOWS AND 6-48" CMP
562          KM                ****** OUTFLOW EXITS AT SE CORNER OF EXPANSION AREA ******
563          RS       1    STOR
564          SV       0    7.44   15.98   25.62
565          SE     100     102     104     106
566          SL     102    75.4     .37      .5
567          SS   103.0     100     2.6     1.5
568          ZZ
```

1

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

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   62       SUB10
                .
                .
   73           .       SUB20
                .           .
                .           .
   79       SUM21............
                V
                V
   82       DET21
                V
                V
   89       RCH51
                .
                .
   94           .       SUB30
                .           .
                .           .
  100           .           .       SUB40
                .           .           .
                .           .           .
  106       SUM51........................
                V
                V
  108       RCH71
                .
                .
  113           .       SUB50
                .           .
                .           .
  119           .           .       SUB60
                .           .           .
                .           .           .
  125           .           .           .       SUB70
                .           .           .           .
                .           .           .           .
  131       SUM71.....................................
                V
                V
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133     RCH77
            .
            .
138         .       SUB75
            .          .
            .          .
 44     SUM77............
            V
            V
146    RCH241
            .
            .
151         .       SUB76
            .          .
            .          .
157         .          .      SUB80
            .          .        .
            .          .        .
164         .          .        .      SUB90
            .          .        .        .
            .          .        .        .
170         .          .      SUM91............
            .          .        V
            .          .        V
173         .          .      DET91
            .          .        V
            .          .        V
180         .          .     RCH137
            .          .        .
            .          .        .
185         .          .        .     SUB100
            .          .        .        .
            .          .        .        .
191         .          .        .        .     SUB110
            .          .        .        .        .
            .          .        .        .        .
197         .          .        .        .        .     SUB130
            .          .        .        .        .        .
            .          .        .        .        .        .
 03         .          .        .        .     SUM131............
            .          .        .        .        V
            .          .        .        .        V
206         .          .        .        .     DET131
            .          .        .        .        .
            .          .        .        .        .
213         .          .     SUM137......................
            .          .        V
            .          .        V
215         .          .     RCH147
            .          .        .
            .          .        .
220         .          .        .     SUB140
            .          .        .        V
            .          .        .        V
227         .          .        .     DET141
            .          .        .        .
            .          .        .        .
234         .          .     SUM147............
            .          .        V
            .          .        V
236         .          .     RCH167
            .          .        .
            .          .        .
241         .          .        .     SUB150
            .          .        .        .
            .          .        .        .
247         .          .        .        .     SUB160
            .          .        .        .        .
            .          .        .        .        .
253         .          .        .     SUM161............
            .          .        .        V
            .          .        .        V
256         .          .        .     DET161
            .          .        .        .
            .          .        .        .
263         .          .     SUM167............
            .          .        V
            .          .        V
265         .          .     RCH181
            .          .        .
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270                 SUB170
                       .
                       .
276                    .        SUB175
                       .           .
                       .           .
282                    .           .        SUB180
                       .           .           .
                       .           .           .
288            SUM181.....................................
                   V
                   V
291            DET181
                   .
                   .
298                 SUB190
                       V
                       V
304                 RCH207
                       .
                       .
306                    .        SUB200
                       .           .
                       .           .
312            SUM207.......................
                   .
                   .
314                 SUB210
                       V
                       V
320                 RCH227
                       .
                       .
322                    .        SUB220
                       .           .
                       .           .
328                    .           .        SUB225
                       .           .           .
                       .           .           .
334                 SUM227.......................
                       .
                       .
336                    .        SUB230
                       .           .
                       .           .
342            SUM231.......................
                   V
                   V
345            DET231
                   .
                   .
352     SUM241.......................
            V
            V
354     RCH267
            .
            .
359         .     SUB250
                     .
                     .
365         .     SUB260
                     .
                     .
371     SUM267.......................
            V
            V
373     RCH281
            .
            .
378         .     SUB270
                     .
                     .
384         .     SUB280
                     .
                     .
390     SUM281.......................
            V
            V
393     DET281
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                V
                V
400       RCH441
                .
                .
405             .     SUB290
                .          .
                .          .
412             .          .     SUB300
                .          .          .
                .          .          .
418             .     SUM301............
                .          V
                .          V
421             .     DET301
                .          V
                .          V
428             .     RCH349
                .          .
                .          .
433             .          .     SUB310
                .          .          .
                .          .          .
439             .          .          .     SUB320
                .          .          .          .
                .          .          .          .
445             .          .          .          .     SUB330
                .          .          .          .          V
                .          .          .          .          V
451             .          .          .          .     RCH347
                .          .          .          .          .
                .          .          .          .          .
456             .          .          .          .          .     SUB340
                .          .          .          .          .          .
                .          .          .          .          .          .
462             .          .          .          .     SUM347............
                .          .          .          .          .
                .          .          .          .          .
464             .     SUM349.................................
                .          V
                .          V
467             .     DET349
                .          V
                .          V
474             .     RCH377
                .          .
                .          .
479             .          .     SUB350
                .          .          .
                .          .          .
485             .          .          .     SUB360
                .          .          .          .
                .          .          .          .
491             .          .          .          .     SUB370
                .          .          .          .          .
                .          .          .          .          .
497             .     SUM377.................................
                .          V
                .          V
499             .     RCH407
                .          .
                .          .
504             .          .     SUB380
                .          .          .
                .          .          .
510             .          .          .     SUB390
                .          .          .          .
                .          .          .          .
516             .          .     SUM401............
                .          .          V
                .          .          V
519             .          .     DET401
                .          .          .
                .          .          .
 26             .          .          .     SUB400
                .          .          .          .
                .          .          .          .
532             .     SUM407........................
                .          V
                .          V
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534          .      RCH441
             .          .
             .          .
539          .          .     SUB410
             .          .          .
             .          .          .
545          .          .          .     SUB425
             .          .          .          .
             .          .          .          .
551          .          .          .          .     SUB440
             .          .          .          .          .
             .          .          .          .          .
557     SUM441.............................................
             V
             V
560     DET441
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/10/1992  TIME  15:37:38 *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

SUN CITY WEST EXPANSION
STANLEY CONSULTANTS JOB # 11028 DATE: 10 JAN 92
HEC-1 MODEL 11028N (DESIGN COND ONSITE)

****** 11028N SAME AS 11028M EXCEPT NO OFFSITE CONTRIBUTION *****

CLARK UNIT HYDROGRAPH

2-HR STORM DISTRIBUTION (FCDMC HYDROLOGIC DESIGN MANUAL; TABLE 2.2)
P100 = 2.77"

NO AREAL REDUCTION FACTOR (TYPICAL FOR ALL AREAS)

COMPUTATION TIME INTERVAL 5 MINUTES

GREEN-AMPT LOSS RATES FOR ONSITE DEVELOPED CONDITIONS ARE AREA-WEIGHTED
FROM TABLE 2 OF THE CONCEPTUAL MASTER DRAINAGE REPORT.
BASIC LOSS RATES AND PERCENT IMPERVIOUS (FOR DEVELOPED CONDITION)
SELECTED TO PRODUCE RAINFALL EXCESS SIMILAR TO CORRESPONDING
RATIONAL RUNOFF COEFFICIENT FOR PARTICULAR LAND USE.

TIME OF CONCENTRATION AND STORAGE COEFFICIENT R ARE BASED ON RESULTS
FROM MCUHP1 WITH LENGTHS AND SLOPES ESTIMATED FROM PRELIMINARY
LOT LAYOUTS AND GRADING.

Kb BASED ON HYDRO MANUAL FIGURE/TABLE 3.1 (m=-0.025, b=.15 for exist)
(m=-0.00625, b=.04 for urban)

TIME-AREA RELATION FROM TABLE 5.2:
ONSITE AREAS USE AN URBAN TIME-AREA UA RECORD

HYDROGRAPH ROUTING THROUGH STREET REACHES USES KENEMATIC WAVE
RECTANGULAR CHANNEL WITH WIDTH OF 68 FEET AND "n"=0.015

HYDROGRAPH ROUTING THROUGH GUNITE-LINED, TRAPEZOIDAL CHANNEL ASSUMES:
Wbase = 10'(MIN), 20'(MAX); Side Slope = .5:1 (H\V); n = .016

HYDROGRAPH ROUTING THROUGH GOLF COURSE CHANNELS ASSUMES:
MODIFIED PULS ROUTING, 100 FOOT TOTAL TOPWIDTH
LOW FLOW CHANNEL IS 10' BOTTOM WIDTH, SS=4:1, MANNING n = 0.025
(UNLESS SPECIFIED OTHERWISE)
OVERBANK WIDTHS VARY AND HAVE SS=6:1, MANNING n = 0.030
CHANNEL SLOPE RANGES FROM 0.003 TO 0.006 FEET PER FEET
NSTPS (ON RS RECORD) = LENGTH \ (VEL * 300 SEC)
(VEL ASSUMED @ 5 FPS, TIME INTERVAL 5 MINUTES)

CULVERTS ARE ASSUMED TO NOT INFLUENCE CHANNEL ROUTING

```
                    HYDROGRAPH ROUTING THROUGH DETENTION BASINS ASSUMES:
                          TRAPEZOIDAL, LEVEL BOTTOM, 6:1 SIDESLOPES
                          BOTTOM WIDTHS RANGE FROM 50' TO 250' (100' TYPICAL)
                          BASIN OUTLETS ASSUME PIPE WITH INLET CONTROL.
                          PIPE SIZE RANGES FROM SINGLE 18" CMP TO 4 - 48" CMP
                          LOW-FLOWS ASSUME ORFICE EQUATION:
                          Q = C * A(pipe) * H(above FL)^0.5
                          WHERE C IS ORIFICE COEFFICIENT ESTIMATED TO BE 0.37
                          (GIVES FLOWS SIMILAR TO RESULTS OF BPR INLET CONTROL CURVES)
                          WIERS ARE USED IN COMBINATION WITH PIPES

61 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                    NMIN          5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1   0  ENDING DATE
                  NDTIME       1635  ENDING TIME
                   ICENT         19  CENTURY MARK

             COMPUTATION INTERVAL     .08 HOURS
                  TOTAL TIME BASE   16.58 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT
1
                                          RUNOFF SUMMARY
                                     FLOW IN CUBIC FEET PER SECOND
                                  TIME IN HOURS,  AREA IN SQUARE MILES

                                 PEAK   TIME OF   AVERAGE FLOW FOR MAXIMUM PERIOD   BASIN   MAXIMUM   TIME OF
       OPERATION       STATION   FLOW    PEAK                                       AREA    STAGE    MAX STAGE
+                                                  6-HOUR     24-HOUR     72-HOUR
       HYDROGRAPH AT
+                      SUB10     43.    1.25        4.         1.          1.       .02
       HYDROGRAPH AT
+                      SUB20     12.    1.42        2.         1.          1.       .01
       2 COMBINED AT
+                      SUM21     52.    1.25        5.         2.          2.       .03
       ROUTED TO
+                      DET21      1.    2.83        0.         0.          0.       .03
+                                                                                          102.01     2.83
       ROUTED TO
+                      RCH51      0.    3.17        0.         0.          0.       .03
+                                                                                           95.03     3.17
       HYDROGRAPH AT
+                      SUB30     31.    1.25        3.         1.          1.       .02
       HYDROGRAPH AT
+                      SUB40     30.    1.25        3.         1.          1.       .02
       3 COMBINED AT
+                      SUM51     60.    1.25        6.         2.          2.       .06
       ROUTED TO
                       RCH71     55.    1.33        6.         2.          2.       .06
                                                                                           96.06     1.33
       HYDROGRAPH AT
+                      SUB50     17.    1.50        3.         1.          1.       .02
       HYDROGRAPH AT
```

+		SUB60	59.	1.33	7.	3.	3.	.04		
	HYDROGRAPH AT									
+		SUB70	60.	1.25	6.	2.	2.	.03		
	4 COMBINED AT									
+		SUM71	185.	1.33	22.	8.	8.	.15		
	ROUTED TO									
+		RCH77	172.	1.42	22.	8.	8.	.15		
+									96.92	1.42
	HYDROGRAPH AT									
+		SUB75	37.	1.33	5.	2.	2.	.02		
	2 COMBINED AT									
+		SUM77	206.	1.42	26.	10.	10.	.18		
	ROUTED TO									
+		RCH241	197.	1.50	26.	10.	10.	.18		
+									97.17	1.50
	HYDROGRAPH AT									
+		SUB76	23.	1.75	7.	3.	3.	.06		
	HYDROGRAPH AT									
+		SUB80	66.	1.33	7.	3.	3.	.04		
	HYDROGRAPH AT									
+		SUB90	82.	1.42	11.	4.	4.	.06		
	2 COMBINED AT									
+		SUM91	147.	1.33	18.	6.	6.	.09		
	ROUTED TO									
+		DET91	20.	2.25	13.	5.	5.	.09		
+									105.64	2.25
	ROUTED TO									
+		RCH137	20.	2.42	13.	5.	5.	.09		
+									96.64	2.42
	HYDROGRAPH AT									
+		SUB100	11.	1.83	3.	1.	1.	.03		
	HYDROGRAPH AT									
+		SUB110	52.	1.25	4.	1.	1.	.02		
	HYDROGRAPH AT									
+		SUB130	43.	1.33	5.	2.	2.	.03		
	2 COMBINED AT									
+		SUM131	93.	1.25	9.	3.	3.	.05		
	ROUTED TO									
+		DET131	19.	1.83	7.	3.	3.	.05		
+									105.23	1.83
	3 COMBINED AT									
+		SUM137	47.	2.00	23.	9.	9.	.17		
	ROUTED TO									
+		RCH147	47.	2.08	23.	9.	9.	.17		
+									97.03	2.08
	HYDROGRAPH AT									
+		SUB140	42.	1.17	3.	1.	1.	.02		
	ROUTED TO									
+		DET141	3.	1.67	1.	0.	0.	.02		
+									102.52	1.67
	2 COMBINED AT									
+		SUM147	50.	2.00	24.	9.	9.	.19		
	ROUTED TO									
+		RCH167	50.	2.08	24.	9.	9.	.19		
+									97.06	2.08
	HYDROGRAPH AT									

+		SUB150	37.	1.25	3.	1.	1.	.02		
	HYDROGRAPH AT									
+		SUB160	83.	1.25	7.	3.	3.	.04		
	2 COMBINED AT									
		SUM161	120.	1.25	10.	4.	4.	.06		
	ROUTED TO									
+		DET161	39.	1.58	8.	3.	3.	.06		
+									105.35	1.58
	2 COMBINED AT									
+		SUM167	83.	1.92	32.	12.	12.	.24		
	ROUTED TO									
+		RCH181	83.	2.00	32.	12.	12.	.24		
+									97.32	2.00
	HYDROGRAPH AT									
+		SUB170	98.	1.33	10.	4.	4.	.05		
	HYDROGRAPH AT									
+		SUB175	34.	1.58	8.	3.	3.	.06		
	HYDROGRAPH AT									
+		SUB180	8.	1.33	1.	0.	0.	.01		
	4 COMBINED AT									
+		SUM181	151.	1.42	50.	19.	19.	.36		
	ROUTED TO									
+		DET181	124.	2.00	47.	18.	18.	.36		
+									104.76	2.00
	HYDROGRAPH AT									
+		SUB190	102.	1.33	11.	4.	4.	.06		
	ROUTED TO									
		RCH207	99.	1.33	10.	4.	4.	.06		
	HYDROGRAPH AT									
+		SUB200	80.	1.33	9.	3.	3.	.05		
	3 COMBINED AT									
+		SUM207	254.	1.42	66.	25.	25.	.47		
	HYDROGRAPH AT									
+		SUB210	62.	1.25	5.	2.	2.	.03		
	ROUTED TO									
+		RCH227	62.	1.25	5.	2.	2.	.03		
	HYDROGRAPH AT									
+		SUB220	63.	1.33	9.	3.	3.	.05		
	HYDROGRAPH AT									
+		SUB225	34.	1.25	3.	1.	1.	.01		
	3 COMBINED AT									
+		SUM227	150.	1.25	16.	6.	6.	.09		
	HYDROGRAPH AT									
+		SUB230	50.	1.42	6.	2.	2.	.04		
	3 COMBINED AT									
+		SUM231	421.	1.42	88.	33.	33.	.60		
	ROUTED TO									
+		DET231	69.	3.08	57.	26.	26.	.60		
+									105.39	3.08
	3 COMBINED AT									
		SUM241	235.	1.50	87.	38.	38.	.83		
	ROUTED TO									
+		RCH267	236.	1.58	87.	38.	38.	.83		
+									97.15	1.58
	HYDROGRAPH AT									

+		SUB250	38.	1.33	4.	2.	2.	.02		
+	HYDROGRAPH AT	SUB260	29.	1.25	2.	1.	1.	.01		
+	3 COMBINED AT	SUM267	270.	1.50	93.	40.	40.	.87		
+	ROUTED TO	RCH281	268.	1.58	93.	40.	40.	.87		
+									97.53	1.58
+	HYDROGRAPH AT	SUB270	12.	1.67	3.	1.	1.	.02		
+	HYDROGRAPH AT	SUB280	50.	1.25	4.	2.	2.	.02		
+	3 COMBINED AT	SUM281	298.	1.58	100.	43.	43.	.91		
+	ROUTED TO	DET281	244.	1.83	93.	40.	40.	.91		
+									103.61	1.83
+	ROUTED TO	RCH441	244.	1.83	93.	40.	40.	.91		
+									97.41	1.83
+	HYDROGRAPH AT	SUB290	21.	1.42	3.	1.	1.	.02		
+	HYDROGRAPH AT	SUB300	45.	1.25	4.	1.	1.	.02		
+	2 COMBINED AT	SUM301	61.	1.25	7.	2.	2.	.04		
+	ROUTED TO	DET301	8.	2.08	4.	2.	2.	.04		
+									104.40	2.08
+	ROUTED TO	RCH349	8.	2.42	4.	2.	2.	.04		
+									96.38	2.42
+	HYDROGRAPH AT	SUB310	18.	1.50	3.	1.	1.	.03		
+	HYDROGRAPH AT	SUB320	24.	1.33	3.	1.	1.	.01		
+	HYDROGRAPH AT	SUB330	9.	1.58	3.	1.	1.	.03		
+	ROUTED TO	RCH347	8.	1.92	3.	1.	1.	.03		
+									95.36	1.92
+	HYDROGRAPH AT	SUB340	8.	1.33	1.	0.	0.	.01		
+	2 COMBINED AT	SUM347	11.	1.67	4.	1.	1.	.04		
+	4 COMBINED AT	SUM349	49.	1.42	14.	5.	5.	.12		
+	ROUTED TO	DET349	23.	2.42	8.	3.	3.	.12		
+									102.22	2.42
+	ROUTED TO	RCH377	23.	2.50	8.	3.	3.	.12		
+									95.69	2.50
+	HYDROGRAPH AT	SUB350	17.	1.33	2.	1.	1.	.01		
	HYDROGRAPH AT									

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+                    SUB360      30.   1.25        3.        1.        1.      .01
        HYDROGRAPH AT
+                    SUB370      48.   1.33        5.        2.        2.      .03
        4 COMBINED AT
                     SUM377      92.   1.33       17.        6.        6.      .18
        ROUTED TO
+                    RCH407      83.   1.42       17.        6.        6.      .18
+                                                                          96.39      1.42
        HYDROGRAPH AT
+                    SUB380      93.   1.33       12.        4.        4.      .05
        HYDROGRAPH AT
+                    SUB390      38.   1.33        5.        2.        2.      .03
        2 COMBINED AT
+                    SUM401     131.   1.33       17.        6.        6.      .08
        ROUTED TO
+                    DET401      35.   2.00       13.        5.        5.      .08
+                                                                         104.70      2.00
        HYDROGRAPH AT
+                    SUB400      48.   1.50        7.        3.        3.      .06
        3 COMBINED AT
+                    SUM407     152.   1.50       37.       14.       14.      .31
        ROUTED TO
+                    RCH441     150.   1.50       37.       14.       14.      .31
+                                                                          96.71      1.50
        HYDROGRAPH AT
+                    SUB410     108.   1.25       11.        4.        4.      .06
        HYDROGRAPH AT
                     SUB425      27.   1.50        5.        2.        2.      .03
        HYDROGRAPH AT
+                    SUB440      25.   1.50        4.        2.        2.      .04
        5 COMBINED AT
+                    SUM441     432.   1.67      146.       61.       61.     1.35
        ROUTED TO
+                    DET441     376.   1.92      135.       55.       55.     1.35
+                                                                         103.30      1.92
1
                          SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                             (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                   INTERPOLATED TO
                                                                COMPUTATION INTERVAL
   ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT      PEAK    TIME TO     VOLUME
                                          PEAK                                     PEAK

                        (MIN)     (CFS)    (MIN)      (IN)    (MIN)     (CFS)    (MIN)       (IN)

   RCH207   MANE         1.62    100.92    82.74      1.75     5.00     98.82    80.00       1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5207E+01 EXCESS= .0000E+00 OUTFLOW= .5218E+01 BASIN STORAGE= .2098E-06 PERCENT ERROR=   -.2

   RCH227   MANE          .58     61.58    75.31      1.75     5.00     61.51    75.00       1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2325E+01 EXCESS= .0000E+00 OUTFLOW= .2329E+01 BASIN STORAGE= .4183E-06 PERCENT ERROR=   -.2


*** NORMAL END OF HEC-1 ***
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APPENDIX D
1977 SUN CITY WEST MASTER DRAINAGE

Section H
INTRODUCTION TO DRAINAGE MASTER PLAN

Section H
INTRODUCTION TO DRAINAGE MASTER PLAN

Drainage analysis has been conducted for the purposes of evaluating the existing conditions on and adjacent to the Sun City West Phase I site and the future conditions relating to the proposed development of the project site for the control of periodic flooding conditions which result from a 100 year Frequency Storm.

From this analysis a Master Drainage Plan has been developed consisting of roadways, roadways with center channels and lined drainage channels to carry the design Frequency Storm away from the proposed development. Once implemented, this Plan will insure that housing construction is above flood levels for design frequency storms.

The study area contains approximately 5,687 acres of land within Township 4 North, Range 1 West. This land is owned by the Del E. Webb Development Company and is currently being farmed by several different parties, primarily Boswell Farms, Inc. and a cattle feeding yard (Lizard Acres) operated as Circle One Ranch. The total acreage is not under cultivation but varies in useage from raw desert to fallow to agricultural with the latter being the primary useage.

1. NATURAL FEATURES

The study area lies within the portion of the state designated as the upper Sonoran Desert and has all of the general terrain features usually associated with a typical southwestern desert region. This consists of creosote bushes and Saguaro Cactus as the predominate plants on the flats, with Palo Verde and Ironwood trees lining the washes including Mesquite bushes which generally form very dense thickets at ends of washes.

The topography consists of flat desert plain sloping southeast with the White Tank Mountains to the west and the Wickenburg and Hieroglyphic Mountains to the north. The Beardsley Canal and proposed Central Arizona Project Canal

lie north of the project site. In 1956 the Army Corps of Engineers completed construction of a Detention Basin known as the McMicken Dam to protect Luke Air Force Base from flooding by Trilby Wash. The outlet for this basin is an earth lined channel (McMicken Dam Outlet Channel) varying in width from 20' to 50' along the north side of the project site.

The area is drained by many arroyos and washes which discharge into the Detention Basin or Outlet Channel and ultimately discharge into the Agua Fria River located along the east side of the project site. This river along with the other rivers in the Phoenix area are dry and have no permanent flow. In the vicinity of the project site the Agua Fria River banks are reasonably well defined as a water course and are capable of carrying sizeable flows resulting from high intensity summer storms prevalent to this area.

The climate of the area is typical of the arid Sonoran Desert. Temperatures vary from highs near 120° F in summer to lows below 20° F. in winter. Long range temperature approximates 70° F.

Rainfall in the area is usually concentrated in the months of December-March and July-September. Winter storms are normally the result of the easterly movement of storm fronts arising in the Northern Pacific. These fronts pass across the state in cycles during the winter months and usually exert their maximum influence in the higher elevations and along the Mogollon Rim Country; however, they are frequently of several days' duration and may result in significant precipitation within the watershed being studied.

Summer storms more often result from the movement of wet air masses northward from the Gulf of Mexico traveling generally from southwest to northeast across the state. These storms are frequently of high intensity and may produce cyclonic activity as well as large amounts of precipitation. Local thunderstorms are also frequently observed during the summer and fall. These generally do not cover large areas, but may result in severe localized flooding due to their high intensity. Floods may, of course, result from any of the types of storms discussed, depending on duration and location of high intensity rainfall.

2. HYDROLOGY

Storm runoff has been estimated by the Soil Conservation Service Method using precipitation maps prepared by the U. S. Weather Bureau for the Soil Conservation Service. Values of precipitation were selected from these maps for the study area for 6 hour and 24 hour duration storms of 100 year frequency. These values were then converted to 12, 3, 2 & 1 hour railfalls by use of equations relating 6 hour and 24 hour durations. Storm runoff quantities were then computed by the TR-20

Hydrology Program in the study area for 100 year Frequency Storms of 24, 12, 6, 3, 2 & 1 hour duration, utilizing the appropriate curve numbers of the contributing drainage areas.

3. DESIGN CRITERIA

FROM: Arizona Highway Department - Bridge Division
"Hydrologic Design for Highway Drainage in Arizona"

PRECIPITATION (Inches)

DURATION (Hours)	10 yr. Freq.	25 yr. Freq.	50 yr. Freq.	100 yr. Freq.
6	2.1	2.6	2.9	3.3
24	2.5	3.2	3.6	4.20
2*	1.79*	2.14*	2.36*	2.61
1	1.5	2.0	2.2	2.40

* Interpolated values equating 6 hour and 24 hour rainfalls
($P_{2\,hr.} = 1.77\,P_6 - 0.77\,P_{24}$)

Peak runoff estimate based on 100 Year Frequency Storm of 24 hour duration.

Runoff Quantities have been calculated using computer application of the TR-20 Hydrology Program based on Soil Conservation Unit hydrograph equation for estimating peak rate of runoff:

$$Q_p = \frac{484\ AQ}{T_p}$$

WHERE:

Q_p = peak discharge is cfs

A = Drainage Area in square miles

Q = Runoff volume of the watershed in inches

T_p = Time to peak in hours

484 = is a constant for the units used

Time to peak is based on the following

$$T_p = \frac{D}{2} + 0.6T_c$$

Where:

T_p = time to peak in hours

D = Duration of storm in hours

T_c = time of concentration in hours

The Runoff volume Q is a function of the storm rainfall and a curve number (CN) which is based on a vegetative cover type and density and a hydrologic soil group. The hydrologic soil group within Sun City West and the surrounding area is constant as group C (slow infiltration rate). The cover type and density within Sun City West will vary considerably for each drainage area; thus the CN will be based on a weighted CN corresponding to the type of development using the following values:

CN	Type of Development
91	Commercial Areas
87	Single Family Housing Area
83	Apartment Complex Area
83	Duplex Areas
80	Undeveloped Desert Areas
74	Golf Course Areas

Section I
HYDROLOGICAL ANALYSIS

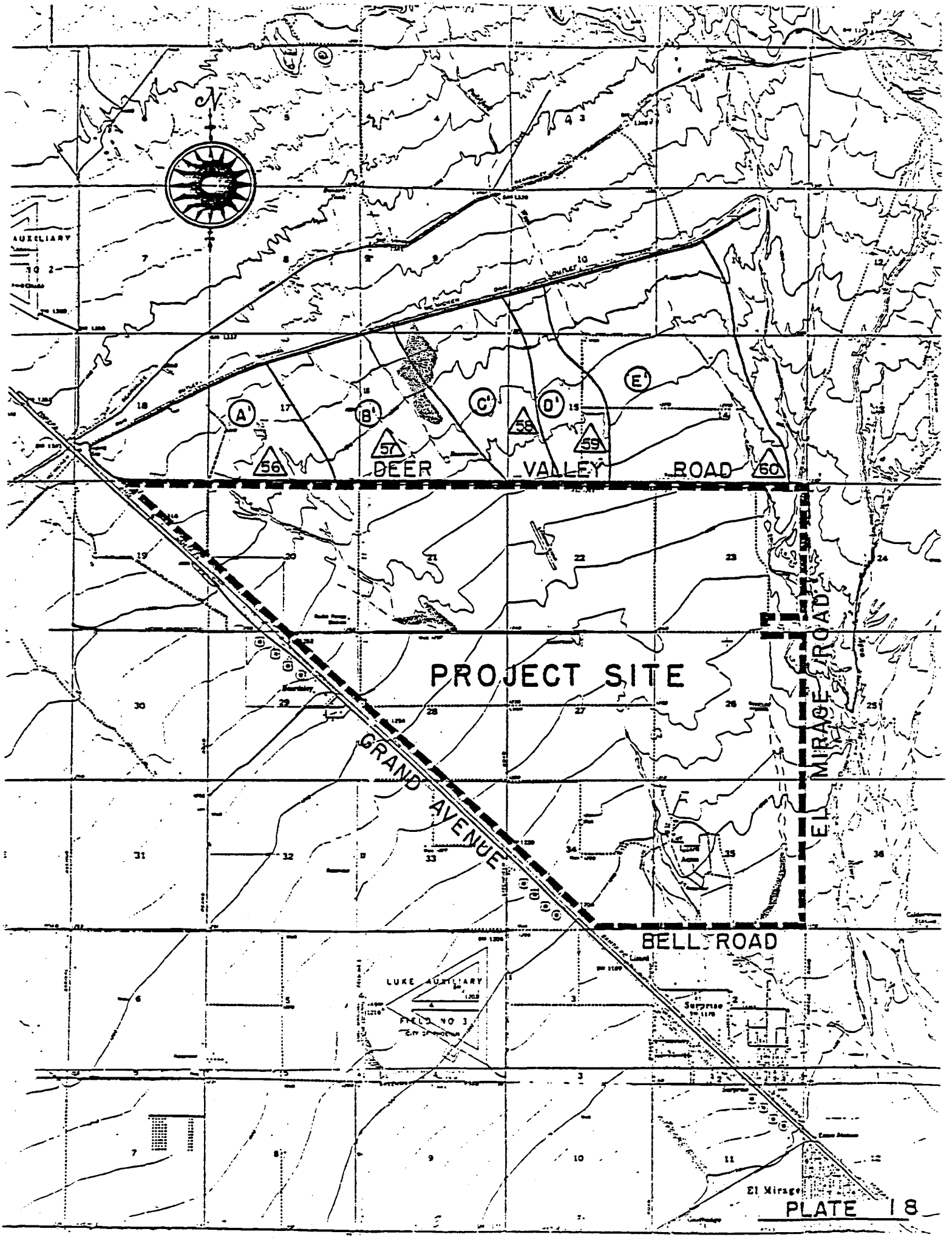

N
AUXILIARY
A'
B'
C'
D'
E'
56
57
58
59
60
DEER VALLEY ROAD
PROJECT SITE
GRAND AVENUE
EL MIRAGE ROAD
BELL ROAD
LUKE AUXILIARY
FIELD NO 3
Surprise
El Mirage

PLATE 18

Runoff Quantities and Concentration Points

Storm runoff contributions have been estimated for each Offsite Drainage Area (as shown on Plate 18) for a 100 year Frequency Storm of 24 hour duration. Runoff quantities for each Drainage Area are presented in Table 6. TR-20 Program routed storm runoff quantities, at indicated concentration points, are presented in Table 7.

Runoff calculations were based on the land within the drainage area remaining undeveloped or in agricultural useage. If offsite land use changes, it will be the responsibility of the owner(s) of said land to increase the channel size associated with the proposed Deer Valley Road improvement if runoff quantities are sufficiently increased or cause any flood of Sun City West.

2. ONSITE DRAINAGE

Onsite Drainage Area Description

As shown by Plate 19, the drainage area of the project site extends from Bell Road to Deer Valley Road and from Grand Avenue to El Mirage Road, containing approximately 9 square miles of area. This land is currently in varying stages of useage ranging from Desert to fallow to agricultural. The surface runoff south of Deer Valley Road now is a combination of surface sheet flow and defined washes conveyed in a southeasterly direction. Upon reaching Bell Road, surface runoff is conveyed under the road in a system of pipe culverts and reinforced concrete box culverts.

The overall drainage pattern is in a southeasterly direction on an average slope of a 0.5' drop per 100 feet horizontal run. The elevations within the study area range from 1322 in the northwest corner to 1176 in the southeast corner, which gives a fall of 146 feet over the area.

The existing cover type varies from Desert Brush to agricultural crop with a density ranging from "poor" to "good" and having a hydrologic soil group in Category "C". Proposed development of the study area will include single family housing, apartments, golf courses, cemetery, shopping centers, recreation centers and other commercial uses resulting in varying curve numbers.

The central core designated by Drainage Area AA on Plate 19 contains model housing, apartments, a recreation center and a golf course. The unique feature of this core is that it will contribute no surface runoff as all the runoff will be stored on the golf course or it's lakes for use in irrigation of the golf course.

The surface runoff, with improvements, of the other drainage areas will be in the southeasterly direction. It is proposed that the drainage handling system for the project will use the roadway system network, grass or lined channels and a combination of roadways with median channels to transport the runoff to a discharge point. Once this runoff reaches Bell Road it will be conveyed under the roadway in box culverts and collected on the south side in a large channel to be conveyed east for discharge into the Agua Fria River channel.

Section I
HYDROLOGICAL ANALYSIS

The Master Drainage Plan is based on the quantities and characteristics of runoff, both within the proposed developed new community and from the surrounding area. Presented below is a description of the onsite and offsite drainage areas and their associated runoff quantities and points of storm water discharge concentration.

1. OFFSITE DRAINAGE

Offsite Drainage Area Description

As shown by Plate 18 the offsite drainage area of this study encompasses Sections 14, 15 and 16 and parts of Sections 9, 10, 11, 17 and 18 of Township 4 North, Range 1 West up to the outlet channel of McMicken Dam. This study area is mostly undeveloped desert land with a small mix of agricultural row crop useage by Bodine Produce Company in Sections 14 and 15. The type of cover in this area is considered to be Desert Brush with density rating of "poor" and a Hydrologic Soil Group C, all as described in Arizona Highway Department Hydrologic Design Manual.

In addition to the aforementioned sections, the offsite drainage includes overflow from McMicken Dam outlet channel ranging between 4450 cfs and 14,000 cfs, including side inflows from adjacent drainage areas. This flow comes down an existing wash along the east boundary of Sections 11, 14, 23 and 26 before being intercepted by Agua Fria River Channel.

There presently exists along the north side of Deer Valley Road an earth channel of varying depth and width between Reams Road and El Mirage Road. This ditch will divert storm water runoff from the north in an easterly direction to its intersection with El Mirage Road Channel Section for conveyance to the Agua Fria River. The existing ditch section increases in width and depth as it proceeds east.

The existing design capacity of this ditch is not known at this time as no field data was taken north of Deer Valley Road. This ditch will intercept runoff from two defined washes in the area with the remainder being interception of sheet flow off desert land and agricultural land.

The entire project site is above the delineated Flood Plain of the Agua Fria River as shown on Flood Plain Maps prepared by the Maricopa County Flood Control District.

Runoff Quantities and Concentration Points

Storm runoff quantities have been estimated for each Onsite Drainage Area (as shown on Plate 19) for a 100 year Frequency Storm of 24 hour duration. Runoff quantities for each Drainage Area are presented in Table 8. The TR-20 Program routed storm runoff quantities, at indicated concentration points, are presented in Table 9.

TABLE 6

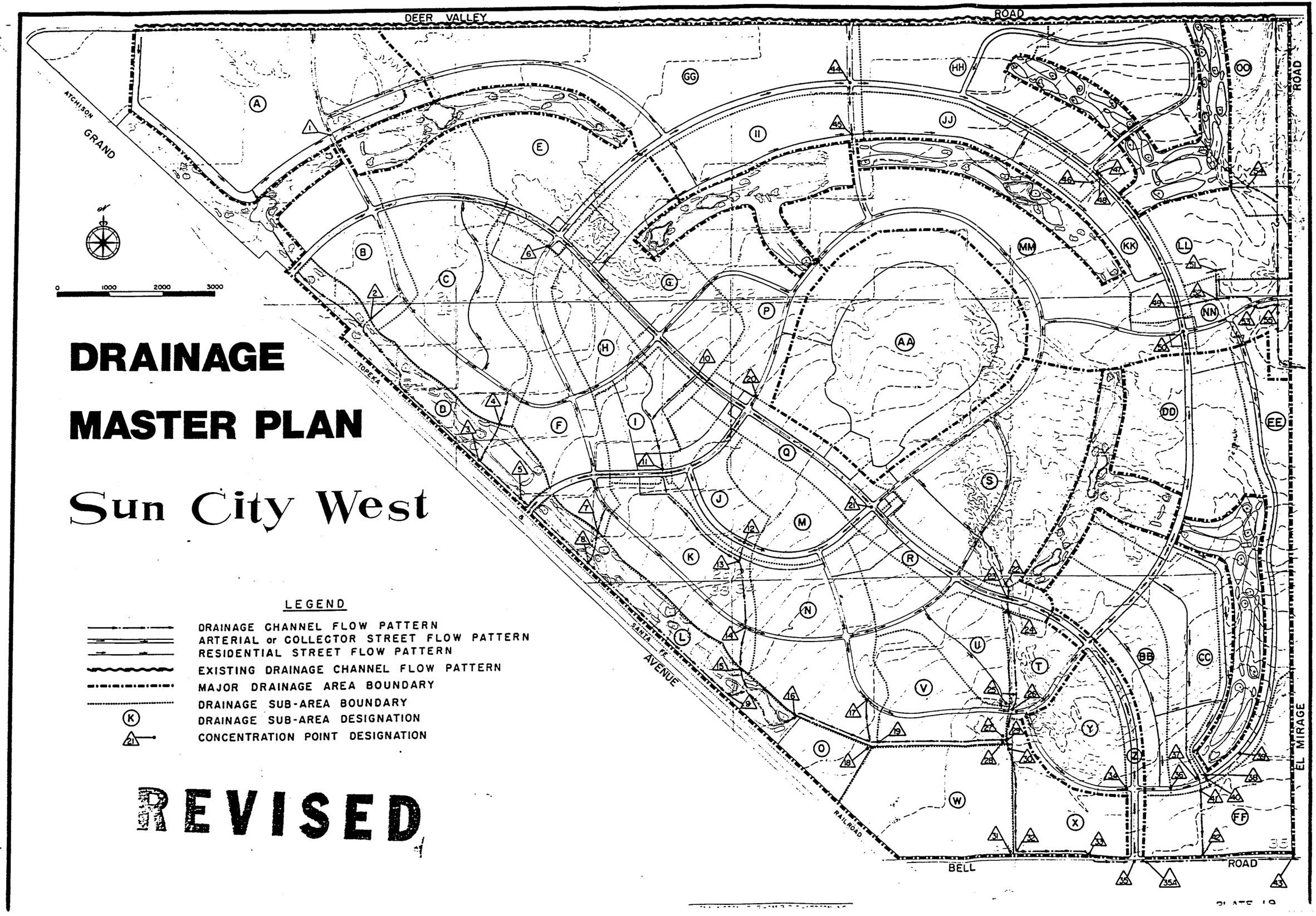
OFF-SITE STORM RUNOFF

SYMBOL	DRAINAGE AREA (Acres)	CURVE NUMBER	T_c (Min)	ESTIMATED PEAK (cfs)
A'	550	80	41.5	718
B'	595	80	58	637
C'	467	80	52.5	535
D'	301	80	54.5	338
E'	1101	80	78.5	958

TABLE 7

OFF-SITE ROUTED STORM RUNOFF

CONCENTRATION POINT	DRAINAGE AREA (Acres)	TIME TO PEAK (Hours)	ESTIMATED PEAK RUNOFF (cfs)	REMARKS
56	550	12.26	718	D.A. A'
57	1145	12.50	1315	D.A. A'&B'
58	1612	12.78	1583	D.A. A',B'&C'
59	1913	12.81	1794	D.A. A',B',C'&D'
60	3014	13.21	2381	D.A. A',B',C',D'&E'



DRAINAGE MASTER PLAN

Sun City West

PLATE 19

HYDROGEOLOGICAL REVIEW OF SUN CITY WEST AREA AND PLANNED ADDITION OF 1,045 ACRES WITH CONSIDERATION OF EFFECT OF RECHARGE OF TREATED WASTEWATER

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HYDROGEOLOGICAL REVIEW OF SUN CITY WEST AREA AND PLANNED ADDITION OF 1,045 ACRES WITH CONSIDERATION OF EFFECT OF RECHARGE OF TREATED WASTEWATER

By
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Philip C. Halpenny

Water Development Corporation
Tucson, Arizona
April 1991

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Recharge from both areas

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Ms. Koko Kvistad–Maricopa Water District
Mr. Frank Postillion–Dames and Moore

who provided water level measurement data.

NOTE

Owing to rounding at various stages of the many computations in this report, where figures have been computed in acre-feet per year differences of one acre-foot can be found when comparing various numbers.

HYDROGEOLOGICAL REVIEW OF SUN CITY WEST AREA AND PLANNED ADDITION OF 1,045 ACRES WITH CONSIDERATION OF EFFECT OF RECHARGE OF TREATED WASTEWATER

By
Leonard C. Halpenny
Philip C. Halpenny

SUMMARY AND CONCLUSIONS

Summary

The hydrogeological investigation and related computations as described in this report is summarized as follows:

1. Sun City West is planning to expand by including 1,045 gross acres that adjoin Sun City West along the north side, in Secs. 15, 16, and 17, T.4N., R1W., G.R.B.M.

2. The total gross area after the expansion will be 6,761 acres (5,716 + 1,045).

3. The total municipal water demand for the expansion area has been computed under two scenarios. Under the first scenario (No. 1) the residential water demand within the expansion area has been calculated on the basis of 141 gallons per day per resident. Scenario No. 2 considers residential demand within the expansion area to be at the same rate as in Sun City West.

4. The 1990 municipal demand for Sun City West has been increased to be the demand after full buildout has been achieved. This adjusted figure has been applied for a period of 100 years. The municipal demand for the expansion area is based on instantaneous full buildout and has been applied for 100 years.

5. Del Webb's Sun City West is currently preparing an application for a Groundwater Recharge and Recovery Permit based on recharge of wastewater treated at the Sun City West Wastewater Treatment Plant. This report contains some of the data required for preparation of the application.

6. We were requested to submit our computations for the 100-year period based upon inclusion of total water demand for municipal and golf course use within the expanded Sun City West area, offset by recovery of the volume of groundwater recharged as a part of the operation of the wastewater treatment plant. The computations were made by establishing a groundwater model.

7. Two piezometric water-surface decline maps have been prepared for the situation discussed in Item 6, one for Scenario No. 1 and the other for Scenario No. 2.

8. One piezometric water-surface rise map has been prepared based on an input rate of 2,442,377 gpd. The average rise of the water table underlying the expanded Sun City West resulting from this groundwater recharge during a 100-year period was found to be 7.3 feet.

9. The total water demand for the expanded Sun City West, after full buildout, is shown to be as follows:

	Annual Volume (acre-feet per year)	
Item	Scenario No. 1	Scenario No. 2
Municipal Demand	5,965	6,184
Golf Course Demand	5,481	5,481
Subtotal	11,446	11,665
Less Recovered recharge	-2,736	-2,736
Total	8,710	8,929

10. The average depth to the water table underlying the expanded Sun City West area as of the spring of 1991, was 413 feet.

11. The average regional decline of the water table underlying the expanded Sun City West area during the period Spring of 1972–Spring of 1991, was found to be 50.356 feet in 19 years, a rounded average of 2.58 feet per year.

12. The locally-generated decline of the water table underlying the expanded Sun City West area after 100 years of operation was found to be a total of 33.5 (use 34) feet under Scenario No. 1 and 34 feet under Scenario No. 2.

13. The average decline of the water table underlying the expanded Sun City West during a 100–year period was computed to be as follows:

	Water Level Decline (feet in 100 years)	
Item	Scenario No. 1	Scenario No. 2
Regional decline (2.58 x 100)	258	258
From projected operation	34	34
Total	292	292
Average, ft/yr (rounded)	3.0	3.0

These average declines are within the maximum not-to-exceed limit of 10 feet per year as set forth in State-mandated regulations.

14. The computed average depth to the water table underlying the expanded Sun City West 100 years hence is as follows:

	Total Depth to Water Table (ft)	
Item	Scenario No. 1	Scenario No. 2
1991 depth to water table	413	413
After 100 years of regional decline	258	258
After 100 years of projected operation (includes effect of recharge)	34	34
Total	712	712

These figures are less than the maximum permitted depth of 1,200 feet as set forth in State-mandated regulations.

15. Chemical quality of the groundwater underlying the expanded Sun City West was not an issue in preparation of this report because voluminous data collected over a period of many years indicate it is generally acceptable under Arizona Safe Drinking Water Standards.

Conclusion

The analysis described herein indicates that the predicted annual decline of the water table and the predicted depth to the water table 100 years hence are less than the State-mandated upper limits.

INTRODUCTION

Initial Scope of Work

In late November 1990, Water Development Corporation (WADEVCO) was requested by Del Webb's Sun City West to conduct a hydrogeological investigation of a tract of land adjoining Sun City West along the north side of Deer Valley Road in Secs. 15, 16, and 17, T.4N., R.1W., G.R.B.M. (see general location map, Figure 2–1). At that time the available land for which purchase negotiations were in progress were as follows:

Section	Gross Area (ac)	Less Planned Reduction for Deer Valley Parkway (ac)	Considered Available (ac)
15	320	0	320
16	640	15	625
17	160	28	132
Total	1,120	43	1,077

At a preliminary conference with DWR (Arizona Department of Water Resources) officials in early December, Wadevco was requested to consider the scope of the assignment to result in evaluating the hydrogeological impact of the tract separately from Sun City West. Owing to pressures of time, a draft report was prepared and submitted to the Del Webb office for review and comment on January 15, 1991. By the time the report was submitted to the Del Webb office for review, several factors had changed, resulting in the necessity for a new report.

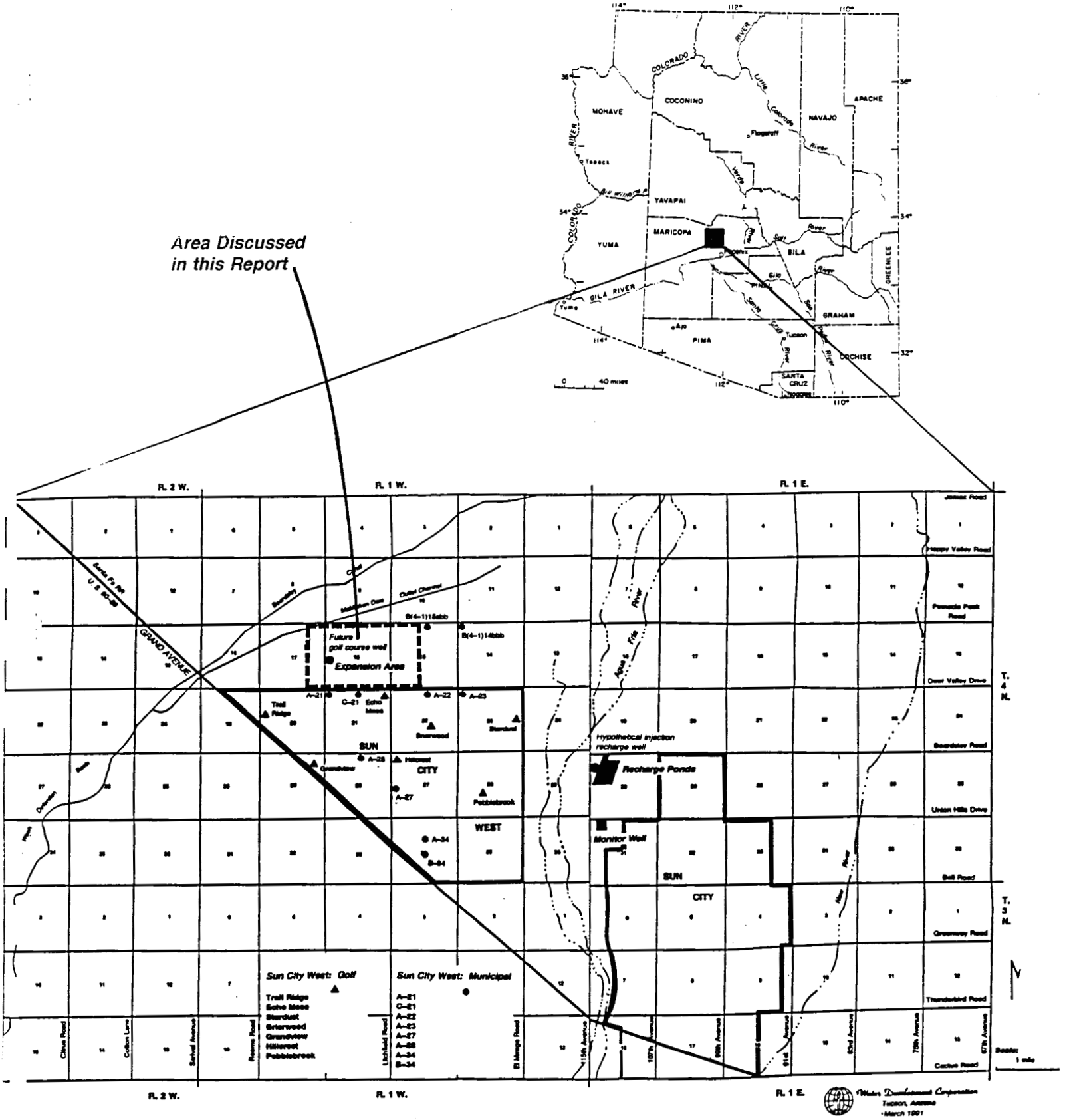


Figure 2–1. Index map of Arizona Showing Location of Area Discussed in this Report.

Changes in Scope of Work

In early December, Wadevco was informed that an on-going plan was underway to apply for a Groundwater Recharge and Recovery Permit from DWR. Preparation of this application is assigned to the consulting firm of AGK Engineers. The application is based upon the fact that, following construction of the Sun City West Wastewater Treatment Plant in SW¼ Sec. 19, T.4W., R.1E., the treated wastewater was disposed of in a series of eleven percolation ponds in NW¼ Sec. 30 of the same township. The application will claim credit for recovery via any one or all of the seven golf course wells within Sun City West, to the extent of the volume recharged at the percolation ponds. Wadevco was requested to make the necessary hydrologic computations to determine whether any, or all, of the seven golf course wells are within the area of hydrologic impact resulting from the recharge.

By late March the number of acres that would be available for the additional land north of Deer Valley Road had been modified several times. The final selection of land for the expansion area is a gross total of 1,120 acres, of which 320 acres are in Sec. 15, 640 in Sec. 16, and 160 in Sec. 17 (see Plate 1). A planned new parkway will require 75 acres along the north side for right-of-way. Of the remaining 1,045 acres, it is planned to use 150 acres for an 18-hole golf course and the remaining 895 acres for construction of 3,300 residences.

A second conference with DWR officials was held early in February. At that conference Wadevco was requested to make changes in the scope of work and prepare the report to include discussion of the following:

1. Review the hydrogeological impact of Sun City West water demand for a period of 100 years after full buildout;

2. Include the additional land north of Deer Valley Road after full buildout as part of the Item 1 analysis;

3. Include the amount of recharge, after full buildout of Sun City West and the additional land, to determine the rise of water levels within Sun City West that will result from the recharge facility;

4. Determine the average current depth to static water level of the portion of the aquifer underlying Sun City West and the additional land;

5. Determine the current annual rate of regional change in depth to static water level underlying the land, based on historic data and expressed as feet of change per year;

6. Determine the total change in depth to static water level underlying Sun City West and the additional land during a 100-year period, based on Items 1, 2, and 3.

7. Determine the predicted annual rate of change in the water level underlying the land resulting from the sum of the data determined from Items 5 and 6. This figure cannot exceed 10 feet per year;

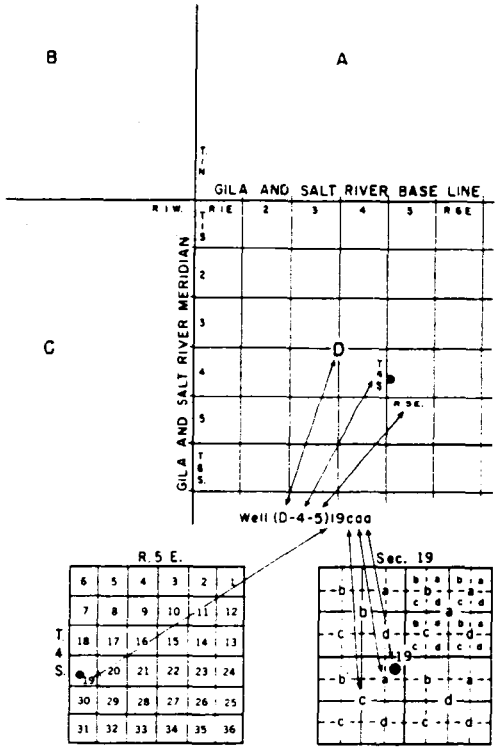
8. Determine the total depth to the static water level underlying the land at the end of 100 years (Item 4), the 100–year total of current regional decline (Item 5), and the 100–year total of predicted annual decline (Item 6). This total cannot exceed 1,200 feet.

This final draft of the report is based partly on figures provided us by Del Webb's Sun City West or by other consultants employed by them. The figures supplied include the following:

Gross area of Sun City West:	Revised from 5,760 to 5,716 acres;
Existing residences, 1991, Sun City West:	Revised from 10,650 to 11,600;
Residences remaining to be built, Sun City West:	Revised from 2,550 to 2,000;
Total ultimate residences, Sun City West:	Revised from 13,200 to 13,600;
Total ultimate residences, Expansion area:	3,300;
Annual rate of recharge at recharge ponds:	2,736 ac-ft/yr

Well Numbering System

The well numbering system used in this report conforms with the system used by DWR and is described in Figure 2–2. This system was devised by Robert L. Cushman and Leonard C. Halpenny in the early 1950's, when they were employed by the Water Resources Division of the U. S. Geological Survey. It was accepted by the Arizona State Land Department soon thereafter and later adopted by DWR.



The well numbers used by the Arizona Department of Water Resources are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the state into four quadrants. These quadrants are designated counterclockwise by the capital letters A, B, C and D. All land north and east of the point of origin is in A quadrant, that north and west in B quadrant, that south and west in C quadrant, and that south and east in D quadrant. The first digit of a well number indicates the township, the second the range, and the third the section in which the well is situated. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160–acre tract, the second the 40–acre tract, and the third the 10–acre tract. These letters are also assigned in a counterclockwise direction, beginning in the northeast quarter. If the location is known within the 10–acre tract, three lowercase numbers are shown in the well number. In the example shown, well number D(4-5)19caa designates the well as being in the NE¼ NE¼ SW¼ Sec. 19, T.4S., R.5E. Where more than one well is within a 10–acre tract, consecutive numbers beginning with 1 are added as suffixes.

Figure 2–2. Well Numbering System Used in Arizona.

HYDROLOGIC REVIEW OF SUN CITY WEST

Gross Area

The gross area occupied by Sun City West is 5,716 acres, all in B(4–1) (see maps accompanying this report).

Gradient of the Water Table

Plate 2 is a copy of a portion of a groundwater contour map prepared by Reeter and Remick (see reference on map). Their map provided 1983 data for the entire Salt River Valley. Lines indicating the directions of groundwater movement have been drawn on their contours. These lines show that the direction of groundwater movement underlying Sun City West is generally southward and then trends gently southwest into the large cone of depression sometimes referred to as the Luke Field cone. This cone began to develop shortly after World War I as a result of development of irrigation for growing urgently needed cotton. Plate 3, which shows depths to water in the spring of 1972, shows the Luke cone of depression.

Average Depth to Water Table
Spring of 1991

The average depth to the water table in Sun City West as of Spring 1991 is 417 feet (see Table 3–1, which is based on planimetric measurements from Plate 4).

Average Annual Decline of Water Table
Spring 1972–Spring 1991

The average decline of the water table within Sun City West was 57.3 feet during the period Spring of 1972 to Spring of 1991 (see Table 3–2, which was based on planimeter measurements from Plate 5).

Accordingly, the average decline in the 19–year period was 3.0 feet per year.

Nine water-level hydrographs have been prepared (see Figures 3–1, 3–2 and 3–3). The wells selected were those in the area for which an adequate long-term record exists. Fortunately sufficient well records were found to ring the boundaries of the study area. All but one of the hydrographs [A(4–1)30abb$_2$] show a flattening or a rise beginning with the effects of recharge from the flood events of 1978 and 1980 and a general transition from agricultural irrigation to the urbanization of farmland, with a consequent lessening of demand on the aquifer. Well A(4–1)30abb$_2$ was not measured from 1966 to 1984.

TABLE 3–1

WEIGHTED AVERAGE DEPTH TO WATER TABLE
SPRING OF 1991
WITHIN SUN CITY WEST AND EXPANSION AREA
(Based on planimeter measurements, Plate 4)

SUN CITY WEST

Zone (ft)	Average Depth (ft)	Area (ac)	Product (ac-ft)
370–380	375	62	23,250
380–400	390	1,457	568,230
400–420	410	1,690	692,900
420–440	430	1,647	708,210
440–460	450	725	326,250
460–465	462.5	135	62,440
		5,716	2,381,280

Weighted average: 2,381,280 / 5,716 = 416.6 ft
Use: 417 ft

EXPANSION AREA

Zone (ft)	Average Depth (ft)	Area (ac)	Product (ac-ft)
380–400	390	964	375,960
400–420	410	156	63,960
		1,120	439,920

Weighted average: 439,920 / 1,120 = 392.8 ft
Use: 393 ft

OVERALL AVERAGE

Zone (ft)	Average Depth (ft)	Area (ac)	Product (ac-ft)
Sun City West	417	5,716	2,383,572
Expansion Area	393	1,120	440,160
		6,836	2,823,732

Weighted average: 413.1 ft
Use: 413 ft

TABLE 3–2

WEIGHTED AVERAGE CHANGE IN DEPTH TO WATER TABLE
SPRING 1972—SPRING 1991
WITHIN SUN CITY WEST AND EXPANSION AREA
(Based on planimeter measurements)

SUN CITY WEST

Zone (ft)	Average Change (ft)	Area (ac)	Product (ac-ft)
0– -20	-10	904	9,040
-20– -20	-20	185	3,700
-20– -40	-30	873	26,190
-40– -60	-50	911	45,550
-60– -80	-70	714	49,980
-80– -100	-90	2,000	180,000
-100	-100	129	12,900
		5,716	327,360

Weighted average: 327,360 / 5,716 = 57.27 ft in 19 years
Regional Decline: 57.27 / 19 = 3.01 ft/yr
Use 3.0 ft/yr

EXPANSION AREA

Section	Zone (ft)	Average Change (ft)	Area (ac)	Product (ac-ft)
15	-10– -15	-12.5	290	3,625
16	-2– -10	-6	757	4,542
17	0	0	73	0
			1,120	8,167

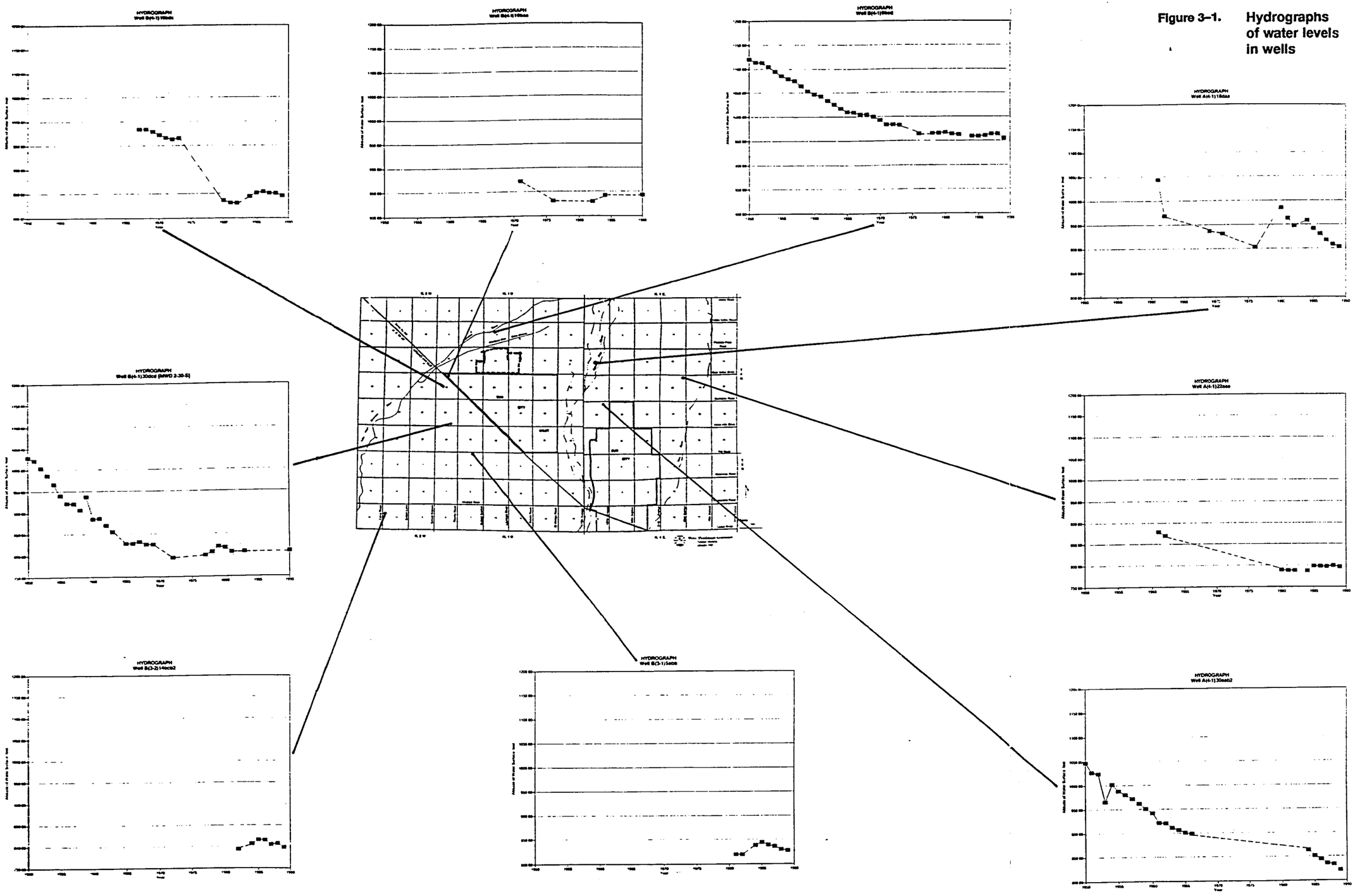
Weighted average: 8,167 / 1,120 = 7.29 ft in 19 years
Regional decline 7.3 / 19 = .38 ft/yr
Use .4 ft/yr

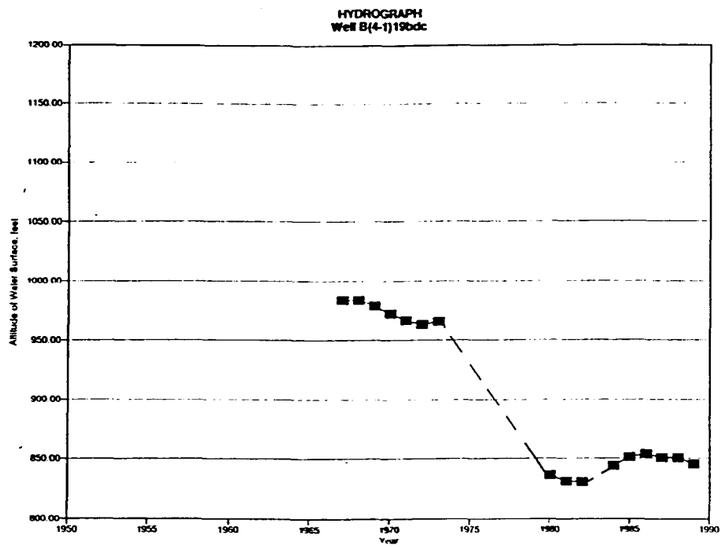
OVERALL AVERAGE (19 years)

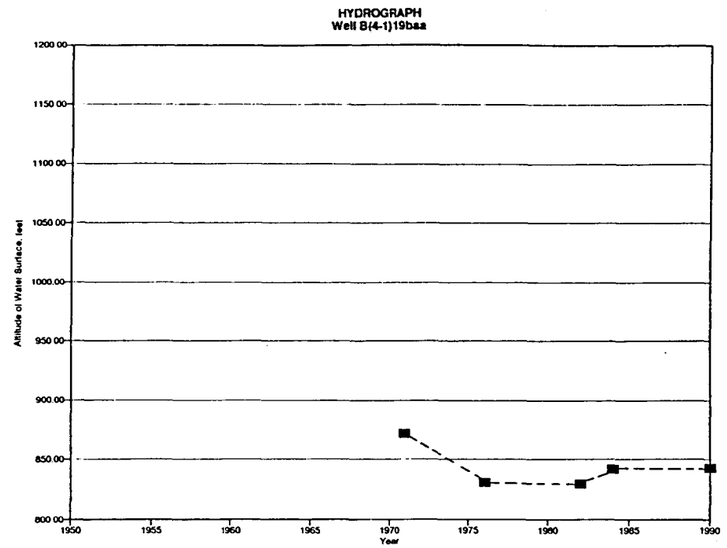
Zone (ft)	Average Change (ft)	Area (ac)	Product (ac-ft)
Sun City West	57.27	5,716	327,355
Expansion Area	7.30	1,120	8,176
		6,836	335,531

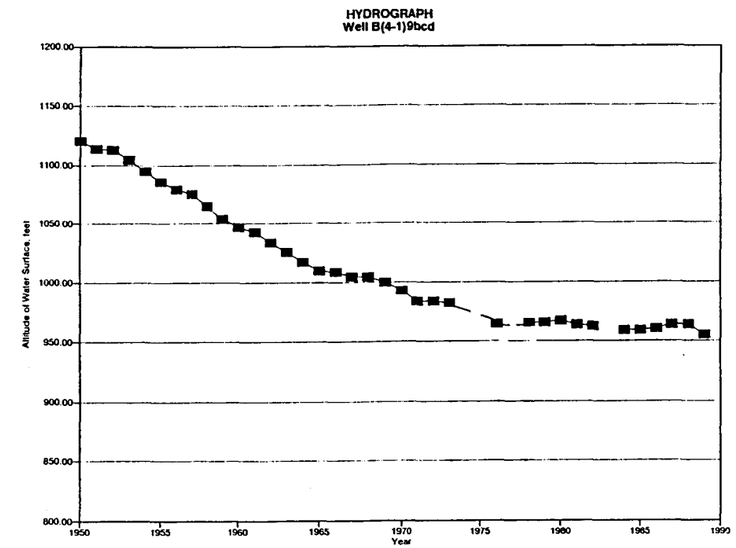
Weighted average: 335,531 / 6,836 = 49.08 ft
Regional decline: 49.08 / 19 = 2.58 ft/yr
Or = **258 feet in 100 years**

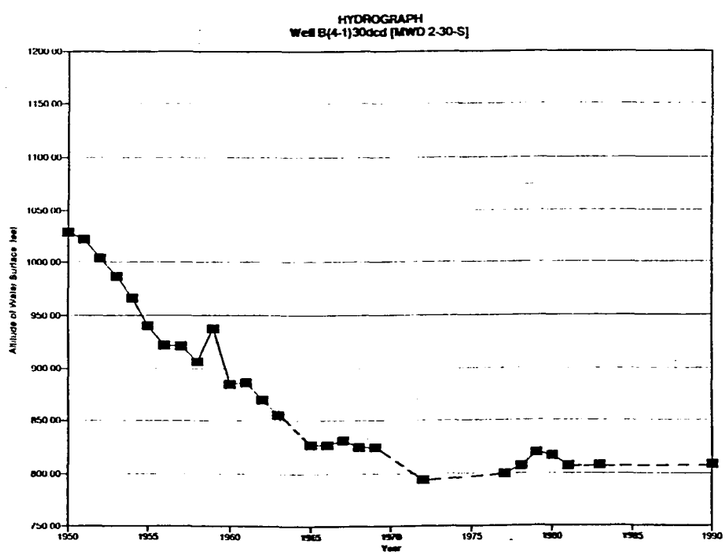
Figure 3–1. Hydrographs of water levels in wells

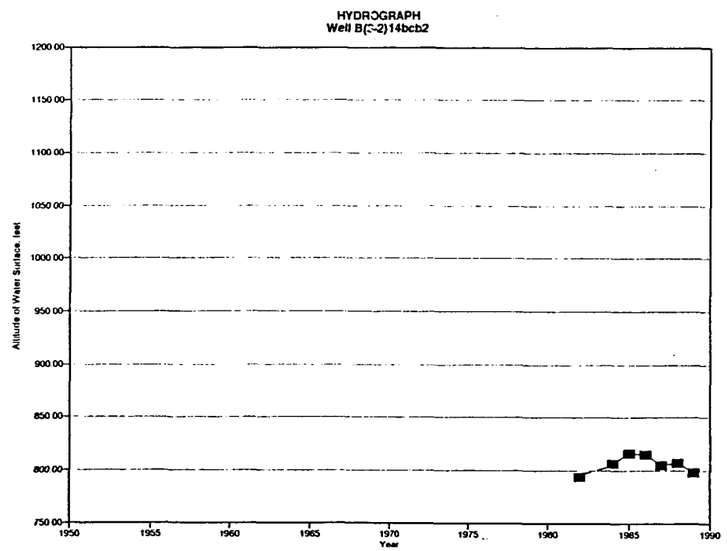












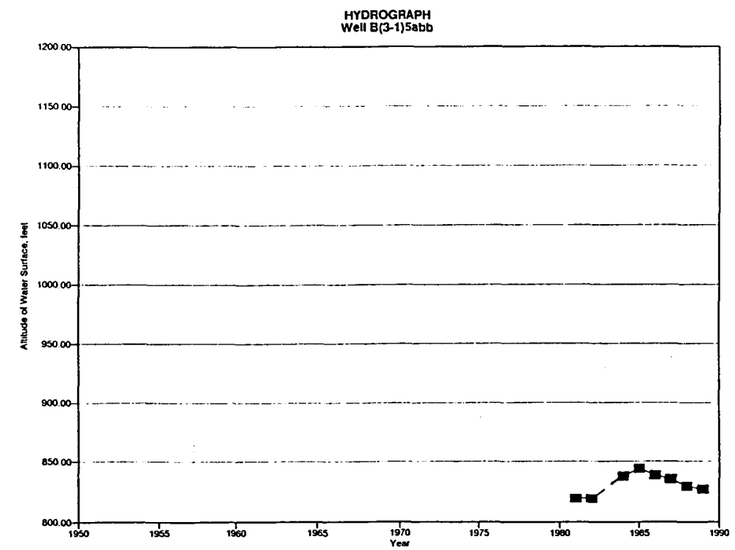
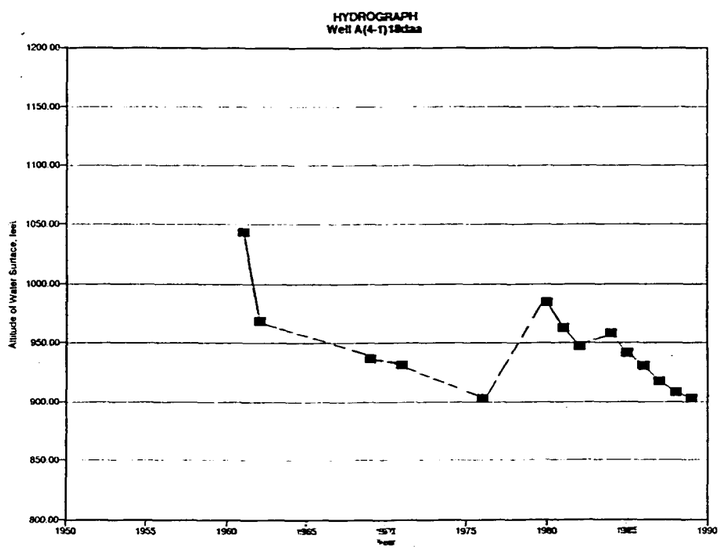
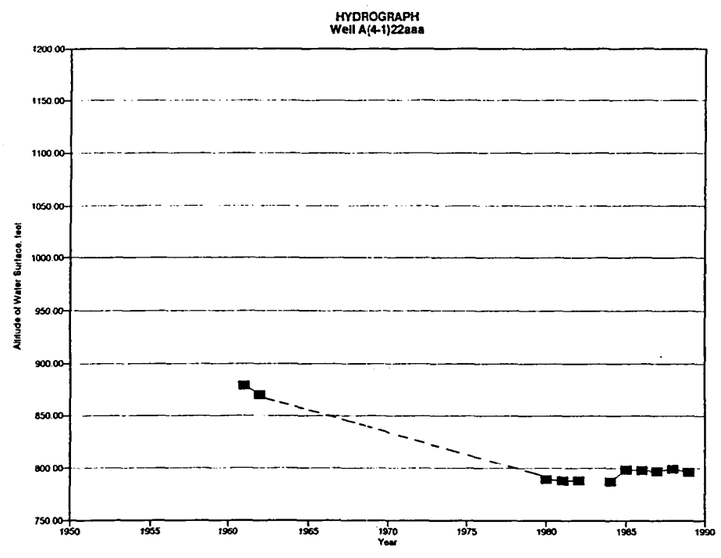


Figure 3–2. Hydrographs of water levels: T. 4 N. R. 1 W.





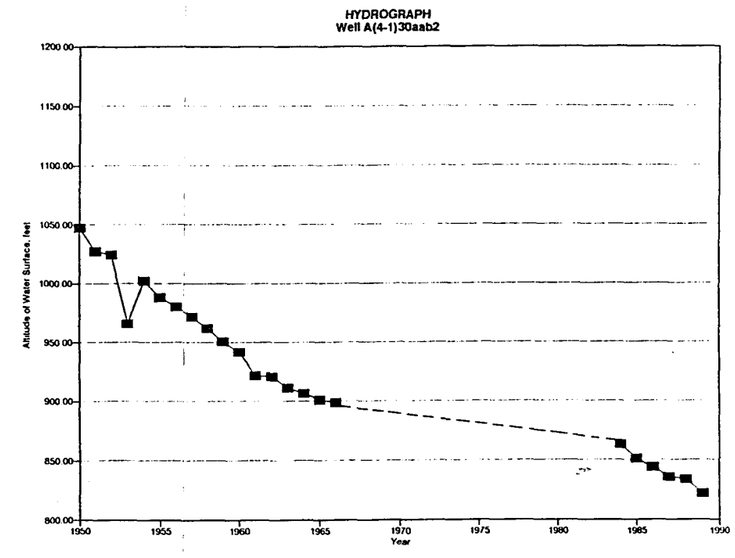


Figure 3–3. Hydrographs of water levels: T. 4 N. R. 1 E.

Historic Water Demand

Municipal

The volume of water produced for municipal use at Sun City West in 1990 was 1,382.774 million gallons (4,244 ac-ft), an average of 3,788,422 gallons per day.

Time Required to Reach Full Buildout

Officials of Sun City West have informed us that full buildout at Sun City West will be achieved in less than 6 more years.

Municipal Water Demand After Full Buildout

Total water produced for municipal use in 1990 was 1,382, 774,000 gallons. As of the end of 1990 the data relating to full buildout were as follows:

Item	No. of Residences	Percent of Total	Population at 1.9 per residence
In 1990	11,600	85.3	22,040
Planned additional	2,000	14.7	3,800
Full buildout total	13,600	100.0	25,840

The demand after full buildout would be 1,382,774,000 gal/year, divided by .853, equal to 1,621,071,512 gallons, equivalent to an average of 4,441,292 gallons per day (4,975 ac-ft/yr). On a per resident basis, the figure is 171.8 (use 172) gpdpc.

In 1990 the volume of water produced from each of the eight operable wells ranged from 29 to 1,105 acre-feet. During an operating cycle of 100 years it is considered that this variability would continue to occur but that the overall volume produced per well during a 100–year period would be equal for all eight wells. Therefore, the average daily production per well was assumed to be 555,161 gallons per day.

Golf Course Water Demand After Full Buildout

As of the end of 1990, five of the ultimate seven golf courses had been operated long enough to be considered "mature" for projecting 1990 demand into the future. The data for these five courses are as follows:

Name of Course	Gross Area (ac)	1989–1990 Water Demand (Year)	(ac-ft/yr)	(average gpd)
Stardust	97.6	1989	536.2	478,656
Briarwood	174.2	1990	742.7	662,995
Grandview	174.1	1989	826.6	737,890
Hillcrest	179.6	1990	599.8	535,430
Pebblebrook	150.4	1989	790.1	705,308
Total	775.9		3,495.4	3,120,279

Average: 4.505 ac-ft/ac/yr

The remaining two golf courses were not fully constructed as of February 1991. Parts are finished enough for limited play, but construction continues. These two courses cannot be considered mature. The long-range water demand for these courses was estimated by applying data for the five mature courses as follows:

Name of Golf Course	Gross Area (ac)	Unit Demand (ac-ft/ac/yr)	Projected Demand (ac-ft/yr)	(average gpd)
Trail Ridge	180.0	4.505	810.9	723,876
Echo Mesa	110.6	4.505	498.3	444,823
Total	290.6		1,309.2	1,168,699
TOTAL, 7 courses	1,066.5		4,804.6	4,288,978

Total Sun City West Demand After Full Buildout

The data contained in this chapter are summarized as follows:

Category of Demand	Amount (gpd)	(ac-ft/yr)
Municipal	4,441,292	4,975
Golf Courses	4,288,978	4,805
TOTAL	8,730,270	9,780

HYDROGEOLOGICAL ANALYSIS OF EXPANSION AREA

Current Development Plan

As stated previously in this report, the expansion area will consist of 895 acres for residential construction and 150 acres for an 18-hole golf course.

Rate of Buildout to Full Development

It is estimated that residential sales in the expansion area cannot begin until the latter half of 1993 or early in 1994. Residential sales at Sun City West fluctuate from year to year resulting from variations in economic conditions. Overall, however, Del Webb anticipates full buildout will occur in 6 years or less and could not possibly exceed 10 years. Our computations are based on instantaneous full buildout at the beginning of the 100–year period.

Municipal Water Demand

The negotiations with DWR during conduct of this investigation have resulted in two scenarios being developed for computation of water demand, discussed in the following subtopics.

Scenario No. 1: 141 gpdpc

For the 895 acres assigned for residential use, the prevailing DWR regulations for *new* subdivisions require a maximum water use per person of 141 gallons per day. Based on this figure the total annual demand would be as follows:

Item	Amount	
Gross area	895	ac
Residences per gross acre	3.7	
Total residences	3,300	
People per residence	1.9	
Total population	6,270	
Demand per person	141	gpd
Total demand	884,070	gpd
		or
	990.4	ac-ft/yr

The figure of 1.9 people per residence is derived from actual occupancy rates in Sun City West: as a retirement community with age residency restrictions this figure differs from occupancy rates for the general population, which would include children.

Scenario No. 2: Prorated Demand

Giving consideration to the difficulty confronting the water provider resulting from a higher water use in Sun City West than in the expansion area, Scenario No. 2 is based on equal deliveries of water to Sun City West and to the expansion area. The water demand within the expansion area has been computed as follows:

Item	Amount	
Total full buildout water demand, Sun City West	4,441,292	gpd
Total full buildout number of residences, Sun City West	13,600	
Daily demand per residence, Sun City West	327	gpd
Total full buildout number of residences, Expansion area	3,300	
Total full buildout water demand, Expansion area	1,079,100	gpd
	1,209	ac-ft/yr

Golf Course Water Demand

The historic water demand for mature golf courses in Sun City West was analyzed in Chapter 3 of this report and found to be 4.505 ac-ft/gross acre/yr. Applying this figure to 150 gross acres of golf course in the expansion area indicates an annual demand of 675.75 acre-feet, equivalent to an average demand of 603,230 gallons per day.

It is considered that if a golf course is constructed in the expansion area, a new well would need to be constructed. For the groundwater modeling, the site selected is B(4–1)16bcc.

Average Depth to Water Table
Spring of 1991

The average depth to the water table in the expansion area as of the spring of 1991 is 393 feet (see Table 3–1, which was based on planimeter measurements from Plate 4).

Average Annual Decline of Water Table
Spring 1972—Spring 1991

The average decline of the water table in the expansion area was 7.3 feet in the period Spring 1972—Spring 1991 (see Table 3–2, which was based on planimeter measurements from Plate 5).

Accordingly, the average decline in the 19–year period was 0.38 foot per year, rounded to 0.4 foot per year.

COMBINED WATER DEMAND AND GROUNDWATER RECHARGE SUN CITY WEST AND EXPANSION AREA

The figures contained in this chapter are summarized from Chapters 3 and 4.

Municipal Water Demand

Two figures have been developed for municipal water demand after full buildout in Sun City West and in the expansion area—Scenario No. 1 and Scenario No. 2. The data are as follows:

Item	Amount Scenario No. 1	Amount Scenario No. 2
Sun City West, gpd	4,441,292	4,441,292
Expansion area, gpd	884,070	1,079,100
Total, gpd	5,325,362	5,520,392

Golf Course Demand

Item	Amount	
Sun City West, gpd	4,288,978	
Expansion Area, gpd	603,230	
Total	4,892,208	gpd

Total Demand

Item	Amount Scenario No. 1	Amount Scenario No. 2
Municipal, gpd	5,325,362	5,520,392
Golf courses, gpd	4,892,208	4,892,208
Total, gpd	10,217,570	10,412,600
ac-ft/yr	11,446	11,665

EFFECT OF RECHARGE PROJECT UPON GROUNDWATER LEVELS IN VICINITY OF SUN CITY WEST

A concurrent project is underway consisting of the preparation of an application for a Permit to operate a Groundwater Recharge and Recovery Project. Water would continue to be recharged into the groundwater system via recharge ponds in the river-lain alluvial material of the Agua Fria River. The ponds are situated in NW¼ Sec. 30, T.4N., R.1E. (see Plate 1). The ponds are furnished treated wastewater from the Sun City West Wastewater Treatment Plant in SW¼ Sec. 19 of the same township. Water has been recharged since the plant was constructed in the early 1980's.

Production of wastewater in Sun City West is greatest in the winter months and least in the summer months. The proposal is to recover the recharge, to the extent approved, to reduce the demand upon the groundwater supply for turf irrigation of the seven golf courses within Sun City West. Each golf course is provided water from a well at the course. The demand for water for turf irrigation is greatest in the summer and negligible in the winter.

We have been informed by other consultants employed by Sun City West that the annual volume of water to be recharged after full buildout of Sun City West and the expansion area will be 2,736 acre-feet per year. For use of the groundwater model utilized in predicting the shape of the groundwater mound that will result from the recharge it is necessary to assume a constant rate of recharge throughout the year. A volume of 2,736 acre-feet per year is equivalent to a constant input of 2,442,000 gallons per day (rounded). Because the modeling of other influences upon the groundwater level is based on a period of 100 years, a map showing the shape of the recharge mound 100 years hence has been prepared as a part of this report (see Plate 8).

SIMULATIONS OF AREA DRAWDOWN AFTER 100 YEARS OF PUMPAGE SUN CITY WEST AND EXPANSION AREA

Program Utilized

The program utilized in calculating the drawdown from wells operating in the study area for 100 years is THWELLS, version 3.11 released in April 1990 by the International Groundwater Modeling Center, Holcomb Research Institute, Butler University. This model applies the Theis equation to the combined effect of pumping or recharging up to 100 wells simultaneously. A correction factor is applied when the model is utilized for unconfined (water-table) conditions, within limits which were met by the data of this study.

The input parameters for the model consist of a transmissivity factor in gpd/ft, storage coefficient, and aquifer thickness. There is a provision to include regional slope of the water table. Boundary effects on the aquifer are described by image wells. The input parameters for each well consist of location data, pumping rate (or injection rate for a recharge well) in gpd, and period of pumping in days.

The frame of the model is in grid form and for this study a Cartesian coordinate system was utilized, with a point of origin, x-axis and y-axis locational coordinates, and elevations expressed as the z-axis. The program calculates drawdowns as positive numbers on the z-axis, so the recharge component consists of negative values as both input and output.

The output of the model consists of calculated drawdowns from the initial piezometric surface at nodes specified on the grid, at a density determined by the purposes and magnitude of the study. The calculated drawdowns are listed in tabular form, and/or can be plotted in graphic form on a representation of the grid. The THWELLS program provides both forms of output. For the purposes of this study, the calculated drawdowns in tabular form were filtered through a spreadsheet program which provided greater facility in presenting the data in an easily read form than in the somewhat limited format of the THWELLS output. Similarly, the output was filtered through a contour mapping program (SURFER, version 4) which provided much greater flexibility than the THWELLS output in producing water-surface contours. The drawdown contours were printed on transparent film, which were then overlain on the base map utilized in this study.

Scope of Model

The procedure required by the THWELLS program is to establish a grid sufficiently large to include the study area, with a point of origin for the x and y axes. The point of origin for this study was selected at the intersection of Secs. 1, 2, 11 and 12, T.3N., R.2W. From this zero point locations of operating wells are entered into the model by determining the *x* and *y* distances, in feet from this point. The x-axis in this study is a line extending east from the point of origin, in effect Greenway Road. The y-axis is a line north, effectively Cotton Lane. The east distance of the grid was 8 miles, to 107th Avenue, or a distance of 42,240 feet. The north distance was 7 miles, to Jomax Road, a distance of 36,960 feet. This is a total of 56 square miles.

Density of Nodes

A node is the intersection of the x and y lines of the grid. For this study a grid of 1,320 feet (¼-mile) was selected, with an extra line in both dimensions: the grid used was 33 x 29 rather than 32 x 28. The 33 x 29 grid gave 957 intersecting nodes, for which drawdowns were calculated.

Consideration of Possible Negative Boundaries

According to Sheet 1 of the report by Reeter and Remick (Reeter, R. W., and Remick, W. H., 1986, *Maps showing groundwater conditions in the West Salt River, East Salt River, Lake Pleasant, Carefree and Fountain Hills Sub–Basins of the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona–1983*: Az. Dept. of Water Resources Hydrologic Map Series Report No. 12) the distance from the zero point of the grid utilized in the model to the eastern edge of the White Tank Mountains is 5 miles. The southernmost tip of the Hieroglyphic Mountains is 4 miles east and 7 miles north of the zero point.

The negative boundary of the White Tank Mountains ends about 1¼ miles north of the zero point of the grid, where the flank of the mountain mass turns nearly directly west. The portion of the Hieroglyphic Mountains nearest the grid is only about 1 mile wide and the main mass lies 3 miles north and is only 3 miles wide. For these reasons it was considered that the limited zones of impermeable bedrock would have only a minor effect upon the computed figures for water level declines or rises, and negative image wells were not included in the computations.

Effect of Water Table Gradient

From the Reeter and Remick map (*idem.* Sheet 1) the gradient of the water table in the vicinity of Sun City West is southward and amounts to approximately 100 feet in 6 miles. Converting this to an angle in degrees, the gradient is .0181 degrees southward along the y-axis and zero along the x-axis. The point source of recharge is about opposite the middle of Sun City West along the y-axis. For operation of the model it was considered that elimination of the effect of the water-table gradient would have only a minor effect on the results, and hence the effect of the gradient was not included.

Parameters Utilized

The coefficient of transmissivity T that was selected is 90,000 gpd/ft, based on a transmissivity map of central Arizona (Anderson, T. W., 1964, *Electrical-analog analysis of ground-water depletion in Central Arizona*: U. S. Geol. Survey Water-Supply Paper 1860, Plate 2A).

The coefficient of storage S applied to the Central Arizona area by Anderson (*idem.*, p. 10) was 19 percent. For the model a figure of 15 percent was selected, which is considered conservative and is the lower limit of the range discussed by Anderson.

The time t selected was 36, 500 days (100 years) based on a recommendation by officials of DWR.

The discharges (Q) that were utilized for each producing well are required by the model program to be expressed in gallons per day. Development of discharges for the golf course wells are set forth on pages 3–7, 3–8 and 4–4 in this report. Potable water for the expansion area will be supplied from the existing water system in Sun City West, consisting of eight operating production wells, collection mains, and storage reservoirs. Because water can be delivered to the expansion area from any of the existing wells, the total average daily demand was considered to be distributed equally among all wells as shown in Table 7–1. Table 7–2 shows the locations of all wells used.

A hypothetical well situated at the center of the recharge ponds was utilized to simulate the daily injection of 2,442,377 gpd from the ponds.

TABLE 7–1

DISCHARGE AND RECHARGE DATA ENTERED INTO DRAWDOWN MODEL

Designation of Well	Scenario No. 1 (gpd)	Scenario No. 2 (gpd)
Golf Course Wells		
Trail Ridge	723,876	723,876
Echo Mesa	444,823	444,823
Stardust	478,656	478,656
Briarwood	662,995	662,995
Grandview	737,890	737,890
Hillcrest	535,430	535,430
Pebblebrook	705,308	705,308
Expansion Area	603,230	603,230
Subtotal	4,892,208	4,892,208
Municipal Wells		
A–21	665,670	690,049
C–21	665,670	690,049
A–22	665,670	690,049
A–23	665,670	690,049
A–27	665,670	690,049
A–28	665,670	690,049
A–34	665,670	690,049
B–34	665,672	690,049
Subtotal	5,325,362	5,520,392
TOTAL	**10,217,570**	**10,412,600**
Recharge	**2,442,377**	**2,442,377**

TABLE 7–2

WELLS, WELL LOCATIONS AND DWR WELL REGISTRATION NUMBERS

Sun City West
and
Expansion Area

Well Name	Location	DWR Registration Number	DWR Industrial Use Permit
Sun City West: Golf	***Recreation Centers***		
Trail Ridge	B(4–1)20bcb	55–612962	511016 511017
Echo Mesa	B(4–1)21aaa	55–612961	[511014?] 511015
Stardust	B(4–1)23dab	55–610211	511009
Briarwood	B(4–1)22dba	55–610213	511011
Grandview	B(4–1)29abb	55–604494	[511012?] 511013
Hillcrest	B(4–1)27bbb	55–610216	
Pebblebrook	B(4–1)26cac	55–610212	
Sun City West: Municipal	***Citizens Utilities***		
A–21	B(4–1)21bbb	55–612959	
C–21	B(4–1)21abb	55–520840	
A–22	B(4–1)22abb	55–610214	
A–23	B(4–1)23bbb	55–610215	
A–27	B(4–1)27cbb	55–610217 Deepened by: 55–514405	
A–28	B(4–1)28baa	55–612963	
A–34	B(4–1)34acb	55–610219	
B–34	B(4–1)34dbb	55–610220	

Expansion Area:

Hypothetical golf course well	B(4–1)16cbb

Recharge Facility:

Theoretical center of recharge	A(4–1)30bca
Monitor well	A(4–1)31bba

Effect of Groundwater Recharge

This topic is discussed in Chapter 6.

Summary of Water Demand

Table 7–1 contains all of the figures entered into the model for computation of drawdown during a 100–year period for the combination of water demand for Sun City West and the expansion area, offset by water-level rises resulting from recharge of treated wastewater.

Compliance with DWR Requirements

There are two requirements of DWR relating to conduct of a hydrogeological analysis. Both requirements are based on consideration of three components of the withdrawals from the aquifer, as follows:

1. Compute the average historical annual decline of the water table resulting from primarily outside groundwater withdrawals and project this decline into the future for 100 years;

2. Compute the current average depth to the water table underlying the land tract under review;

3. Compute the total water-level decline resulting from the project development for 100 years;

The first applicable DWR regulation is that the combined annual decline (Items 1 and 3) cannot exceed 10 feet per year. The second regulation is that the ultimate depth to the water table 100 years hence cannot exceed 1,200 feet.

Table 7–3 indicates that the results of the investigation show an overall decline rate of 3.0 feet per year and an ultimate depth to the water table (Item 1 x 100, Item 2, and Item 3) will be 712 feet.

TABLE 7–3

SUMMARY OF WATER LEVEL DATA
SUN CITY WEST AND EXPANSION AREA

	Sun City West			New Land			Total		
Item	(ft)	(ac)	Factor	(ft)	(ac)	Factor	Factor	(ac)	(ft)
1991 Static water Level	417	5,716	2,383,572	393	1,045	410,685	2,794,257	6,761	413
100-Year Regional Decline	301	5,716	1,720,516	38	1,045	39,710	1,760,226	6,761	260
Subtotal									673
100-Year Projected Decline With Recharge									34
Water Level at end of 100 Years (cannot exceed 1,200 feet)									707
Annual Rate of Decline, ft/yr (cannot exceed 10 feet per year)									
With Recharge ((260 + 34) / 100)							**USE 2.9**		2.94
Without Recharge ((260 + 34 +7)/100)							**USE 3.0**		3.01

SUMMARY OF COMPUTER SIMULATIONS

Three computer-generated piezometric surface maps were made to depict groundwater changes 100 years hence. The first is generated by Scenario No. 1 and the second by Scenario No. 2. The average change in water level underlying Sun City West and the expansion area is based on 60 nodes at intervals of one-half mile around the perimeter and within the area. The weighted average change was computed by adding the water-level changes at all 60 nodes and dividing by 60.

Plate 6 relates to changes in water level based on the following: Full buildout within the expanded area; the continued historical rate of municipal water use after full buildout within the existing Sun City West; 141 gpd per resident within the expansion area; seven golf courses in existing Sun City West and one in the expansion area; and the positive effect of groundwater recharge at the wastewater treatment plant. The average net decline in the 100-year period was found to be 33 feet.

Plate 7 follows the same criteria as for Plate 6, with one exception. The residential demand within the expansion area was considered to be at the same rate as in Sun City West, slightly greater than 141 gpd per resident. The average net decline in 100 years was found to be 34 feet.

Plate 8 depicts the rise in water level from groundwater recharge at an average rate of 2,442,377 gpd. The average rise of water level underlying Sun City West and the expansion area was found to be 7.3 feet in 100 years.

Appendices A, B, and C contain the model parameters, the well input parameters, graphic plots of the drawdown contours, and the tabular output of the calculated drawdowns for each of the 957 nodes for Plates 6, 7 and 8.

APPENDICES

Input and Output Data for Theis model

Appendix A

SCENARIO NO. 1

Drawdown and Recharge Combined Effect 100–Year Simulation
Demand = 141 gpdpc Applied in Expansion Area

Appendix B

SCENARIO NO. 2

Drawdown and Recharge Combined Effect 100–Year Simulation
Demand = Prorated Current Demand in Sun City West
Applied in Expansion Area

Appendix C

RECHARGE MOUND

Recharge Rise in Water Level: 100–Year Simulation

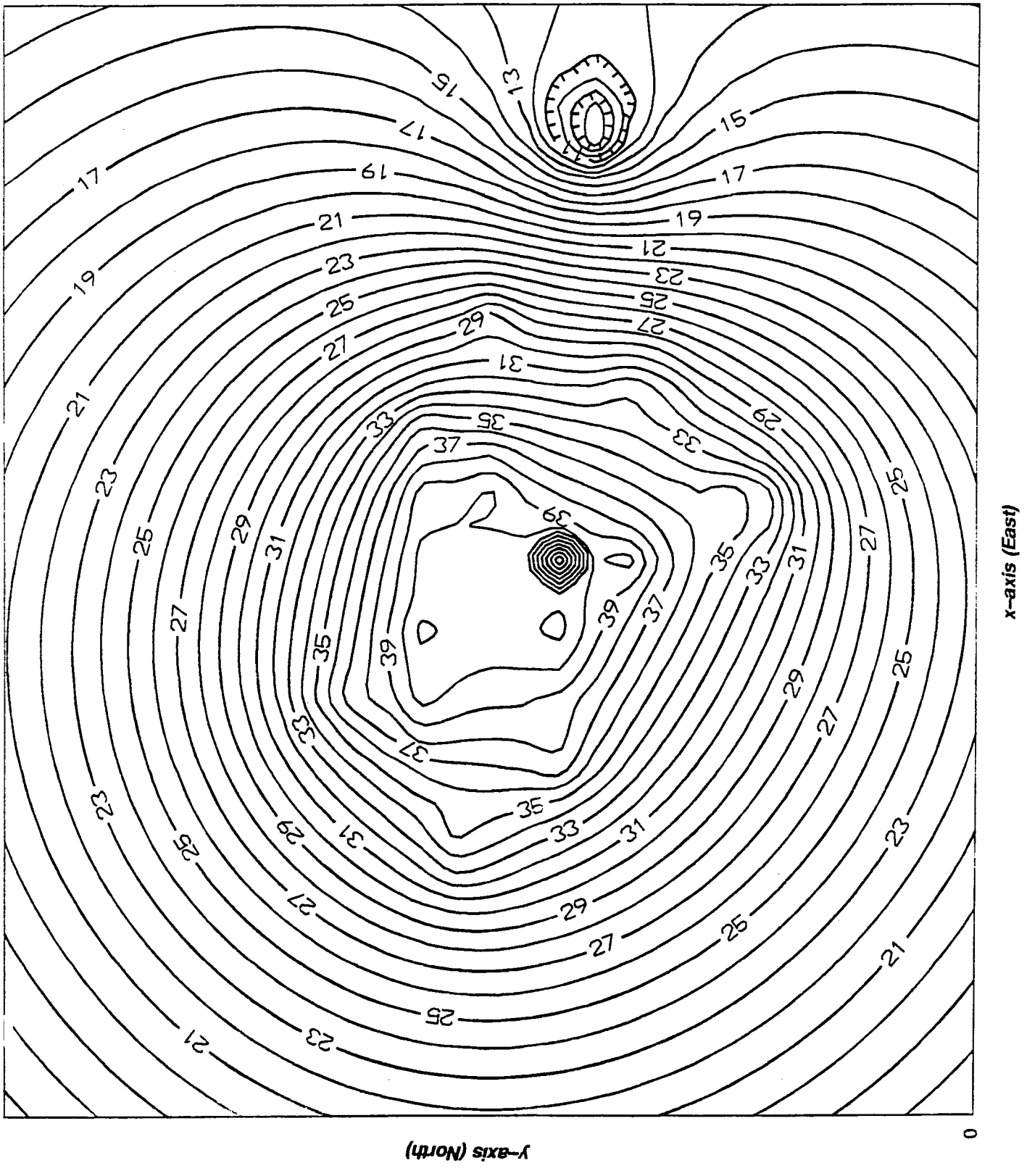
Appendix A

SCENARIO NO. 1

Drawdown and Recharge Combined Effect 100–Year Simulation

Demand = 141 gpdpc Applied in Expansion Area

CONTOUR PLOT OF FEET OF DRAWDOWN AFTER 100 YEARS
Scenario No. 1
Demand in Expansion Area = 141 gpdpc
Recharge from Sun City Wastewater Treatment Plant
Scale: 1 inch = 1 mile
Hachures indicate rise in water level



'LCULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED
AQUIFER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

Recharge and drawdown SCW at 141 gpdpc **SCENARIO NO. 1**

********** INPUT DATA **********

TRANSMISSIVITY	=	90000 [gpd/ft]
STORAGE COEFFICIENT	=	.15
REGIONAL FLOW GRADIENT (positive--downwards--in flow direction)	=	0
REGIONAL FLOW DIRECTION (horizontal angle in degrees counter-clockwise from positive x-axis)	=	0
REGIONAL FLOW OFFSET AT ORIGIN (positive in downwards direction)	=	0 [ft]

WATER TABLE CORRECTION APPLIED

AQUIFER THICKNESS = 1200 [ft]

WELL NO. 1

SCENARIO NO. 1

```
                    X-COORDINATE  =  15312 [ft]
                    Y-COORDINATE  =  21120 [ft]
          PUMPING/INJECTION RATE  =  665670 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

A-21

WELL NO. 2

```
                    X-COORDINATE  =  17952 [ft]
                    Y-COORDINATE  =  21120 [ft]
          PUMPING/INJECTION RATE  =  665670 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

C-21

WELL NO. 3

```
                    X-COORDINATE  =  23232 [ft]
                    Y-COORDINATE  =  21120 [ft]
          PUMPING/INJECTION RATE  =  665670 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

A-22

WELL NO. 4

```
                    X-COORDINATE  =  25872 [ft]
                    Y-COORDINATE  =  21120 [ft]
          PUMPING/INJECTION RATE  =  665670 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

A-23

WELL NO. 5

```
                    X-COORDINATE  =  17952 [ft]
                    Y-COORDINATE  =  15840 [ft]
          PUMPING/INJECTION RATE  =  665670 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

A-28

WELL NO. 6

```
                    X-COORDINATE  =  23232 [ft]
                    Y-COORDINATE  =  8976 [ft]
          PUMPING/INJECTION RATE  =  665670 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

A-34

SCENARIO NO. 1

B-34

WELL NO. 7

```
                    X-COORDINATE  =  23232 [ft]
                    Y-COORDINATE  =  7920 [ft]
          PUMPING/INJECTION RATE  =  665672 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 8

TRAIL RIDGE

```
                    X-COORDINATE  =  10032 [ft]
                    Y-COORDINATE  =  19536 [ft]
          PUMPING/INJECTION RATE  =  723876 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 9

ECHO MESA

```
                    X-COORDINATE  =  20592 [ft]
                    Y-COORDINATE  =  21120 [ft]
          PUMPING/INJECTION RATE  =  444823 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 10

STARDUST

```
                    X-COORDINATE  =  30624 [ft]
                    Y-COORDINATE  =  18480 [ft]
          PUMPING/INJECTION RATE  =  478656 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 11

BRIARWOOD

```
                    X-COORDINATE  =  24288 [ft]
                    Y-COORDINATE  =  18480 [ft]
          PUMPING/INJECTION RATE  =  662995 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 12

GRANDVIEW

```
                    X-COORDINATE  =  13728 [ft]
                    Y-COORDINATE  =  15840 [ft]
          PUMPING/INJECTION RATE  =  737890 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

SCENARIO NO. 1

WELL NO. 13

```
                    X-COORDINATE  =  21120 [ft]
                    Y-COORDINATE  =  15840 [ft]
            PUMPING/INJECTION RATE  =  535430 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

HILLCREST

WELL NO. 14

```
                    X-COORDINATE  =  27984 [ft]
                    Y-COORDINATE  =  12672 [ft]
            PUMPING/INJECTION RATE  =  705308 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

PEBBLEBROOK

WELL NO. 15

```
                    X-COORDINATE  =  15840 [ft]
                    Y-COORDINATE  =  24288 [ft]
            PUMPING/INJECTION RATE  =  603230 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

EXPANSION AREA GOLF

WELL NO. 16

```
                    X-COORDINATE  =  37488 [ft]
                    Y-COORDINATE  =  14784 [ft]
            PUMPING/INJECTION RATE  = -2442377 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

RECHARGE PONDS HYPOTHETICAL INJECTION WELL

WELL NO. 17

```
                    X-COORDINATE  =  21120 [ft]
                    Y-COORDINATE  =  12936 [ft]
            PUMPING/INJECTION RATE  =  665670 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

Recharge and drawdown: Sun City West
1,320 foot grid
Cartesian coordinate grid
Origin: NW corner Sec. 12, T.3N., R2W.
Distances on x and y axes in feet from origin
Z-axis = drawdown in feet
Duration: 100 years
Demand: 141 gpdpc

x-axis	y-axis	Drawdown
0	0	17.0667
0	1320	17.552
0	2640	18.0345
0	3960	18.5109
0	5280	18.9774
0	6600	19.4297
0	7920	19.8625
0	9240	20.2702
0	10560	20.6462
0	11880	20.9836
0	13200	21.2744
0	14520	21.5108
0	15840	21.6848
0	17160	21.7891
0	18480	21.8181
0	19800	21.7689
0	21120	21.642
0	22440	21.4412
0	23760	21.1734
0	25080	20.8472
0	26400	20.4719
0	27720	20.0567
0	29040	19.6102
0	30360	19.1402
0	31680	18.6533
0	33000	18.1555
0	34320	17.6517
0	35640	17.1459
0	36960	16.6416
1320	0	17.5694
1320	1320	18.0936
1320	2640	18.6174
1320	3960	19.1375
1320	5280	19.6498
1320	6600	20.1496
1320	7920	20.6315
1320	9240	21.089
1320	10560	21.5149
1320	11880	21.9008
1320	13200	22.2374
1320	14520	22.5147
1320	15840	22.7221
1320	17160	22.8495
1320	18480	22.8885
1320	19800	22.8344
1320	21120	22.6874
1320	22440	22.4533
1320	23760	22.1418
1320	25080	21.7649
1320	26400	21.3351
1320	27720	20.8638
1320	29040	20.3614
1320	30360	19.8369
1320	31680	19.2978
1320	33000	18.7505
1320	34320	18.2004
1320	35640	17.6515
1320	36960	17.1073
2640	0	18.0732
2640	1320	18.6392
2640	2640	19.2078
2640	3960	19.7755
2640	5280	20.3382
2640	6600	20.8912
2640	7920	21.4285
2640	9240	21.9432
2640	10560	22.4273
2640	11880	22.871
2640	13200	23.2635
2640	14520	23.5922
2640	15840	23.8434
2640	17160	24.0026
2640	18480	24.0567
2640	19800	23.9975
2640	21120	23.8245
2640	22440	23.5468
2640	23760	23.1793
2640	25080	22.7394
2640	26400	22.2433
2640	27720	21.7056
2640	29040	21.1384
2640	30360	20.5517
2640	31680	19.954
2640	33000	19.3521
2640	34320	18.7514
2640	35640	18.1561
2640	36960	17.5695
3960	0	18.5755
3960	1320	19.1861
3960	2640	19.8027
3960	3960	20.4221
3960	5280	21.0402
3960	6600	21.652
3960	7920	22.2516
3960	9240	22.8317
3960	10560	23.3834
3960	11880	23.896
3960	13200	24.3569
3960	14520	24.751
3960	15840	25.0606
3960	17160	25.2652
3960	18480	25.3436
3960	19800	25.2796
3960	21120	25.0713
3960	22440	24.7341
3960	23760	24.2929
3960	25080	23.7733
3960	26400	23.1967
3960	27720	22.5804
3960	29040	21.9382
3960	30360	21.2811
3960	31680	20.6181
3960	33000	19.9562
3960	34320	19.3007
3960	35640	18.6557
3960	36960	18.0242
5280	0	19.0727
5280	1320	19.7306
5280	2640	20.3986
5280	3960	21.0737
5280	5280	21.752
5280	6600	22.4287
5280	7920	23.0979
5280	9240	23.7521
5280	10560	24.382
5280	11880	24.9762
5280	13200	25.5204
5280	14520	25.9974
5280	15840	26.386
5280	17160	26.6586
5280	18480	26.7791
5280	19800	26.7127
5280	21120	26.4524
5280	22440	26.0289
5280	23760	25.4879
5280	25080	24.8671
5280	26400	24.1929
5280	27720	23.4845
5280	29040	22.7563
5280	30360	22.02
5280	31680	21.2847
5280	33000	20.5573
5280	34320	19.8431
5280	35640	19.1455
5280	36960	18.4671
6600	0	19.561
6600	1320	20.2685
6600	2640	20.9911
6600	3960	21.7258
6600	5280	22.4691
6600	6600	23.2165
6600	7920	23.9625
6600	9240	24.7
6600	10560	25.4197
6600	11880	26.1096
6600	13200	26.7542
6600	14520	27.3349
6600	15840	27.8295
6600	17160	28.2072
6600	18480	28.4099
6600	19800	28.3512

6600	21120	28.0023	9240	19800	32.9864	11880	18480	35.5232
6600	22440	27.4431	9240	21120	31.7059	11880	19800	35.4285
6600	23760	26.7644	9240	22440	30.5567	11880	21120	34.6689
6600	25080	26.0167	9240	23760	29.4934	11880	22440	33.5651
6600	26400	25.2265	9240	25080	28.4348	11880	23760	32.304
6600	27720	24.4115	9240	26400	27.3659	11880	25080	30.9418
6600	29040	23.586	9240	27720	26.2959	11880	26400	29.5296
6600	30360	22.7614	9240	29040	25.2404	11880	27720	28.1311
6600	31680	21.9468	9240	30360	24.2123	11880	29040	26.7908
6600	33000	21.149	9240	31680	23.2204	11880	30360	25.5265
6600	34320	20.3723	9240	33000	22.2693	11880	31680	24.3413
6600	35640	19.6198	9240	34320	21.3607	11880	33000	23.2318
6600	36960	18.893	9240	35640	20.4947	11880	34320	22.1926
7920	0	20.0357	9240	36960	19.67	11880	35640	21.2181
7920	1320	20.7952	10560	0	20.9238	11880	36960	20.3027
7920	2640	21.575	10560	1320	21.7922	13200	0	21.6896
7920	3960	22.3729	10560	2640	22.6936	13200	1320	22.6709
7920	5280	23.1856	10560	3960	23.6265	13200	2640	23.7006
7920	6600	24.0093	10560	5280	24.5888	13200	3960	24.7773
7920	7920	24.8391	10560	6600	25.578	13200	5280	25.8989
7920	9240	25.669	10560	7920	26.592	13200	6600	27.0631
7920	10560	26.4903	10560	9240	27.6288	13200	7920	28.2689
7920	11880	27.2913	10560	10560	28.6862	13200	9240	29.5185
7920	13200	28.0551	10560	11880	29.76	13200	10560	30.8202
7920	14520	28.7609	10560	13200	30.8357	13200	11880	32.1936
7920	15840	29.3892	10560	14520	31.8689	13200	13200	33.6867
7920	17160	29.9257	10560	15840	32.7724	13200	14520	35.4486
7920	18480	30.3144	10560	17160	33.5307	13200	15840	37.5894
7920	19800	30.3101	10560	18480	34.4108	13200	17160	37.0731
7920	21120	29.7631	10560	19800	35.073	13200	18480	36.8733
7920	22440	28.9718	10560	21120	33.3702	13200	19800	36.7306
7920	23760	28.1097	10560	22440	32.0831	13200	21120	36.2376
7920	25080	27.2113	10560	23760	30.8852	13200	22440	35.1918
7920	26400	26.2881	10560	25080	29.6758	13200	23760	33.8284
7920	27720	25.3525	10560	26400	28.449	13200	25080	32.2652
7920	29040	24.4179	10560	27720	27.2281	13200	26400	30.5949
7920	30360	23.496	10560	29040	26.0381	13200	27720	28.9747
7920	31680	22.5957	10560	30360	24.8955	13200	29040	27.4686
7920	33000	21.7229	10560	31680	23.8076	13200	30360	26.0814
7920	34320	20.8811	10560	33000	22.7767	13200	31680	24.8027
7920	35640	20.072	10560	34320	21.8015	13200	33000	23.6203
7920	36960	19.2961	10560	35640	20.8796	13200	34320	22.523
9240	0	20.4919	10560	36960	20.008	13200	35640	21.5014
9240	1320	21.305	11880	0	21.3253	13200	36960	20.5473
9240	2640	22.1447	11880	1320	22.2499	14520	0	22.0088
9240	3960	23.0088	11880	2640	23.2148	14520	1320	23.0471
9240	5280	23.8947	11880	3960	24.2186	14520	2640	24.1429
9240	6600	24.7994	11880	5280	25.2595	14520	3960	25.2948
9240	7920	25.7192	11880	6600	26.3356	14520	5280	26.4996
9240	9240	26.6495	11880	7920	27.4458	14520	6600	27.7531
9240	10560	27.5842	11880	9240	28.5908	14520	7920	29.0526
9240	11880	28.5129	11880	10560	29.7742	14520	9240	30.3993
9240	13200	29.4177	11880	11880	31.0039	14520	10560	31.8016
9240	14520	30.2695	11880	13200	32.289	14520	11880	33.2785
9240	15840	31.0418	11880	14520	33.6059	14520	13200	34.8693
9240	17160	31.761	11880	15840	34.707	14520	14520	36.6612
9240	18480	32.5752	11880	17160	35.2477	14520	15840	38.4299

14520	17160	38.3134
14520	18480	38.2013
14520	19800	38.3756
14520	21120	38.5475
14520	22440	37.0516
14520	23760	35.5686
14520	25080	33.7125
14520	26400	31.5897
14520	27720	29.6991
14520	29040	28.0292
14520	30360	26.5313
14520	31680	25.1718
14520	33000	23.9275
14520	34320	22.7816
14520	35640	21.721
14520	36960	20.7352
15840	0	22.2744
15840	1320	23.3691
15840	2640	24.5325
15840	3960	25.7629
15840	5280	27.0552
15840	6600	28.4015
15840	7920	29.7938
15840	9240	31.2297
15840	10560	32.7145
15840	11880	34.2595
15840	13200	35.8714
15840	14520	37.4876
15840	15840	38.7213
15840	17160	39.1425
15840	18480	39.282
15840	19800	39.6719
15840	21120	40.3353
15840	22440	38.4342
15840	23760	37.4877
15840	25080	35.0934
15840	26400	32.3039
15840	27720	30.2082
15840	29040	28.4244
15840	30360	26.8482
15840	31680	25.4303
15840	33000	24.1408
15840	34320	22.9591
15840	35640	21.8698
15840	36960	20.8608
17160	0	22.4762
17160	1320	23.6258
17160	2640	24.858
17160	3960	26.1721
17160	5280	27.5605
17160	6600	29.0081
17160	7920	30.4963
17160	9240	32.0153
17160	10560	33.5705
17160	11880	35.171
17160	13200	36.8234
17160	14520	38.5805

17160	15840	40.2375
17160	17160	40.1421
17160	18480	40.0886
17160	19800	40.4144
17160	21120	40.6759
17160	22440	38.8969
17160	23760	37.0274
17160	25080	34.8621
17160	26400	32.5045
17160	27720	30.4331
17160	29040	28.6222
17160	30360	27.0132
17160	31680	25.5655
17160	33000	24.2509
17160	34320	23.0485
17160	35640	21.9424
17160	36960	20.9198
18480	0	22.6024
18480	1320	23.803
18480	2640	25.104
18480	3960	26.5088
18480	5280	28.0094
18480	6600	29.579
18480	7920	31.1747
18480	9240	32.7688
18480	10560	34.3815
18480	11880	36.0398
18480	13200	37.6947
18480	14520	39.4065
18480	15840	41.3219
18480	17160	40.7348
18480	18480	40.5215
18480	19800	40.7548
18480	21120	41.2077
18480	22440	38.8843
18480	23760	36.6482
18480	25080	34.4899
18480	26400	32.3715
18480	27720	30.4037
18480	29040	28.6249
18480	30360	27.0223
18480	31680	25.5723
18480	33000	24.2531
18480	34320	23.046
18480	35640	21.9357
18480	36960	20.9098
19800	0	22.6395
19800	1320	23.8826
19800	2640	25.2482
19800	3960	26.7499
19800	5280	28.3891
19800	6600	30.1289
19800	7920	31.8681
19800	9240	33.5107
19800	10560	35.1298
19800	11880	36.917
19800	13200	38.6058

19800	14520	39.7681
19800	15840	40.7192
19800	17160	40.7177
19800	18480	40.5608
19800	19800	40.6176
19800	21120	40.4369
19800	22440	38.4984
19800	23760	36.2539
19800	25080	34.1034
19800	26400	32.0698
19800	27720	30.1814
19800	29040	28.454
19800	30360	26.8827
19800	31680	25.4528
19800	33000	24.1474
19800	34320	22.9507
19800	35640	21.8488
19800	36960	20.8298
21120	0	22.5735
21120	1320	23.8431
21120	2640	25.2581
21120	3960	26.8511
21120	5280	28.6582
21120	6600	30.6773
21120	7920	32.6974
21120	9240	34.3087
21120	10560	35.673
21120	11880	37.5354
21120	13200	40.3458
21120	14520	39.855
21120	15840	47.8677
21120	17160	40.5484
21120	18480	40.3403
21120	19800	40.3742
21120	21120	40.3192
21120	22440	38.0704
21120	23760	35.7571
21120	25080	33.6076
21120	26400	31.6223
21120	27720	29.7979
21120	29040	28.1288
21120	30360	26.6049
21120	31680	25.2126
21120	33000	23.9371
21120	34320	22.7647
21120	35640	21.6829
21120	36960	20.6809
22440	0	22.3921
22440	1320	23.6631
22440	2640	25.0945
22440	3960	26.7389
22440	5280	28.6898
22440	6600	31.1383
22440	7920	34.0998
22440	9240	35.4762
22440	10560	35.7541
22440	11880	36.7652

22440	13200	37.934
22440	14520	38.6543
22440	15840	39.4007
22440	17160	39.7293
22440	18480	39.9614
22440	19800	40.0203
22440	21120	39.7803
22440	22440	37.4989
22440	23760	35.0958
22440	25080	32.9503
22440	26400	31.0167
22440	27720	29.2613
22440	29040	27.6614
22440	30360	26.1991
22440	31680	24.8592
22440	33000	23.6278
22440	34320	22.4921
22440	35640	21.4412
22440	36960	20.4653
23760	0	22.0892
23760	1320	23.3292
23760	2640	24.7271
23760	3960	26.3375
23760	5280	28.2615
23760	6600	30.7381
23760	7920	34.1053
23760	9240	35.2718
23760	10560	34.9586
23760	11880	35.5258
23760	13200	36.3176
23760	14520	37.0545
23760	15840	37.7864
23760	17160	38.7023
23760	18480	40.0896
23760	19800	39.4273
23760	21120	39.3079
23760	22440	36.6131
23760	23760	34.1769
23760	25080	32.0871
23760	26400	30.238
23760	27720	28.5735
23760	29040	27.0599
23760	30360	25.6747
23760	31680	24.4014
23760	33000	23.2265
23760	34320	22.1387
23760	35640	21.1284
23760	36960	20.187
25080	0	21.6676
25080	1320	22.8439
25080	2640	24.1572
25080	3960	25.6432
25080	5280	27.3462
25080	6600	29.2822
25080	7920	31.2105
25080	9240	32.5388
25080	10560	33.346
25080	11880	34.1171
25080	13200	34.8383
25080	14520	35.4473
25080	15840	36.0866
25080	17160	36.967
25080	18480	38.0407
25080	19800	37.7733
25080	21120	37.4336
25080	22440	35.1968
25080	23760	32.9338
25080	25080	30.9927
25080	26400	29.2812
25080	27720	27.74
25080	29040	26.3344
25080	30360	25.0425
25080	31680	23.849
25080	33000	22.7419
25080	34320	21.7118
25080	35640	20.7504
25080	36960	19.8509
26400	0	21.1396
26400	1320	22.2267
26400	2640	23.4201
26400	3960	24.7343
26400	5280	26.1724
26400	6600	27.6945
26400	7920	29.1746
26400	9240	30.471
26400	10560	31.6295
26400	11880	32.7682
26400	13200	33.5238
26400	14520	33.8095
26400	15840	34.1709
26400	17160	34.6727
26400	18480	35.1138
26400	19800	35.3451
26400	21120	35.6139
26400	22440	33.3431
26400	23760	31.3708
26400	25080	29.6788
26400	26400	28.1611
26400	27720	26.7761
26400	29040	25.4997
26400	30360	24.3162
26400	31680	23.214
26400	33000	22.1843
26400	34320	21.2199
26400	35640	20.3146
26400	36960	19.4629
27720	0	20.5243
27720	1320	21.5065
27720	2640	22.5641
27720	3960	23.6968
27720	5280	24.9008
27720	6600	26.1398
27720	7920	27.3686
27720	9240	28.5711
27720	10560	29.8516
27720	11880	31.6432
27720	13200	32.7199
27720	14520	31.9964
27720	15840	32.0873
27720	17160	32.3943
27720	18480	32.6344
27720	19800	32.5963
27720	21120	32.1019
27720	22440	30.9589
27720	23760	29.5654
27720	25080	28.2005
27720	26400	26.9142
27720	27720	25.7081
27720	29040	24.5763
27720	30360	23.5124
27720	31680	22.5104
27720	33000	21.5653
27720	34320	20.6728
27720	35640	19.8288
27720	36960	19.0298
29040	0	19.8431
29040	1320	20.7139
29040	2640	21.6328
29040	3960	22.5955
29040	5280	23.5911
29040	6600	24.6018
29040	7920	25.6121
29040	9240	26.6324
29040	10560	27.7309
29040	11880	29.0049
29040	13200	29.7213
29040	14520	29.6353
29040	15840	29.8043
29040	17160	30.1872
29040	18480	30.473
29040	19800	30.2056
29040	21120	29.5828
29040	22440	28.7207
29040	23760	27.7048
29040	25080	26.642
29040	26400	25.5895
29040	27720	24.5693
29040	29040	23.5888
29040	30360	22.6503
29040	31680	21.7535
29040	33000	20.8975
29040	34320	20.0808
29040	35640	19.3018
29040	36960	18.5587
30360	0	19.1171
30360	1320	19.8761
30360	2640	20.6598
30360	3960	21.4612
30360	5280	22.2693
30360	6600	23.0714
30360	7920	23.8583

30360	9240	24.6318
30360	10560	25.3995
30360	11880	26.1173
30360	13200	26.6188
30360	14520	26.9203
30360	15840	27.2955
30360	17160	27.9561
30360	18480	29.4171
30360	19800	28.0547
30360	21120	27.3284
30360	22440	26.6397
30360	23760	25.8828
30360	25080	25.0709
30360	26400	24.2338
30360	27720	23.3932
30360	29040	22.5626
30360	30360	21.7498
30360	31680	20.9594
30360	33000	20.1939
30360	34320	19.4548
30360	35640	18.7426
30360	36960	18.0572
31680	0	18.3655
31680	1320	19.0163
31680	2640	19.672
31680	3960	20.323
31680	5280	20.9573
31680	6600	21.5613
31680	7920	22.1231
31680	9240	22.6342
31680	10560	23.088
31680	11880	23.4716
31680	13200	23.784
31680	14520	24.0965
31680	15840	24.5328
31680	17160	25.1697
31680	18480	25.7782
31680	19800	25.5259
31680	21120	25.0993
31680	22440	24.6444
31680	23760	24.1198
31680	25080	23.5266
31680	26400	22.8833
31680	27720	22.2097
31680	29040	21.5216
31680	30360	20.8302
31680	31680	20.1437
31680	33000	19.4675
31680	34320	18.8055
31680	35640	18.1601
31680	36960	17.5329
33000	0	17.6056
33000	1320	18.1547
33000	2640	18.6916
33000	3960	19.2046
33000	5280	19.6789
33000	6600	20.0974
33000	7920	20.4418
33000	9240	20.6953
33000	10560	20.8482
33000	11880	20.914
33000	13200	20.9636
33000	14520	21.1387
33000	15840	21.5564
33000	17160	22.1602
33000	18480	22.6972
33000	19800	22.9303
33000	21120	22.9086
33000	22440	22.7298
33000	23760	22.431
33000	25080	22.0352
33000	26400	21.5656
33000	27720	21.0435
33000	29040	20.4866
33000	30360	19.909
33000	31680	19.321
33000	33000	18.7304
33000	34320	18.143
33000	35640	17.5629
33000	36960	16.9929
34320	0	16.8519
34320	1320	17.3082
34320	2640	17.7382
34320	3960	18.1278
34320	5280	18.4593
34320	6600	18.7106
34320	7920	18.8551
34320	9240	18.8629
34320	10560	18.7069
34320	11880	18.3897
34320	13200	18.018
34320	14520	17.9037
34320	15840	18.359
34320	17160	19.2032
34320	18480	20.0168
34320	19800	20.5778
34320	21120	20.8665
34320	22440	20.9373
34320	23760	20.8424
34320	25080	20.6207
34320	26400	20.3031
34320	27720	19.9147
34320	29040	19.4755
34320	30360	19.0012
34320	31680	18.5041
34320	33000	17.9936
34320	34320	17.4767
34320	35640	16.9589
34320	36960	16.4442
35640	0	16.1167
35640	1320	16.4908
35640	2640	16.8277
35640	3960	17.1117
35640	5280	17.3223
35640	6600	17.4329
35640	7920	17.408
35640	9240	17.1999
35640	10560	16.7438
35640	11880	15.9608
35640	13200	14.8395
35640	14520	13.9683
35640	15840	14.7366
35640	17160	16.3243
35640	18480	17.6271
35640	19800	18.509
35640	21120	19.0425
35640	22440	19.3113
35640	23760	19.3821
35640	25080	19.3042
35640	26400	19.114
35640	27720	18.8395
35640	29040	18.5022
35640	30360	18.1192
35640	31680	17.7038
35640	33000	17.2663
35640	34320	16.8148
35640	35640	16.3554
35640	36960	15.8929
36960	0	15.4096
36960	1320	15.7135
36960	2640	15.9729
36960	3960	16.1713
36960	5280	16.2871
36960	6600	16.2915
36960	7920	16.1439
36960	9240	15.7838
36960	10560	15.1111
36960	11880	13.9316
36960	13200	11.7595
36960	14520	7.38292
36960	15840	10.6259
36960	17160	13.8725
36960	18480	15.6758
36960	19800	16.7901
36960	21120	17.4821
36960	22440	17.8829
36960	23760	18.0717
36960	25080	18.1019
36960	26400	18.0116
36960	27720	17.8295
36960	29040	17.5775
36960	30360	17.2728
36960	31680	16.9288
36960	33000	16.5564
36960	34320	16.164
36960	35640	15.7582
36960	36960	15.3444
38280	0	14.7374
38280	1320	14.9836
38280	2640	15.1815
38280	3960	15.3154

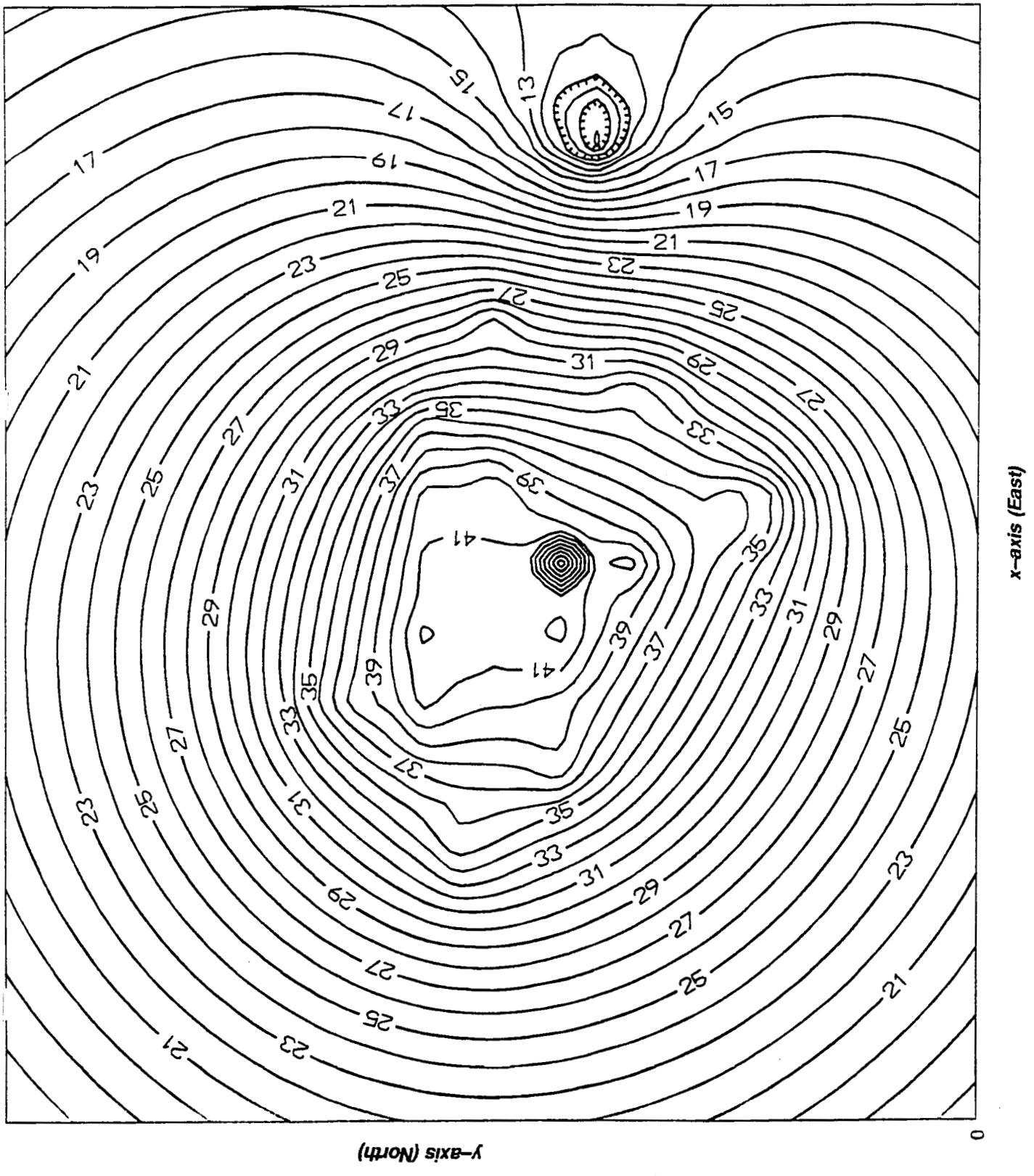
38280	5280	15.3646
38280	6600	15.3019
38280	7920	15.089
38280	9240	14.6692
38280	10560	13.95
38280	11880	12.7577
38280	13200	10.7115
38280	14520	7.58314
38280	15840	9.74847
38280	17160	12.6153
38280	18480	14.3564
38280	19800	15.4772
38280	21120	16.2078
38280	22440	16.6653
38280	23760	16.9206
38280	25080	17.0217
38280	26400	17.0034
38280	27720	16.8921
38280	29040	16.7084
38280	30360	16.4685
38280	31680	16.1855
38280	33000	15.8698
38280	34320	15.5299
38280	35640	15.1726
38280	36960	14.8033
39600	0	14.1043
39600	1320	14.3049
39600	2640	14.4568
39600	3960	14.5462
39600	5280	14.5555
39600	6600	14.4624
39600	7920	14.2381
39600	9240	13.8445
39600	10560	13.2336
39600	11880	12.3573
39600	13200	11.2608
39600	14520	10.4942
39600	15840	11.0596
39600	17160	12.3942
39600	18480	13.6141
39600	19800	14.5405
39600	21120	15.2021
39600	22440	15.6491
39600	23760	15.9246
39600	25080	16.0627
39600	26400	16.0905
39600	27720	16.0299
39600	29040	15.8984
39600	30360	15.7105
39600	31680	15.4781
39600	33000	15.2108
39600	34320	14.9167
39600	35640	14.6024
39600	36960	14.2732
40920	0	13.5117
40920	1320	13.6777
40920	2640	13.7975
40920	3960	13.8597
40920	5280	13.8509
40920	6600	13.7558
40920	7920	13.557
40920	9240	13.2382
40920	10560	12.7914
40920	11880	12.2419
40920	13200	11.7071
40920	14520	11.4565
40920	15840	11.7337
40920	17160	12.4135
40920	18480	13.1865
40920	19800	13.8713
40920	21120	14.4118
40920	22440	14.8059
40920	23760	15.0679
40920	25080	15.2163
40920	26400	15.2688
40920	27720	15.2413
40920	29040	15.1478
40920	30360	15.0002
40920	31680	14.8087
40920	33000	14.5819
40920	34320	14.3271
40920	35640	14.0504
40920	36960	13.757
42240	0	12.959
42240	1320	13.0999
42240	2640	13.1987
42240	3960	13.247
42240	5280	13.2356
42240	6600	13.1557
42240	7920	13
42240	9240	12.7667
42240	10560	12.468
42240	11880	12.144
42240	13200	11.8802
42240	14520	11.7975
42240	15840	11.9756
42240	17160	12.3737
42240	18480	12.8698
42240	19800	13.3561
42240	21120	13.773
42240	22440	14.098
42240	23760	14.3279
42240	25080	14.4688
42240	26400	14.5301
42240	27720	14.5219
42240	29040	14.4545
42240	30360	14.3371
42240	31680	14.1779
42240	33000	13.9843
42240	34320	13.7627
42240	35640	13.5186
42240	36960	13.2567

Appendix B

SCENARIO NO. 2

Drawdown and Recharge Combined Effect 100–Year Simulation
Demand = Prorated Current Demand in Sun City West
Applied in Expansion Area

CONTOUR PLOT OF FEET OF DRAWDOWN AFTER 100 YEARS
Scenario No. 2
Demand in Expansion Area = Prorated Current Demand in Sun City West
Recharge from Sun City Wastewater Treatment Plant
Scale: 1 inch = 1 mile
Hachures indicate rise in water level



ALCULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED AQUIFER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

Recharge and drawdown SCW at prorated demand **SCENARIO NO. 2**

********** INPUT DATA **********

TRANSMISSIVITY	=	90000 [gpd/ft]
STORAGE COEFFICIENT	=	.15
REGIONAL FLOW GRADIENT (positive--downwards--in flow direction)	=	0
REGIONAL FLOW DIRECTION (horizontal angle in degrees counter-clockwise from positive x-axis)	=	0
REGIONAL FLOW OFFSET AT ORIGIN (positive in downwards direction)	=	0 [ft]

WATER TABLE CORRECTION APPLIED

AQUIFER THICKNESS	=	1200 [ft]

WELL NO. 1 *SCENARIO NO. 2*

```
                    X-COORDINATE  =  15312 [ft]
                    Y-COORDINATE  =  21120 [ft]      A-21
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 2

```
                    X-COORDINATE  =  17952 [ft]
                    Y-COORDINATE  =  21120 [ft]      C-21
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 3

```
                    X-COORDINATE  =  23232 [ft]
                    Y-COORDINATE  =  21120 [ft]      A-22
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 4

```
                    X-COORDINATE  =  25872 [ft]
                    Y-COORDINATE  =  21120 [ft]      A-23
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 5

```
                    X-COORDINATE  =  17952 [ft]
                    Y-COORDINATE  =  15840 [ft]      A-28
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 6

```
                    X-COORDINATE  =  23232 [ft]
                    Y-COORDINATE  =  8976 [ft]       A-34
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

SCENARIO NO. 2

B-34

WELL NO. 7

```
                    X-COORDINATE  =  23232 [ft]
                    Y-COORDINATE  =  7920 [ft]
            PUMPING/INJECTION RATE  =  690049 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

TRAIL RIDGE

WELL NO. 8

```
                    X-COORDINATE  =  10032 [ft]
                    Y-COORDINATE  =  19536 [ft]
            PUMPING/INJECTION RATE  =  723876 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

ECHO MESA

WELL NO. 9

```
                    X-COORDINATE  =  20592 [ft]
                    Y-COORDINATE  =  21120 [ft]
            PUMPING/INJECTION RATE  =  444823 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

STARDUST

WELL NO. 10

```
                    X-COORDINATE  =  30624 [ft]
                    Y-COORDINATE  =  18480 [ft]
            PUMPING/INJECTION RATE  =  478656 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

BRIARWOOD

WELL NO. 11

```
                    X-COORDINATE  =  24288 [ft]
                    Y-COORDINATE  =  18480 [ft]
            PUMPING/INJECTION RATE  =  662995 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

GRANDVIEW

WELL NO. 12

```
                    X-COORDINATE  =  13728 [ft]
                    Y-COORDINATE  =  15840 [ft]
            PUMPING/INJECTION RATE  =  737890 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

WELL NO. 13 *SCENARIO NO. 2*

```
                    X-COORDINATE  =  21120 [ft]
                    Y-COORDINATE  =  15840 [ft]
          PUMPING/INJECTION RATE  =  535430 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

HILLCREST

WELL NO. 14

```
                    X-COORDINATE  =  27984 [ft]
                    Y-COORDINATE  =  12672 [ft]
          PUMPING/INJECTION RATE  =  705308 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

PEBBLEBROOK

WELL NO. 15

```
                    X-COORDINATE  =  15840 [ft]
                    Y-COORDINATE  =  24288 [ft]
          PUMPING/INJECTION RATE  =  603230 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

EXPANSION AREA GOLF

WELL NO. 16

```
                    X-COORDINATE  =  37488 [ft]
                    Y-COORDINATE  =  14784 [ft]
          PUMPING/INJECTION RATE  = -2442377 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

RECHARGE PONDS HYPOTHETICAL INJECTION WELL

WELL NO. 17

```
                    X-COORDINATE  =  21120 [ft]
                    Y-COORDINATE  =  12936 [ft]
          PUMPING/INJECTION RATE  =  690049 [gpd]
TIME SINCE START PUMPING/INJECTION  =  36500 [day]
```

Recharge and drawdown: Sun City West
1,320 foot grid
Cartesian coordinate grid
Origin: NW corner Sec. 12, T.3N., R.2W.
Distances on x and y axes in feet from origin
Z-axis = drawdown in feet
Duration: 100 years
Demand: current SCW

x-axis	y-axis	Drawdown
0	0	17.4571
0	1320	17.9515
0	2640	18.443
0	3960	18.928
0	5280	19.4028
0	6600	19.8627
0	7920	20.3027
0	9240	20.7169
0	10560	21.0987
0	11880	21.4408
0	13200	21.7356
0	14520	21.9748
0	15840	22.1505
0	17160	22.2554
0	18480	22.2838
0	19800	22.2327
0	21120	22.1028
0	22440	21.8978
0	23760	21.6248
0	25080	21.2923
0	26400	20.9099
0	27720	20.4868
0	29040	20.0318
0	30360	19.5527
0	31680	19.0565
0	33000	18.549
0	34320	18.0353
0	35640	17.5196
0	36960	17.0053
1320	0	17.9723
1320	1320	18.5065
1320	2640	19.0401
1320	3960	19.5696
1320	5280	20.0909
1320	6600	20.5993
1320	7920	21.0891
1320	9240	21.5539
1320	10560	21.9862
1320	11880	22.3775
1320	13200	22.7185
1320	14520	22.9991
1320	15840	23.2085
1320	17160	23.3366
1320	18480	23.375
1320	19800	23.3189
1320	21120	23.1685
1320	22440	22.9297
1320	23760	22.6123
1320	25080	22.2285
1320	26400	21.7906
1320	27720	21.3106
1320	29040	20.7987
1320	30360	20.2642
1320	31680	19.7148
1320	33000	19.157
1320	34320	18.5961
1320	35640	18.0365
1320	36960	17.4815
2640	0	18.4891
2640	1320	19.0659
2640	2640	19.6451
2640	3960	20.2231
2640	5280	20.7958
2640	6600	21.3582
2640	7920	21.9043
2640	9240	22.4271
2640	10560	22.9184
2640	11880	23.3683
2640	13200	23.7658
2640	14520	24.0983
2640	15840	24.3519
2640	17160	24.512
2640	18480	24.5655
2640	19800	24.5041
2640	21120	24.3274
2640	22440	24.0443
2640	23760	23.6702
2640	25080	23.2223
2640	26400	22.7173
2640	27720	22.1698
2640	29040	21.592
2640	30360	20.9943
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2640	35640	18.5524
2640	36960	17.9542
3960	0	19.0044
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7920	14520	29.3703
7920	15840	30.0039
7920	17160	30.5433
7920	18480	30.9321
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7920	35640	20.5132
7920	36960	19.7219
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9240	10560	28.1924
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11880	29040	27.3702
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11880	34320	22.6833
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14520	17160	39.1289	17160	15840	41.1592	19800	14520	40.692
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14520	19800	39.2169	17160	18480	40.9909	19800	17160	41.6394
14520	21120	39.4026	17160	19800	41.3298	19800	18480	41.4771
14520	22440	37.8579	17160	21120	41.6047	19800	19800	41.5319
14520	23760	36.3252	17160	22440	39.7658	19800	21120	41.3393
14520	25080	34.4267	17160	23760	37.8337	19800	22440	39.3637
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14520	27720	30.3418	17160	26400	33.214	19800	25080	34.8712
14520	29040	28.6409	17160	27720	31.1032	19800	26400	32.7927
14520	30360	27.1143	17160	29040	29.2568	19800	27720	30.8636
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14520	34320	23.2902	17160	33000	24.797	19800	31680	26.0338
14520	35640	22.2079	17160	34320	23.5697	19800	33000	24.7004
14520	36960	21.2018	17160	35640	22.4404	19800	34320	23.4778
15840	0	22.8186	17160	36960	21.3961	19800	35640	22.3519
15840	1320	23.9381	18480	0	23.1647	19800	36960	21.3107
15840	2640	25.1274	18480	1320	24.394	21120	0	23.1458
15840	3960	26.3847	18480	2640	25.7259	21120	1320	24.4471
15840	5280	27.7046	18480	3960	27.1638	21120	2640	25.8977
15840	6600	29.0786	18480	5280	28.6993	21120	3960	27.5313
15840	7920	30.4983	18480	6600	30.3044	21120	5280	29.3848
15840	9240	31.961	18480	7920	31.9346	21120	6600	31.456
15840	10560	33.472	18480	9240	33.561	21120	7920	33.5262
15840	11880	35.0427	18480	10560	35.2045	21120	9240	35.1704
15840	13200	36.6802	18480	11880	36.8933	21120	10560	36.5563
15840	14520	38.3217	18480	13200	38.5774	21120	11880	38.4555
15840	15840	39.5751	18480	14520	40.3217	21120	13200	41.3329
15840	17160	40.0045	18480	15840	42.2839	21120	14520	40.7798
15840	18480	40.1516	18480	17160	41.664	21120	15840	48.7812
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15840	21120	41.2519	18480	19800	41.6802	21120	18480	41.25
15840	22440	39.2814	18480	21120	42.1538	21120	19800	41.2838
15840	23760	38.2744	18480	22440	39.7603	21120	21120	41.2171
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15840	31680	25.9961	18480	30360	27.6307	21120	29040	28.7743
15840	33000	24.6806	18480	31680	26.1506	21120	30360	27.2169
15840	34320	23.4748	18480	33000	24.8037	21120	31680	25.7939
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15840	36960	21.3328	18480	35640	22.437	21120	34320	23.292
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17160	3960	26.811	19800	2640	25.8806	22440	1320	24.2685
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17160	7920	31.2279	19800	6600	30.8801	22440	5280	29.4269
17160	9240	32.7766	19800	7920	32.6589	22440	6600	31.9436
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22440	13200	38.847	25080	11880	34.9511	27720	10560	30.597
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22440	22440	38.3699	25080	21120	38.3369	27720	19800	33.3861
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22440	27720	29.9403	25080	26400	29.9792	27720	25080	28.8923
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22440	30360	26.8085	25080	29040	26.9613	27720	27720	26.3368
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22440	35640	21.9432	25080	34320	22.2291	27720	33000	22.0903
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23760	35640	21.6275	26400	34320	21.7307	29040	33000	21.412
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35640	0	16.5787
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35640	5280	17.8391
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35640	7920	17.9478
35640	9240	17.7493
35640	10560	17.3013
35640	11880	16.5251
35640	13200	15.4089
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35640	15840	15.3111
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35640	19800	19.0776
35640	21120	19.6052
35640	22440	19.8661
35640	23760	19.9273
35640	25080	19.8383
35640	26400	19.6357
35640	27720	19.3479
35640	29040	18.9968
35640	30360	18.5996
35640	31680	18.1699
35640	33000	17.718
35640	34320	17.2523
35640	35640	16.7788
35640	36960	16.3026
36960	0	15.8572
36960	1320	16.1741
36960	2640	16.4461
36960	3960	16.6567
36960	5280	16.7841
36960	6600	16.7993
36960	7920	16.6614
36960	9240	16.31
36960	10560	15.6446
36960	11880	14.471
36960	13200	12.3035
36960	14520	7.92995
36960	15840	11.1743
36960	17160	14.4208
36960	18480	16.2223
36960	19800	17.333
36960	21120	18.0196
36960	22440	18.4135
36960	23760	18.5938
36960	25080	18.6142
36960	26400	18.5131
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36960	29040	18.0549
36960	30360	17.7373
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38280	1320	15.4289
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38280	5280	15.8428
38280	6600	15.7897
38280	7920	15.5855
38280	9240	15.1735
38280	10560	14.4609
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38280	17160	13.1392
38280	18480	14.8785
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38280	27720	17.3638
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38280	30360	16.9176
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38280	34320	15.9431
38280	35640	15.5737
38280	36960	15.1925
39600	0	14.5239
39600	1320	14.7353
39600	2640	14.8977
39600	3960	14.9971
39600	5280	15.0157
39600	6600	14.9313
39600	7920	14.7148
39600	9240	14.3282
39600	10560	13.7232
39600	11880	12.8516
39600	13200	11.7588
39600	14520	10.9945
39600	15840	11.5609
39600	17160	12.8953
39600	18480	14.1136
39600	19800	15.037
39600	21120	15.6944
39600	22440	16.1359
39600	23760	16.4047
39600	25080	16.5351
39600	26400	16.5543
39600	27720	16.4843
39600	29040	16.3428
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39600	31680	15.9012
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39600	34320	15.3178
39600	35640	14.9923
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40920	0	13.9177
40920	1320	14.0936
40920	2640	14.2229
40920	3960	14.2942
40920	5280	14.294
40920	6600	14.2067
40920	7920	14.015
40920	9240	13.7024
40920	10560	13.2609
40920	11880	12.7157
40920	13200	12.1841
40920	14520	11.9356
40920	15840	12.2137
40920	17160	12.8932
40920	18480	13.6648
40920	19800	14.3469
40920	21120	14.8836
40920	22440	15.2727
40920	23760	15.5288
40920	25080	15.6703
40920	26400	15.715
40920	27720	15.6791
40920	29040	15.5766
40920	30360	15.4195
40920	31680	15.2181
40920	33000	14.9812
40920	34320	14.7162
40920	35640	14.4291
40920	36960	14.1254
42240	0	13.3519
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42240	7920	13.4401
42240	9240	13.2125
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42240	11880	12.5984
42240	13200	12.3375
42240	14520	12.2566
42240	15840	12.4356
42240	17160	12.8334
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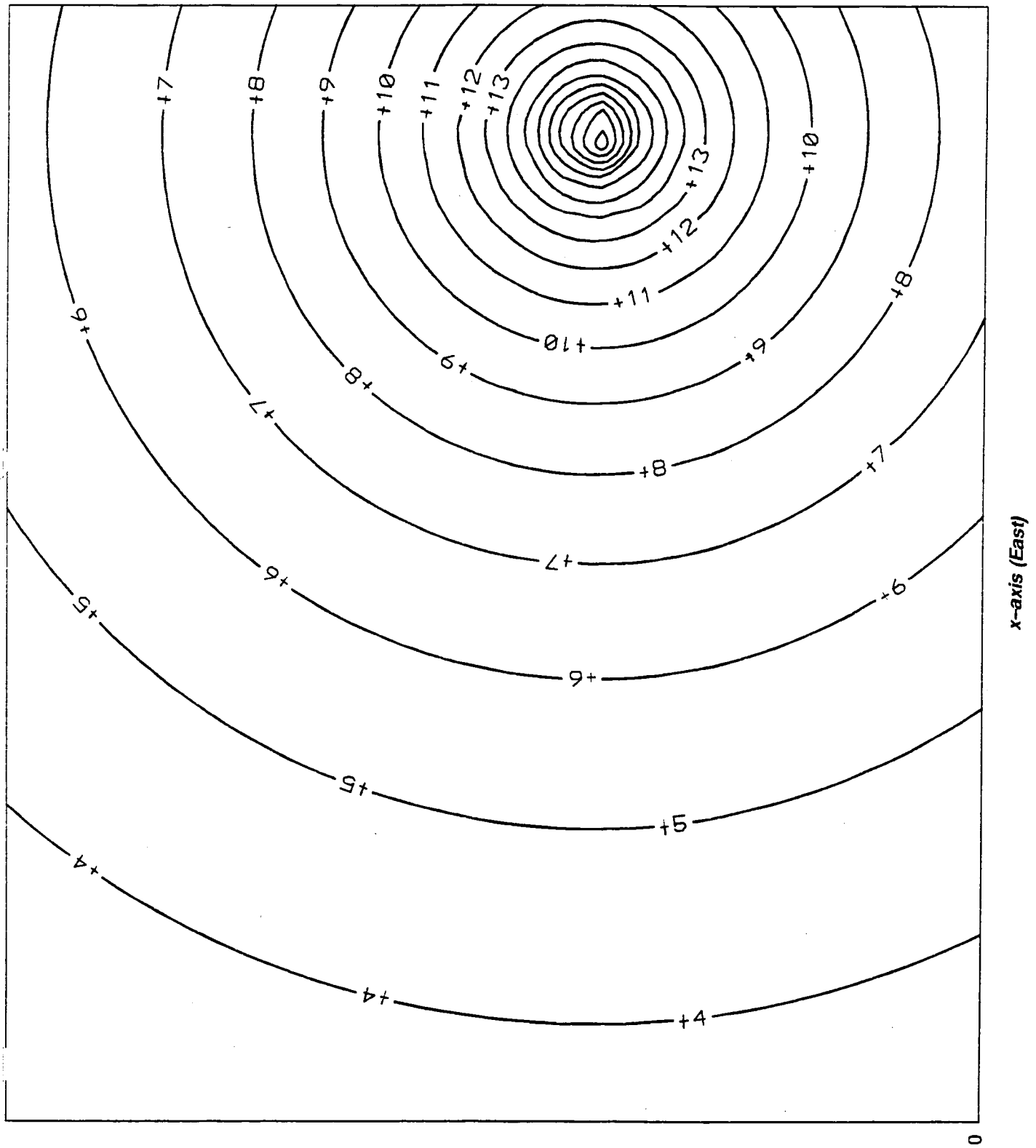
42240	19800	13.812
42240	21120	14.2255
42240	22440	14.546
42240	23760	14.7706
42240	25080	14.9053
42240	26400	14.9595
42240	27720	14.9438
42240	29040	14.8682
42240	30360	14.7421
42240	31680	14.5739
42240	33000	14.3711
42240	34320	14.14
42240	35640	13.8863
42240	36960	13.6147

Appendix C
RECHARGE MOUND
Recharge Rise in Water Level: 100–Year Simulation

CONTOUR PLOT OF FEET OF RISE AFTER 100 YEARS
Recharge Mound
Recharge from Sun City Wastewater Treatment Plant
Scale: 1 inch = 1 mile



ALCULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED
..QUIFER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

Recharge mound after 100 years **RECHARGE MOUND**

********** INPUT DATA **********

TRANSMISSIVITY	=	90000 [gpd/ft]
STORAGE COEFFICIENT	=	.15
REGIONAL FLOW GRADIENT (positive--downwards--in flow direction)	=	0
REGIONAL FLOW DIRECTION (horizontal angle in degrees counter-clockwise from positive x-axis)	=	0
REGIONAL FLOW OFFSET AT ORIGIN (positive in downwards direction)	=	0 [ft]

WATER TABLE CORRECTION APPLIED

AQUIFER THICKNESS	=	1200 [ft]

WELL NO. 1

RECHARGE MOUND

X-COORDINATE	=	37488 [ft]
Y-COORDINATE	=	14784 [ft]
PUMPING/INJECTION RATE	=	-2442377 [gpd]
TIME SINCE START PUMPING/INJECTION	=	36500 [day]

RECHARGE PONDS HYPOTHETICAL INJECTION WELL

Recharge: Sun City West
1,320 foot grid
Cartesian coordinate grid
Origin: NW corner Sec. 12, T.3N., R.2W.
Distances on x and y axes in feet from origin
Z-axis = feet of elevation
Duration: 100 years
Model computes drawdown
Negative values = feet of elevation

x-axis	y-axis	Elevation
0	0	-3.31835
0	1320	-3.36233
0	2640	-3.40322
0	3960	-3.44078
0	5280	-3.47473
0	6600	-3.50483
0	7920	-3.53088
0	9240	-3.55265
0	10560	-3.56999
0	11880	-3.58276
0	13200	-3.59084
0	14520	-3.59419
0	15840	-3.59275
0	17160	-3.58656
0	18480	-3.57565
0	19800	-3.56013
0	21120	-3.54011
0	22440	-3.51575
0	23760	-3.48725
0	25080	-3.4548
0	26400	-3.41866
0	27720	-3.37907
0	29040	-3.33629
0	30360	-3.29059
0	31680	-3.24225
0	33000	-3.19153
0	34320	-3.13871
0	35640	-3.08405
0	36960	-3.0278
1320	0	-3.43555
1320	1320	-3.48276
1320	2640	-3.52674
1320	3960	-3.56717
1320	5280	-3.60377
1320	6600	-3.63626
1320	7920	-3.66439
1320	9240	-3.68794
1320	10560	-3.70671
1320	11880	-3.72053
1320	13200	-3.72929
1320	14520	-3.73291
1320	15840	-3.73135
1320	17160	-3.72464
1320	18480	-3.71284
1320	19800	-3.69603
1320	21120	-3.67438
1320	22440	-3.64805
1320	23760	-3.61727
1320	25080	-3.58228
1320	26400	-3.54335
1320	27720	-3.50076
1320	29040	-3.4548
1320	30360	-3.40579
1320	31680	-3.35402
1320	33000	-3.29979
1320	34320	-3.24341
1320	35640	-3.18516
1320	36960	-3.12532
2640	0	-3.55685
2640	1320	-3.60761
2640	2640	-3.65496
2640	3960	-3.69857
2640	5280	-3.73809
2640	6600	-3.77323
2640	7920	-3.80369
2640	9240	-3.8292
2640	10560	-3.84956
2640	11880	-3.86456
2640	13200	-3.87407
2640	14520	-3.878
2640	15840	-3.87631
2640	17160	-3.86903
2640	18480	-3.85621
2640	19800	-3.83798
2640	21120	-3.8145
2640	22440	-3.78599
2640	23760	-3.75269
2640	25080	-3.71488
2640	26400	-3.67287
2640	27720	-3.62698
2640	29040	-3.57754
2640	30360	-3.5249
2640	31680	-3.46939
2640	33000	-3.41136
2640	34320	-3.35112
2640	35640	-3.289
2640	36960	-3.22529
3960	0	-3.6824
3960	1320	-3.73705
3960	2640	-3.78812
3960	3960	-3.83523
3960	5280	-3.878
3960	6600	-3.91607
3960	7920	-3.94912
3960	9240	-3.97684
3960	10560	-3.99897
3960	11880	-4.01529
3960	13200	-4.02564
3960	14520	-4.02992
3960	15840	-4.02808
3960	17160	-4.02015
3960	18480	-4.0062
3960	19800	-3.98637
3960	21120	-3.96086
3960	22440	-3.92991
3960	23760	-3.89381
3960	25080	-3.85288
3960	26400	-3.80746
3960	27720	-3.75793
3960	29040	-3.70467
3960	30360	-3.64805
3960	31680	-3.58846
3960	33000	-3.52628
3960	34320	-3.46186
3960	35640	-3.39556
3960	36960	-3.3277
5280	0	-3.81233
5280	1320	-3.87127
5280	2640	-3.92644
5280	3960	-3.97743
5280	5280	-4.02381
5280	6600	-4.06516
5280	7920	-4.1011
5280	9240	-4.13128
5280	10560	-4.1554
5280	11880	-4.17321
5280	13200	-4.18451
5280	14520	-4.18918
5280	15840	-4.18718
5280	17160	-4.17852
5280	18480	-4.16329
5280	19800	-4.14167
5280	21120	-4.11388
5280	22440	-4.0802
5280	23760	-4.04097
5280	25080	-3.99656
5280	26400	-3.94737
5280	27720	-3.89381
5280	29040	-3.83633
5280	30360	-3.77535
5280	31680	-3.7113
5280	33000	-3.6446
5280	34320	-3.57565
5280	35640	-3.50483
5280	36960	-3.43251
6600	0	-3.94678
6600	1320	-4.01044
6600	2640	-4.07016
6600	3960	-4.12546
6600	5280	-4.17586
6600	6600	-4.22088
6600	7920	-4.26007
6600	9240	-4.29302
6600	10560	-4.31939
6600	11880	-4.33887
6600	13200	-4.35124
6600	14520	-4.35636
6600	15840	-4.35417
6600	17160	-4.34468
6600	18480	-4.32802

6600	19800	-4.30438
6600	21120	-4.27402
6600	22440	-4.23728
6600	23760	-4.19454
6600	25080	-4.14624
6600	26400	-4.09284
6600	27720	-4.03482
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6600	30360	-3.90691
6600	31680	-3.83798
6600	33000	-3.76636
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7920	5280	-4.33452
7920	6600	-4.38366
7920	7920	-4.42651
7920	9240	-4.4626
7920	10560	-4.49151
7920	11880	-4.5129
7920	13200	-4.52649
7920	14520	-4.53211
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7920	17160	-4.51928
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9240	10560	-4.67243
9240	11880	-4.69599
9240	13200	-4.71097
9240	14520	-4.71718
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9240	18480	-4.68287
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11880	13200	-5.1111
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13200	7920	-5.17874
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13200	17160	-5.31786
13200	18480	-5.29019
13200	19800	-5.25116
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17160	21120	-5.88652
17160	22440	-5.80283
17160	23760	-5.70768
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17160	34320	-4.72518
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18480	2640	-5.64525
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18480	9240	-6.19233
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19800	7920	-6.37262
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19800	11880	-6.61364
19800	13200	-6.65318
19800	14520	-6.66969
19800	15840	-6.6626
19800	17160	-6.63215
19800	18480	-6.57937
19800	19800	-6.50593
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19800	22440	-6.3061
19800	23760	-6.18484
19800	25080	-6.05282
19800	26400	-5.91249
19800	27720	-5.76605
19800	29040	-5.61545
19800	30360	-5.46237
19800	31680	-5.30819
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21120	17160	-6.95614
21120	18480	-6.89454
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21120	22440	-6.57937
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21120	30360	-5.63811
21120	31680	-5.4702
21120	33000	-5.30337
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22440	10560	-7.19801

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22440	13200	-7.33686
22440	14520	-7.35982
22440	15840	-7.34995
22440	17160	-7.3077
22440	18480	-7.23497
22440	19800	-7.13486
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22440	26400	-6.36444
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22440	30360	-5.81524
22440	31680	-5.63242
22440	33000	-5.45196
22440	34320	-5.27472
22440	35640	-5.10131
22440	36960	-4.93216
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23760	1320	-6.31604
23760	2640	-6.51909
23760	3960	-6.72001
23760	5280	-6.91576
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23760	7920	-7.27577
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23760	11880	-7.66075
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23760	14520	-7.75414
23760	15840	-7.74224
23760	17160	-7.69142
23760	18480	-7.60442
23760	19800	-7.48556
23760	21120	-7.34012
23760	22440	-7.17373
23760	23760	-6.99179
23760	25080	-6.79913
23760	26400	-6.59986
23760	27720	-6.39735
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25080	1320	-6.52349
25080	2640	-6.74932
25080	3960	-6.97526
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25080	9240	-7.79836
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25080	13200	-8.15602
25080	14520	-8.18996
25080	15840	-8.17535
25080	17160	-8.11317
25080	18480	-8.00743
25080	19800	-7.86438
25080	21120	-7.69142
25080	22440	-7.49609
25080	23760	-7.2853
25080	25080	-7.06496
25080	26400	-6.83985
25080	27720	-6.61364
25080	29040	-6.38907
25080	30360	-6.1681
25080	31680	-5.95208
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26400	11880	-8.53401
26400	13200	-8.63397
26400	14520	-8.67653
26400	15840	-8.65819
26400	17160	-8.58047
26400	18480	-8.44954
26400	19800	-8.27472
26400	21120	-8.06655
26400	22440	-7.83525
26400	23760	-7.58965
26400	25080	-7.33686
26400	26400	-7.08222
26400	27720	-6.82959
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26400	35640	-5.45326
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27720	14520	-9.2266
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27720	29040	-6.7691
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27720	33000	-6.01124
27720	34320	-5.77976
27720	35640	-5.55853
27720	36960	-5.34716
29040	0	-6.83215
29040	1320	-7.126
29040	2640	-7.43367
29040	3960	-7.75414
29040	5280	-8.08507
29040	6600	-8.42211
29040	7920	-8.75788
29040	9240	-9.08086
29040	10560	-9.37443
29040	11880	-9.61714
29040	13200	-9.78529
29040	14520	-9.85852
29040	15840	-9.82683
29040	17160	-9.69464
29040	18480	-9.47894
29040	19800	-9.20292
29040	21120	-8.88942
29040	22440	-8.55712
29040	23760	-8.21949
29040	25080	-7.88545
29040	26400	-7.56042
29040	27720	-7.24744
29040	29040	-6.948
29040	30360	-6.6626
29040	31680	-6.39114
29040	33000	-6.13319
29040	34320	-5.88813
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30360	1320	-7.3077
30360	2640	-7.64558
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30360	33000	-6.24361
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30360	36960	-5.5112
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31680	2640	-7.83938
31680	3960	-8.23441
31680	5280	-8.65819
31680	6600	-9.11073
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31680	13200	-11.3431
31680	14520	-11.4959
31680	15840	-11.4291
31680	17160	-11.1611
31680	18480	-10.7553
31680	19800	-10.2801
31680	21120	-9.78529
31680	22440	-9.29924
31680	23760	-8.83583
31680	25080	-8.40042
31680	26400	-7.99402
31680	27720	-7.61557
31680	29040	-7.26313
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31680	33000	-6.3401
31680	34320	-6.07041
31680	35640	-5.8168
31680	36960	-5.57779
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33000	10560	-11.2401
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33000	13200	-12.3754
33000	14520	-12.6261
33000	15840	-12.5151
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36960	2640	-8.27981
36960	3960	-8.77711
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36960	6600	-9.99014
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36960	13200	-17.0052
36960	14520	-21.6377
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38280	2640	-8.27472

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38280	17160	-15.2082
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39600	1320	-7.78621
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39600	14520	-15.9286
39600	15840	-15.4689
39600	17160	-14.1541
39600	18480	-12.8665
39600	19800	-11.7858
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39600	22440	-10.1303
39600	23760	-9.47894
39600	25080	-8.90987
39600	26400	-8.40583
39600	27720	-7.95429
39600	29040	-7.54595
39600	30360	-7.17373
39600	31680	-6.83215
39600	33000	-6.51689
39600	34320	-6.22447
39600	35640	-5.95208
39600	36960	-5.69738
40920	0	-7.32385
40920	1320	-7.70304
40920	2640	-8.11789
40920	3960	-8.57461
40920	5280	-9.08086
40920	6600	-9.64588
40920	7920	-10.2801
40920	9240	-10.9932
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40920	11880	-12.6261
40920	13200	-13.3901
40920	14520	-13.803
40920	15840	-13.6165
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40920	31680	-6.77906
40920	33000	-6.47124
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40920	35640	-5.91739
40920	36960	-5.6668
42240	0	-7.22567
42240	1320	-7.58597
42240	2640	-7.97627
42240	3960	-8.40042
42240	5280	-8.86246
42240	6600	-9.36594
42240	7920	-9.91239
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42240	11880	-11.6849
42240	13200	-12.1505
42240	14520	-12.3754
42240	15840	-12.2762
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42240	18480	-11.3431
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42240	22440	-9.57942
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42240	27720	-7.73829
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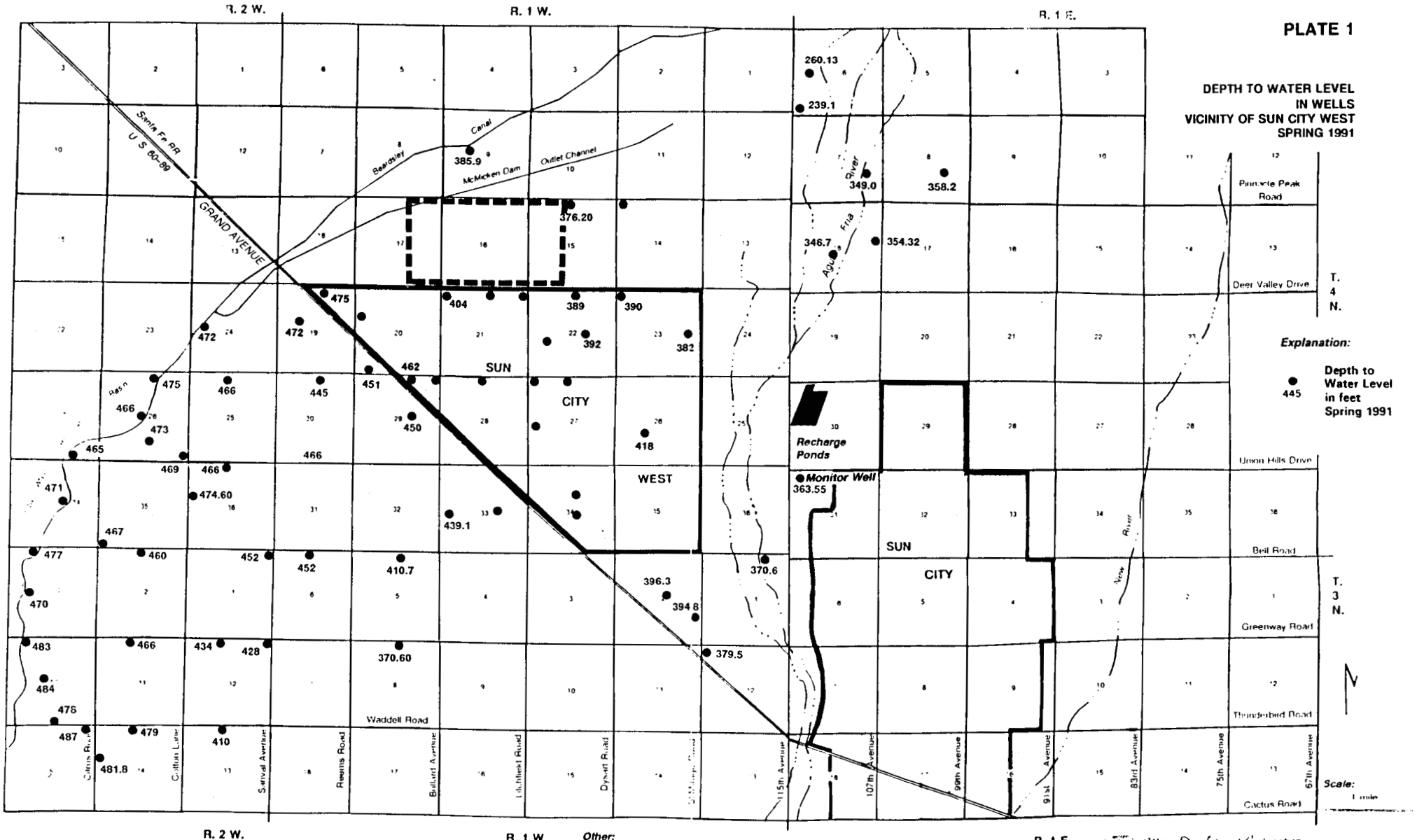
42240	30360	-7.02243
42240	31680	-6.7031
42240	33000	-6.40566
42240	34320	-6.12773
42240	35640	-5.86726
42240	36960	-5.6225

PLATE 1

DEPTH TO WATER LEVEL IN WELLS VICINITY OF SUN CITY WEST SPRING 1991



Sources of data:

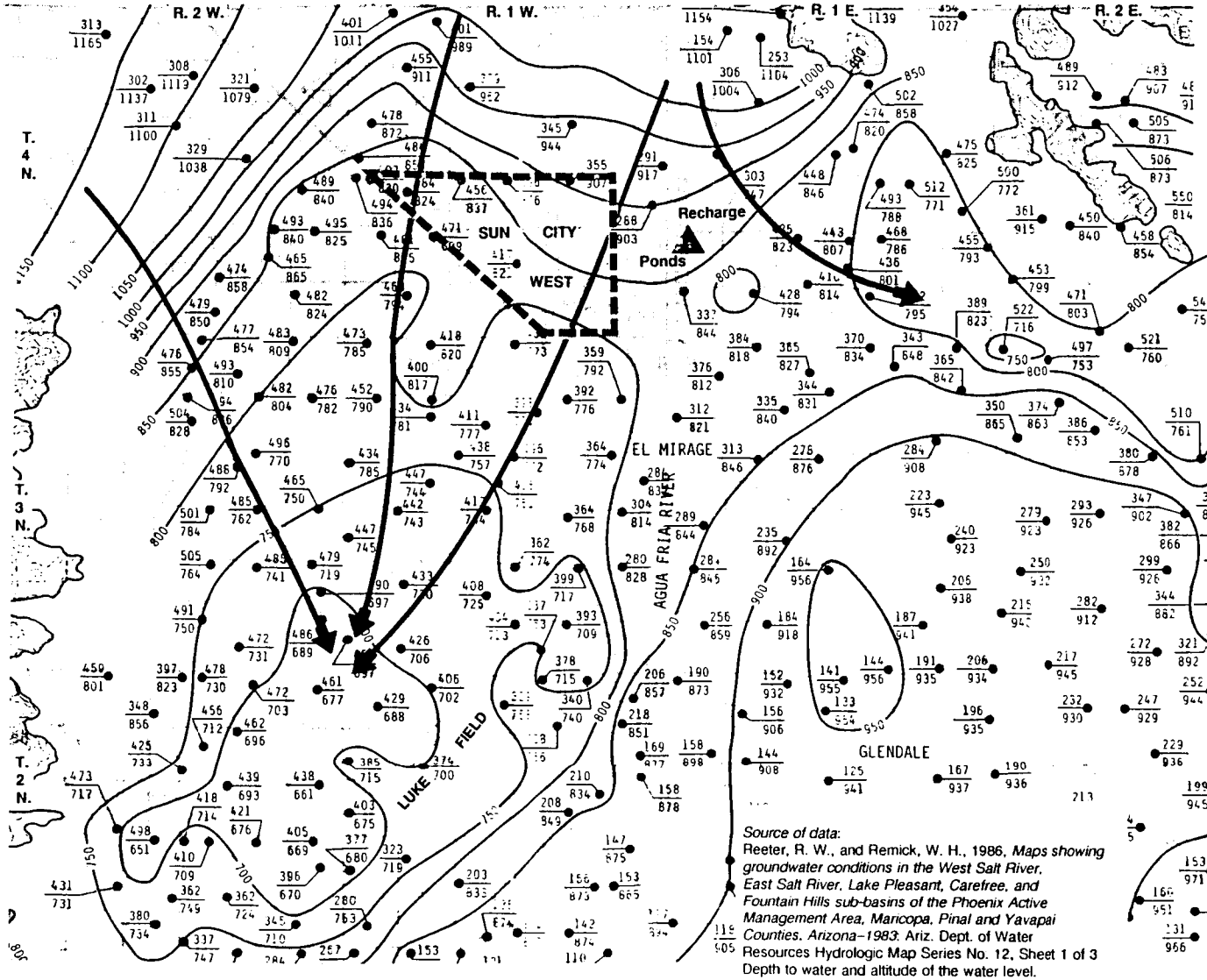
Southeast side of Grand Avenue:
Maricopa Water District

Within Sun City West:
Water Development Corporation
Weber Pump Company

Other:
B(4–1)9, 31; DWR Spring 1990
B(3–1)2, 5, 8, 12; DWR Spring 1990
A(4–1)6, 8, 18;
Frank Postillion (Dames and Moore)
Spring 1991

A(4–1)18, 31;
Water Development Corporation
Spring 1991

Water Development Corporation
Tucson, Arizona
March 1991



PORTION OF MAP OF ALTITUDE OF WATER LEVEL SHOWING DIRECTION OF GROUNDWATER MOVEMENT IN VICINITY OF SUN CITY WEST

Altitude of water table

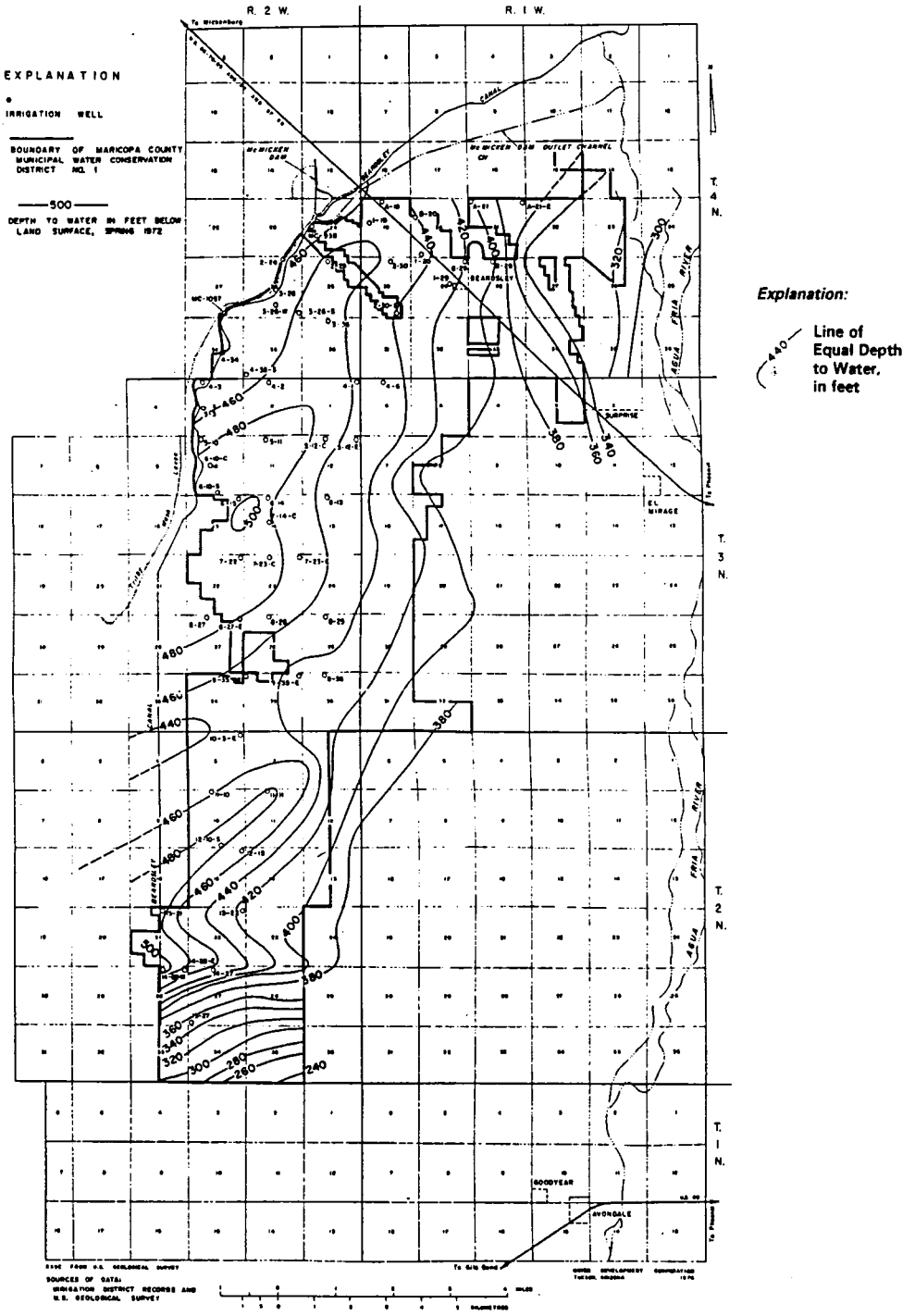
Direction of groundwater movement

Scale: 1 mile

Source of data:
Reeter, R. W., and Remick, W. H., 1986, *Maps showing groundwater conditions in the West Salt River, East Salt River, Lake Pleasant, Carefree, and Fountain Hills sub-basins of the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona–1983*: Ariz. Dept. of Water Resources Hydrologic Map Series No. 12, Sheet 1 of 3 Depth to water and altitude of the water level.

Water Development Corporation
Tucson, Arizona
March 1991

DEPTH TO WATER TABLE
VICINITY OF SUN CITY WEST
SPRING 1972
(Water Development Corporation–1976)



MAP OF A PORTION OF WESTERN SALT RIVER VALLEY, MARICOPA COUNTY, ARIZONA, SHOWING BOUNDARY OF MARICOPA COUNTY MUNICIPAL WATER CONSERVATION DISTRICT NO. 1 AND DEPTH TO WATER, SPRING 1972.

Water Development Corporation

March 1991

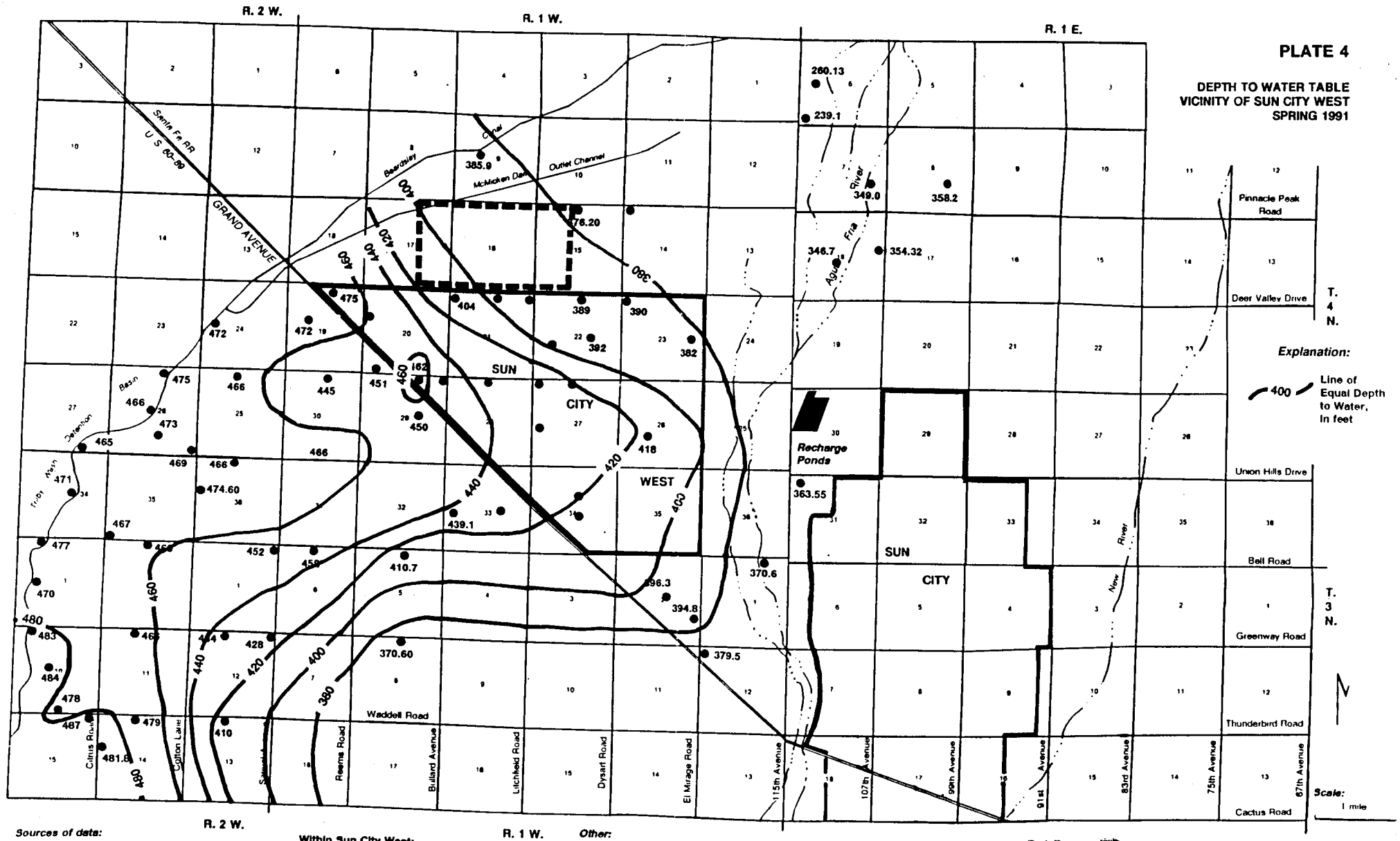


PLATE 4
DEPTH TO WATER TABLE
VICINITY OF SUN CITY WEST
SPRING 1991
R. 2 W.
R. 1 W.
R. 1 E.
T. 4 N.
T. 3 N.
Explanation:
400
Line of Equal Depth to Water, In feet
Scale:
1 mile
SUN CITY WEST
SUN CITY
Recharge Ponds
Santa Fe RR
U S 60-89
GRAND AVENUE
Beardsley Canal
McMicken Dam
Outlet Channel
Agua Fria River
New River
Pinnacle Peak Road
Deer Valley Drive
Union Hills Drive
Bell Road
Greenway Road
Thunderbird Road
Cactus Road
Waddell Road
Citrus Road
Cotton Lane
Reems Road
Bullard Avenue
Litchfield Road
Dysart Road
El Mirage Road
115th Avenue
107th Avenue
99th Avenue
91st Avenue
83rd Avenue
75th Avenue
67th Avenue
260.13
239.1
385.9
349.0
358.2
176.20
346.7
354.32
404
389
390
392
382
475
472
472
451
445
466
475
466
473
465
469
466
474.60
467
477
470
480
483
484
478
487
479
481.8
410
452
458
410.7
439.1
363.55
370.6
396.3
394.8
379.5
370.60
428
444
460
450
418
Sources of data:
Southeast side of Grand Avenue:
Maricopa Water District
Within Sun City West:
Water Development Corporation
Weber Pump Company
Other:
B(4-1)9, 31; DWR Spring 1990
B(3-1)2, 5, 8, 12; DWR Spring 1990
A(4-1)6, 8, 18;
A(4-1)18, 31;
Water Development Corporation
Spring 1991
Water Development Corporation
Tucson, Arizona
March 1991

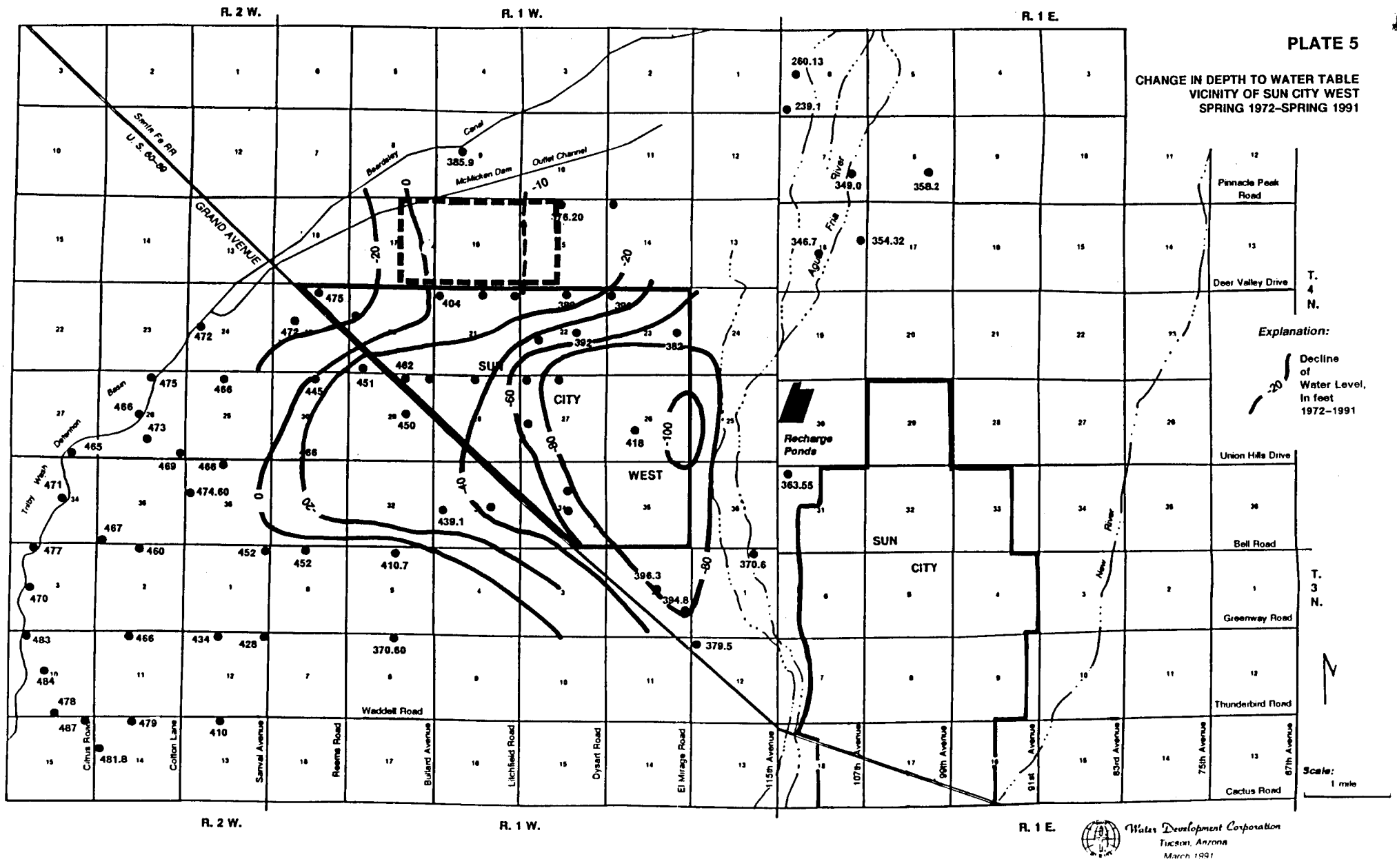


PLATE 5
CHANGE IN DEPTH TO WATER TABLE
VICINITY OF SUN CITY WEST
SPRING 1972–SPRING 1991
R. 2 W.
R. 1 W.
R. 1 E.
T. 4 N.
T. 3 N.
Explanation:
Decline of Water Level, In feet 1972–1991
Scale:
1 mile
SUN CITY WEST
SUN CITY
Recharge Ponds
GRAND AVENUE
U. S. 60-89
Santa Fe RR
Beardsley Canal
McMicken Dam
Outlet Channel
Agua Fria River
New River
Trilby Wash
Detention Basin
Pinnacle Peak Road
Deer Valley Drive
Union Hills Drive
Bell Road
Greenway Road
Thunderbird Road
Cactus Road
Waddell Road
Citrus Road
Cotton Lane
Sarival Avenue
Reems Road
Bullard Avenue
Litchfield Road
Dysart Road
El Mirage Road
115th Avenue
107th Avenue
99th Avenue
91st Avenue
83rd Avenue
75th Avenue
67th Avenue
Water Development Corporation
Tucson, Arizona
March 1991

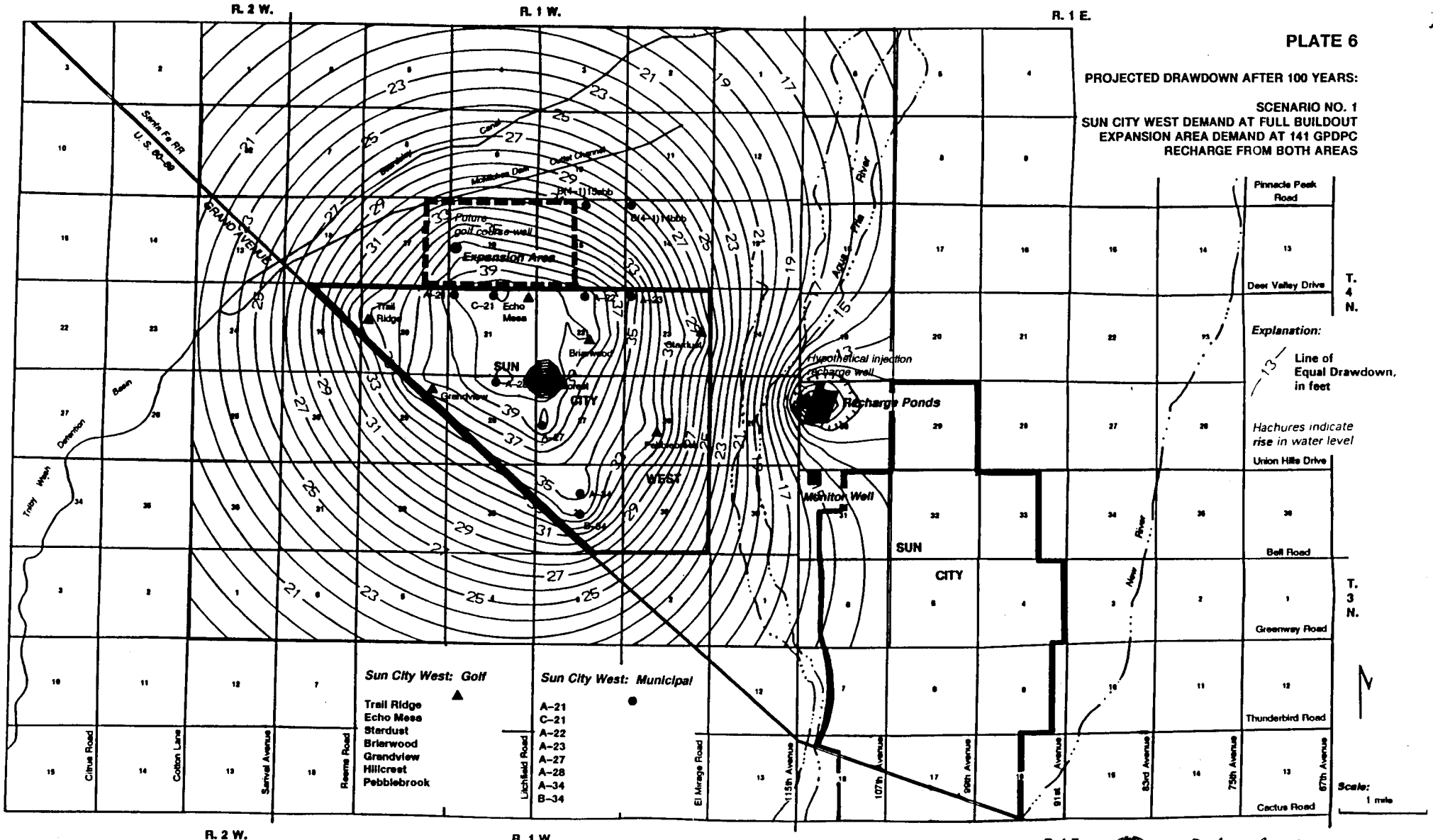


PLATE 6
PROJECTED DRAWDOWN AFTER 100 YEARS:
SCENARIO NO. 1
SUN CITY WEST DEMAND AT FULL BUILDOUT
EXPANSION AREA DEMAND AT 141 GPDPC
RECHARGE FROM BOTH AREAS
R. 2 W.
R. 1 W.
R. 1 E.
T. 4 N.
T. 3 N.
Santa Fe RR
U.S. 60-89
GRAND AVENUE
Expansion Area
Future golf course well
Hypothetical injection recharge well
Recharge Ponds
Monitor Well
SUN CITY WEST
Trail Ridge
Echo Mesa
Brierwood
Grandview
Hillcrest
Pebblebrook
Sun City West: Golf
Trail Ridge
Echo Mesa
Stardust
Brierwood
Grandview
Hillcrest
Pebblebrook
Sun City West: Municipal
A-21
C-21
A-22
A-23
A-27
A-28
A-34
B-34
Explanation:
Line of Equal Drawdown, in feet
Hachures indicate rise in water level
Scale:
1 mile
Pinnacle Peak Road
Deer Valley Drive
Union Hills Drive
Bell Road
Greenway Road
Thunderbird Road
Cactus Road
Citrus Road
Cotton Lane
Sarival Avenue
Reems Road
Litchfield Road
El Mirage Road
115th Avenue
107th Avenue
99th Avenue
91st Avenue
83rd Avenue
75th Avenue
67th Avenue
Agua Fria River
New River
Trilby Wash
Detention Basin
Water Development Corporation
Tucson, Arizona
March 1991

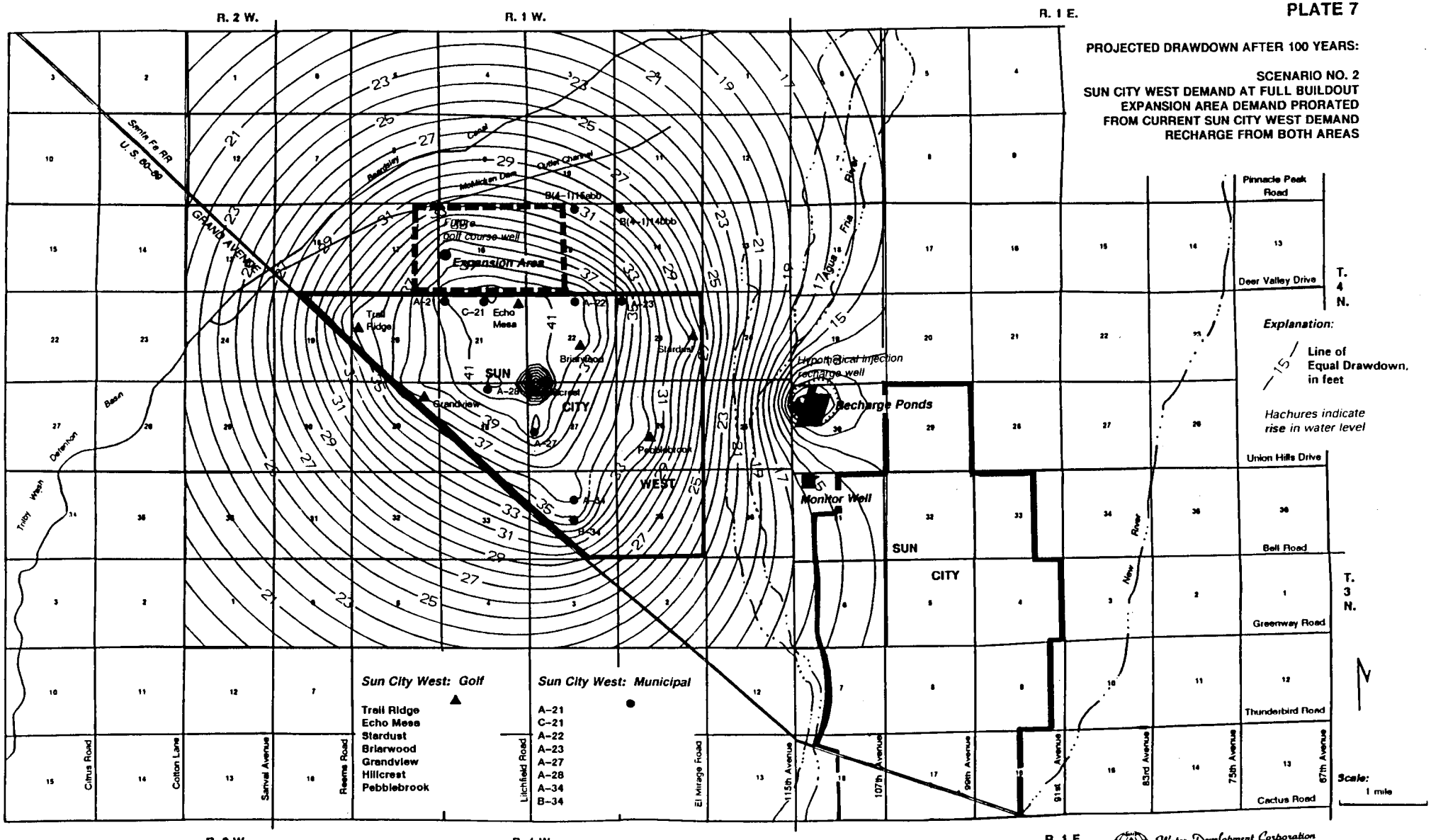
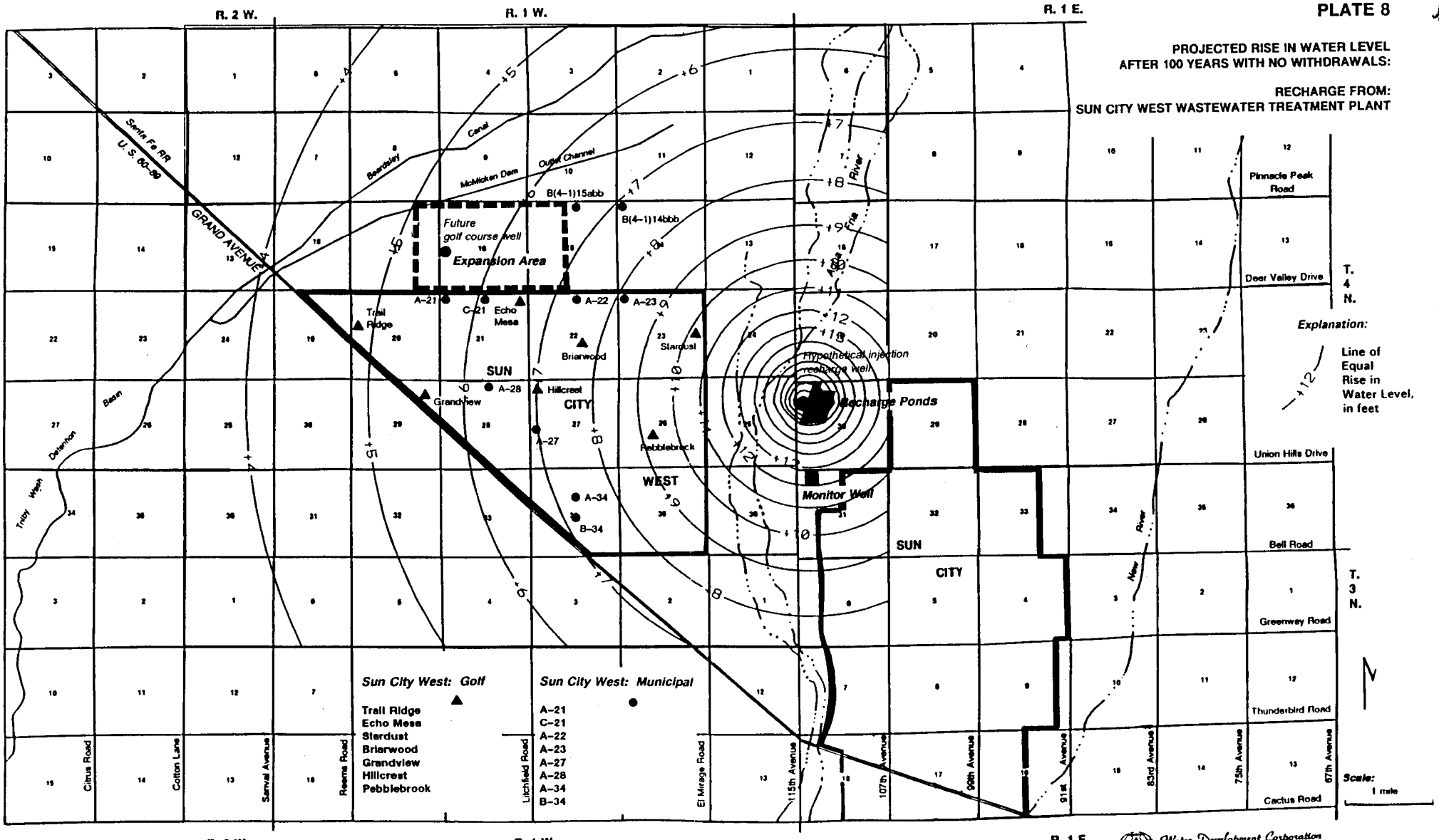


PLATE 7
PROJECTED DRAWDOWN AFTER 100 YEARS:
SCENARIO NO. 2
SUN CITY WEST DEMAND AT FULL BUILDOUT
EXPANSION AREA DEMAND PRORATED
FROM CURRENT SUN CITY WEST DEMAND
RECHARGE FROM BOTH AREAS
R. 2 W.
R. 1 W.
R. 1 E.
T. 4 N.
T. 3 N.
Santa Fe RR
U.S. 60-89
GRAND AVENUE
Beardsley Canal
Other Channel
McMicken Dam
Agua Fria River
New River
Trilby Wash
Detention Basin
Pinnacle Peak Road
Deer Valley Drive
Union Hills Drive
Bell Road
Greenway Road
Thunderbird Road
Cactus Road
Citrus Road
Cotton Lane
Sarival Avenue
Reems Road
Litchfield Road
El Mirage Road
115th Avenue
107th Avenue
99th Avenue
91st Avenue
83rd Avenue
75th Avenue
67th Avenue
B(4-1)14abb
B(4-1)14bbb
Fudge golf course well
Expansion Area
A-21
C-21
Echo Mesa
A-22
A-23
Trail Ridge
Stardust
Briarwood
SUN CITY WEST
A-28
Hillcrest
Grandview
A-27
Pebblebrook
A-34
B-34
Hypothetical injection recharge well
Recharge Ponds
Monitor Well
SUN CITY
Explanation:
Line of Equal Drawdown, in feet
Hachures indicate rise in water level
Sun City West: Golf
Trail Ridge
Echo Mesa
Stardust
Briarwood
Grandview
Hillcrest
Pebblebrook
Sun City West: Municipal
A-21
C-21
A-22
A-23
A-27
A-28
A-34
B-34
Scale:
1 mile
Water Development Corporation
Tucson, Arizona
March 1991

PLATE 8

PROJECTED RISE IN WATER LEVEL AFTER 100 YEARS WITH NO WITHDRAWALS:

RECHARGE FROM: SUN CITY WEST WASTEWATER TREATMENT PLANT



Water Development Corporation
Tucson, Arizona
March 1991

Water Development Corporation

CONSULTANTS IN WATER RESOURCES

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Mobile (Phoenix): 370-0978

April 7, 1991

Mr. Richard Mastin
Vice-President
Land Development
Del Webb's Sun City West
Post Office Box 1705
Sun City West, AZ 85372-1705

Dear Dick:

Enclosed are four copies of the current draft of our hydrogeological report. One of these is in loose-leaf notebook form. We were informed by Tim Crall that it is planned to submit the report with the Recharge Recovery Permit Application, which is in three-hole notebook format.

I will look forward to receiving your comments and suggestions.

Sincerely yours,

Leonard

Leonard C. Halpenny

Enclosures
c:
Dick Mettee, Stanley Consultants
Jerry Green, AGK Engineers
Fred Kriess, Jr., Citizens Utilities
1390
LCH/sc

RECEIVED
APR 10 1991
DEL E. WEBB DEV., CO.