FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

ADOBE DAM FILL CONSTRUCTION,

DETENTION BASIN & OUTLET CHANNEL

Engineering Design
By: M. Bressor
March 7, 1994

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Adobe Dam Basin - Quantity Estimates		
Compacted Fill - In Place	140179	CY
Excavation (Basin)	125906	CY
Excavation (outlet channel)	28631	CY
Excavation (collector channel)	538	CY
Removal 8" PVC	2722	LF
New 8" PVC	2815	LF
Removal 10" PVC	400	LF
New 10" PVC	400	LF
Removal 4" water line	143	LF
New 4" water line	145	LF
Remove 8" water line (fire)	137	LF
New 8" water line (fire)	139	LF
New Asphalt Cement	6084	SF
New ABC Base Course	6084	SF
Remove existing pavement	5273	SF
36" CMP	142	LF
Headwalls	2	EA
Grouted Riprap	163	CF
Guardrails	230	LF
Thrust Blocks	9	EA
Remove 2" Water line		
Remove Underground Electric		

Introduction

The proposed project was initiated by the Planning and Project Management Division of the Flood Control District. The proposed project is located in sections 9 & 16 of township 4 north and range 2 east, and consists of 3 components: 1) construction of a compacted fill area, 2) construction of a detention basin, and 3) construction of an outlet channel. The entire project is located within the District's right-of-way and is presently used as the impoundment area for Adobe Dam. The area located north of Pinnacle Peak Road has been previously zoned for single residential housing. However, structures are not permitted to be built on this land because it is below the Federal Emergency Management Agency's (FEMA) flood elevation. The District desires to elevate this portion of its right-of-way north of Pinnacle Peak Road so that the final elevation is above the designated flood pool elevation. The construction of homes will be permissible on the final elevated area.

The construction of the detention basin serves two purposes. First, it will provide the borrow material required to elevate the area north of Pinnacle Peak Road. Secondly, it will enhance the present level of flood protection provided to The 500 Golf Club located south of Pinnacle Peak Road. Presently, surface runoff from moderate rain events is channelled through the golf course via an existing natural wash that meanders through the golf course beginning at the northwestern edge of the property and continuing to the southeastern edge of the property. The runoff inhibits the use of the golf course. Construction of the detention basin will reroute the surface runoff around the golf course.

An outlet channel will be constructed to drain the detention basin. The outlet channel will begin at the eastern edge of the detention basin, continue eastwardly around the golf course property, and discharge at the southeastern edge of the golf course. The flows from the outlet channel will be directed to the natural wash south of the golf course. The outlet channel will also collect flows from storm drains located south of Pinnacle Peak Road at 47th Avenue. These storm drains presently vent into the open area south of Pinnacle Peak Road and the naturally flowing discharge creates a nuisance problem for the operation of the golf course driving range.

Earthwork

Fill

The dam pool elevation for the 100-year rain event is given in the U.S. Army Corps of Engineers' Design Memorandum (DM) as 1372.5. The Standard Project Flood elevation of the dam is given in the DM to be 1377.8. The flood pool elevation provided by FEMA on the Flood Insurance Rate Map (FIRM) is 1378. The fill area was subsequently designed to be elevated to 1378. A copy of the dam's specifications from the DM is attached in Appendix 1.

The volume of material required to fill the area north of Pinnacle Peak Road was calculated using Microstation. Microstation has a tool capable of measuring areas. By determining the area of existing contours and proposed contours on a horizontal plane, the total volume of material required for fill was calculated by using an average end area method and the elevation difference between measured contours. Appendix 1 contains the volume calculations for the four partial areas that comprise the entire proposed fill area. The total proposed area to be filled is approximately 41.8 acres, and requires approximately 140,200 cubic yards of fill. An independent dam storage computation was performed by Marta Dent of the Information Systems Branch to analyze the storage capacity of the dam and compare that value to the Corps of Engineers original storage capacity. A memo and spreadsheet reflecting the results of the computation is included in Appendix 1.

In addition to elevating the fill area above the flood pool elevation, the fill area was designed to provide drainage conditions that are equivalent to the existing drainage conditions for the local area. To do so, the existing paved streets are not to be elevated. Since the current storm drainage plan for the local area uses the streets to collect and route surface runoff, the proposed drainage plan will also use the existing streets to collect and route surface runoff.

Soil used in the fill area is considered to be engineered fill and is expected to be compacted to at least 95% of its maximum dry density. The fill soil should also be placed between +1% to +3% of its optimum moisture content. This will be discussed in detail later in the geotechnical section.

Earthwork, con't

Borrow Area (Detention Basin)

The sizing of the detention basin was dependent on the volume of material required by the fill area minus the amount of material to be borrowed for construction of the outlet channel. A total of five in-situ density tests were performed in the designated basin area. The tests indicated the average in-situ density of the borrow material was approximately 95% of its maximum dry density, or slightly more. Therefore, corrections were not made for varying densities between the in-situ density and the future in place density of the fill area. Compensation was made to account for an additional 1" of fill material required in the fill area upon compaction of the upper 12" of the existing material. Compensation was also made for approximately 4" of borrow material lost due to clearing and grubbing. Calculations are provided in Appendix 1. The total area of the proposed detention basin is approximately 16.4 acres, and the total volume of material to be removed from the basin is 125,900 cubic yards.

After considering the amount of borrow material needed, the basin was designed with minimal future maintenance requirements in mind. Side slope erosion, or rilling, is believed to be the primary cause for future maintenance. To prevent rilling and to minimize runoff velocity on the sides slopes, the slopes were designed to be 10 feet horizontal to 1 foot vertical. All slopes will be 10:1 with the exception of the side slope adjacent to Pinnacle Peak Road where 6 feet horizontal to 1 foot vertical side slope will be used because it more closely matches the existing slope and yields a greater volume of borrow material

Borrow Area (Outlet Channel)

The outlet channel design was governed by the slope from the eastern most edge of the detention basin to the southeastern edge of the golf course where the flows will be discharged. The channel alignment was chosen such that it would not encroach on any land currently under lease with the Parks and Recreation Department. The length of the outlet channel is 3,340 feet and the elevation difference between the upstream end and the downstream end of the channel is approximately 3.2 feet. The total volume of material to be removed for construction of the outlet channel is approximately 28,600 cubic yards.

Earthwork, con't

Borrow Area (Detention Basin)

The depth of the channel was dependent upon the difference between the invert elevation required to drain the detention basin and the elevation of the natural land. Again, to provide the most "maintenance-free" channel, the side slopes were designed to be 6 feet horizontal versus 1 foot vertical to minimize runoff velocities on the side slope, and to prevent rilling.

Culverts

The full detention basin is required to be drained within 36 hours after a rain event. At the same time, to minimize possible erosion, it was desirable to maintain minimal outflow velocities. 2 - 36" diameter corrugated metal pipes are provided to drain the basin. The culverts are located beneath the golf course entrance road, and drain the basin in approximately 29 hours. The actual basin drainage time may be slightly less because neither evaporation nor infiltration (considered to be negligible, ~1 X 10^{-8} cm/sec) were considered in the calculation of drainage time. Appendix 2 provides the basin's stage-storage information and resulting stage-storage-discharge curve for the basin.

The culverts are designed to be corrugated metal pipes (CMP) because of its inexpensive cost and ease of placement. Each CMP is to be 2 2/3" (pitch) x 1/2" (depth) x 0.040" (wall thickness) and 71 feet in length. Calculations are included in Appendix 2, and the design procedure was obtained from the Handbook of Steel Drainage & Highway Construction Products.

Utility Conflicts and Relocations

Fill Area

Electrical transformers and their concrete pads are located throughout the fill area. The fill material is to be placed so as not to disturb the transformers. Side slopes should be gradually tapered, creating a slightly steeper slope, around the transformers and pads.

Telephone pedestals are also located in the designated fill area. The fill should be placed with particular care up to and around the telephone pedestals, in effect, slightly burying the pedestal.

Utility Conflicts and Relocations, con't

Basin Area

An existing 8" polyvinyl chloride (PVC) water line is located approximately 200 feet south of Pinnacle Peak Road and is in conflict with the location of the proposed detention basin. The water line services Water World USA, located on the southeast corner of 43rd Avenue and Pinnacle Peak Road. Approximately 2800 feet of the water line is to be relocated as shown on the plans. The timing and relocation plan for this utility line should be coordinated with the Parks and Recreation Department as well as the owners of Water World USA.

An existing 10" PVC water line, beginning at the southeast corner of Pinnacle Peak Road and 51st Avenue and continuing to the northwestern edge of the holding pond located on golf course, is presumably in conflict with the proposed detention basin. There are no as-built drawings available identifying the alignment, nor the elevation of the existing line. The approximate location of the existing water line, as shown on the plans, was obtained by scaling from an aerial photo. The relocation for this utility requires the existing line to be lowered to an elevation that will provide at least a 4 feet minimum cover below the final elevation of the basin. The relocation should begin at least 20 feet offset from the top of basin, as shown on the plans.

An existing 2" domestic water line (pipe type unknown) and a buried electrical line are in conflict with the proposed detention basin. Both lines are presently located beneath the existing maintenance road, and service the golf course's maintenance facilities. These lines are to be relocated in coordination with the golf course owners and the Parks and Recreation Department. Ideally, both of the present lines will be abandoned and the maintenance facility will be serviced directly from new lines extending south from Pinnacle Peak Road at 51st Avenue.

Utility Conflicts and Relocations, con't

Outlet Channel

A 4" domestic water line and an 8" fire line (pipe types unknown) cross the proposed outlet channel at stations 2+11 and 3+40, respectively. Each pipe should be replaced with the same material type, and located as shown on the plans.

A buried telephone line and a buried electrical line are also in conflict with the proposed outlet channel at approximate stations 3+10 and 3+15, respectively. These utilities are each to be restored to their existing locations. However, for ease of construction, it is suggested that each of these lines be temporarily relocated as overhead crossings during construction. The project manager should coordinate this action.

The City of Phoenix has proposed to construct a 36" rubber gasket reinforced concrete (RGRCP) sanitary sewer pipe from Pinnacle Peak Road to the abutment of Adobe Dam. The proposed 36" pipe, and the 50 feet construction easement associated with it, are shown on the plans. The proposed outlet channel will cross the pipe at two locations, station 15+18 and station 30+10. A 4 feet minimum clearance is required over the sanitary sewer at these locations.

The existing 8" PVC water line that is to be relocated as discussed above in the detention basin section, will also be in conflict with the drainage collector inlet channel, as shown on the plans. A minimum 4 feet of cover is to be maintained beneath the collector channel, and coordinating issues are the same as previously discussed.

Geotechnical Data

A complete geotechnical report was prepared by the District's geotechnical consultant, SH&B Agra, Inc. (J. Crystal) and is included in appendix 3. The report includes material classification, moisture content-density relationships for borrow material, suggested compaction methods for the borrow material, permeability of material in the detention basin, and the results of an expansive soil test for the borrow material.

The borrow material is mostly classified as sandy silt with moderate to strong lime cementation. Most of the borrow material to be used as construction fill has been identified to be expansive. Several swell tests were performed on the borrow material, and the results of those tests indicate the swell potential (strain) ranges between 8% and 15% for 1 psi loading. The consultant identifies the potential risk to structures built on this material, and recommends the material be placed wet of the optimum moisture content, in lifts not more than 8" loose thickness, and compacted to not more than 98% maximum dry density. More specifically, it is suggested the material be placed between +1% to +3% of the optimum moisture content and compacted to at least 95% of its maximum dry density.

The subsequent owner of the fill area should be made aware of the presence of expansive soils, and future structures built in the proposed fill area may require modifications to compensate for the expansive fill.

Hydrology

A complete hydrology report was prepared by Hasan Mushtaq and is included in Appendix 4. The report is based on the results from the "Little Deer Valley (Conceptual drainage plan, I & II, 1990)". Summarizing, there are two drainage sub-basin concentration points located within the construction area (CP 35.5 and CP 46). CP 35.5 is located at 51st Avenue and Pinnacle Peak Road and CP 46 is located at 47th Avenue and Pinnacle Peak Road. The most critical hydrologic condition is considered to be the existing watershed condition with the implementation of both the 100-year storm drainage plan and 2-year storm drainage plan. Table 1 summarizes the peak discharges for each concentration point:

Hydrology, con't

Concentration Point	2-year Discharge (cfs)	100-year Discharge (cfs)
35.5	155	1373
46	109	1340

Table 1 - Peak Discharges

A drainage inlet collector channel is to be constructed to collect the flows from concentration point 46 and route the flow, via the proposed outlet channel, south of the golf course.

The most critical 2-year and 100-year hydrographs for CP 35.5, as discussed above, are provided in Appendix 4. By routing the discharge from CP 35.5 through the proposed detention basin, a volumetric runoff reduction was computed as a result of the detention basin for both the 100-year event and the 2-year event. The runoff reduction results are also presented in Appendix 4. Slightly more than 40% of the runoff may be redirected around the golf course for a 100-year event, and 100% of the runoff may be redirected around the golf course for the 2-year event.

Appendix 1

Earthwork and Volume Calculations

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GILA RIVER BASIN

NEW RIVER & PHOENIX CITY STREAMS
ARIZONA

ADOBE DAM

(Including Skunk Creek to the Arizona Canal)

DESIGN MEMORANDUM NO. 3

GENERAL DESIGN MEMORANDUM – PHASE II

PROJECT DESIGN – PART 2

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

APRIL 1979

PERTINENT DATA - Continued

ADOBE DAM

Reservoir		
Drainage area	sq mi	89.6
Dam (rolled earthfill)		
Crest elevation	ft msl	1,403.0*
Maximum height above streambed	ft	63
Crest length	ft	11,245
Freeboard	ft	5.5
Spillway		
Crest elevation	ft msl	1,377.8
Crest length	ft	36
Elevation of maximum water surface	ft msl	1,397.5
Outlet works		
Size of conduit	ft	5.9W x 8.85H
Length of conduit	ft	289.5
Intake elevation	ft msl	1,338.0
Dike		
Crest elevation	ft msl	1,400.5
Crest length	ft	1,635
Maximum height above existing ground	ft	6
Reservoir area at spillway crest	acre	1,320
Capacity (gross) at spillway crest	acre-ft	18,350
Storage allocation below spillway crest		
Flood control (net)	acre-ft	15,650
Sedimentation (100-year storage)	acre-ft	2,700
Standard project flood		
Total volume	acre-ft	17,000
Peak inflow	cfs	66,000
Peak outflow	cfs	1,890
Drawdown time	hr	229
Maximum probable flood		
Total volume	acre-ft	61,000
Peak inflow	cfs	119,000
Peak outflow	cfs	12,000
Drawdown time	hr	122
Skunk Creek Channel and Levees		
Standard project flood		
Peak inflow	cfs	54,000
Channel		
Base width	ft	241-271
Length	ft	2,670
Levees		
Maximum height above existing ground	ft	24.8; 25.5
Length	ft	5,550; 6,590
Top width	ft	16
Crest elevation	ft msl	Varies

*Does not include 1.83-foot settlement allowance.

NEW RIVER DAM

Drainage are
Dam (rolled
Crest ele
Maximum h
Crest len
Freeboard
Spillway (d
Crest ele
Crest len
Elevation
Outlet cond
Diameter
Length
Intake el
Saddle dike
Crest ele
Crest ler
Maximum h
Reservoir a
Capacity (
Storage al
Flood co
Sediment
Standard p
Total vo
Peak inf
Peak out
Drawdown
Maximum pr
Total vo
Peak inf
Peak out
Drawdown

*Does not i

C. RESERVOIR OPERATIONS. Adobe Dam is designed to hold water only during times of flood. Regulation of floodwater will be automatic through the ungated outlet conduits.

In the event of a flood, containment of floodwater will temporarily halt recreation in the basin. Standard Project Flood (SPF) inflow at Adobe Dam peaks at 66,000 ft^3/s with a maximum flood pool of 17,000 acre-feet. The areas of the Adobe Dam basin that will be inundated during floods of different frequencies are displayed on plate 5, Flood Zones. Water depths that will be experienced throughout the basin during a standard project flood are also displayed on plate 5 in the form of a histogram. Table 1 lists the flood frequencies, their associated elevations and the length of time it will take to drain the basin for each flood incidence.

Table 1
Periods of Reservoir Inundation (Basin lands closed to the public)

Frequency	Elevation	Draw Down time*
SPF	1377.8	9 days 12 hrs.
100 yr	1372.5	3 days 12 hrs.
50 yr	1369.4	2 days 17 hrs.
25 yr	1366.1	2 days 1 hr.
10 yr	1361.2	1 day 3 hrs.

* Assuming the reservoir is at the flood frequency listed and there is no more inflow, the durations indicate the length of time it will take to drain the basin.

Adobe Dam Design Memo #7
Oct 1984

Chapter 10

DESIGN CRITERIA

A. GENERAL. Components of the recreation development plans for the Adobe Dam basin have been designed in accordance with Department of the Army ER 1110-2-400, Engineering and Design - Design of Recreation Sites, Areas, and Facilities. Specific design criteria for elements of the Adobe Dam recreation development plan are included in this section. The following is intended to serve only as a guide for overall design of facilities. In general, designs are based on accepted recreation standards, the recreation needs of local residents, the desires of the local sponsoring agency, and environmental elements (such as the existing native desert landscape, existing land uses, or identified limiting factors). Support facilities will be sized to service only the cost-shared development. Costs for roads, parking lots, or utilities sized in excess of what is required by the cost-shared development will be the responsibility of the local sponsoring agency or the private developer.

B. DESIGN FEATURES. Adobe Dam basin recreational facilities are being planned and designed in conjunction with Thunderbird recreation area, which adjoins the western edge of the Adobe Dam basin. Design elements to be employed shall be similar for both parks, as well as being consistent with design elements in other Phoenix, Arizona and Vicinity (including New River) projects.

1. Siting. All development will be contained within the available rights-of-way required for the flood control project. Siting limitations for individual facilities are based on flood elevation restrictions, certain environmental factors, and protection of archeological resources. The flood control requirements include protecting structures, swimming pools, and electronic and mechanical equipment from severe damage by flooding through:

- placement outside of the 100-year flood zone (pl. 5);
- building a pad to an elevation equal to or greater than the 100-year flood elevation; or
- flood proofing of structures constructed below the 100-year flood elevation.

Additional flood control considerations include siting of facilities out of water courses and in such a way as to avoid creating separate impoundments within the basin; siting floatable equipment such as tables and trash cans outside of the standard project flood elevation or anchoring them so that they will not interfere with the outlet works during flooding.

Roads used for evacuation in times of flooding should be sited so as to be easily accessible from the various use areas; their vertical alignment will be such that they rise continuously from entrance to exit to assure safe access out of the basin should the reservoir water surface elevation rise.

The environmental factor pertinent to siting of facilities within the Adobe Dam basin is the presence of the mesquite bosque. Development in the immediate vicinity of the bosque will be restricted. Land uses surrounding the bosque must be sited so that the drainage system supporting the mesquite bosque is not impaired in any way and so that with sensitivity to the effect of their noise on the wildlife of the bosque will be minimal.

The petroglyph site opposite the outlet channel is the project's archeological resource. There will be no recreation facilities sited in this area.

2. Architectural Character. The architectural style will enhance the character of the existing natural environment. Basic construction materials will include concrete, hollow core slump block, decorative stone, wood, and metal. The structures will be designed to be pleasing, functional, vandal resistant, and low maintenance. The colors and design of facilities will blend with and complement the hues and textures of the surrounding landscape.

a. Rest Rooms. Corps requirements for accessibility by the handicapped will be followed. Where feasible, rest rooms will be located in close proximity to activity areas. Six restrooms are planned. The exact locations will be determined based on Corps and MCPRD planning standards and on Maricopa County Health Department recommendations. Construction materials will be selected based on their long life, ease of maintenance, and resistance to vandalism. Exterior design and materials will be similar to those at Thunderbird recreation area. The type of waste disposal chosen will depend on site specific factors and will be subject to approval by the Maricopa County Health Department. Installation of a sewer main line along the park entry road to which the park's sewage line will be connected is the preferred alternative. If recreation development occurs prior to installation of the sewer line or if it is not feasible to tie remote sites in to the sewer main, the leach field method or an aerobic digestion method is preferred.

b. Picnic Tables and Ramadas. These elements shall be similar in design to those constructed at Thunderbird recreation area. Ramadas are to be built when trees are not existing or are not to be included in the detailed design.

3. Esthetics. Structures built for cost shared or non-cost shared recreation facilities will incorporate a similar design style in order to establish and maintain a consistent basin character. Earth berming, native landscaping, and application of petroglyph motifs on building walls are recommended in addition to the use of similar basic construction materials.

4. Lighting. Lighting will follow the illumination levels set by the Maricopa County Parks and Recreation Department for various use areas. Areas developed directly adjacent to Pinnacle Peak Road are more likely to impact on nearby residential development than are interior areas, and will therefore require careful evaluation when determining acceptable lighting levels.

5. Landscaping. Planting will enhance the natural landscape by emphasizing landforms and native plant communities. Landscaping will be used to define specific features, circulation, and recreation use areas. In addition to creating a pleasant atmosphere, designs also will be manipulated to lessen the impact of adverse climatic conditions and environmental elements by using plants as buffers, articulators, screens and shade. Existing riparian vegetation will, for the most part, be left undisturbed to serve as a buffer between use areas.

6. Signs. A hierarchy of sign types will guide and direct visitors throughout the Adobe Dam basin:

Type One: These include entry signs marking major recreation and interpretive features (i.e. aquatic facility or the kiosk facility, respectively), and the main park entry sign. The main entry sign and kiosk facility sign will carry the U. S. Army Corps of Engineers, the Flood Control District of Maricopa County and the Maricopa County Parks and Recreation Department insignias.

Type Two: These include signs marking smaller recreation features (examples are picnic areas, campgrounds, nature area), directional signs, and regulatory signs. An identification sign will be placed at the entrance to each recreation area. Directional signs will be placed along major arteries near the basin to provide visitors with proper access information.

All signs will be constructed of vandal resistant material and will be positioned for high visibility. Signs will be compatible with the esthetic character of the park. Road signs shall conform to standards set by the Maricopa County Highway Department. Whenever possible, Federal recreation symbols are to be used.

7. Utilities. Due to the present relatively rural nature of the area, construction of utility lines into the Adobe Dam basin will be necessary. Water and power lines will be brought into the basin by the Corps and the local recreation sponsor to service the cost-shared recreation facilities. Local developments will be responsible for their own utility service. At present there is an existing water main terminating at 35th Avenue and Pinnacle Peak Road and existing power lines located along Pinnacle Peak Road. Both utilities will be brought into the basin at 43rd and Pinnacle Peak Road. All such work and utility alinements will comply with County standards.

8. Parking and Circulation. The main access road will be paved and two-way, built to accommodate one lane of traffic in each direction. Interior circulation roads will also be paved and single directional to lessen congestion at points of intersection with the main park access road. Spur roads leading to camping and picnicking areas will be paved and two-directional. Roads constructed by the Corps and the local recreation sponsor will follow whichever agency's standard is higher. Roads constructed by concessionaires will comply with the Maricopa County Highway Department Standards.

All parking areas will be paved. Overflow parking will be provided where needed and will consist of a decomposed granite or gravel covering over a cleared and graded area. Adequate space will be allowed in the parking areas for handicapped visitors and recreation vehicles.

9. Water Conservation. Detailed design of the recreation facilities proposed for development will reflect various methods of achieving water conservation. The designs will be reviewed by MCPRD, the Maricopa County Health Department, the Arizona Department of Water Resources and the Corps for acceptable water conservation methods. Among those methods to be investigated are: use of treated effluent, minimization of turf, use of drought tolerant grasses, use of native or drought tolerant plants for landscaping, night watering of vegetation to minimize evaporation, and use of low water or non-flush toilets.

10. Noise Control. Relatively little noise from sources inside the proposed recreation development is expected to reach adjacent land uses; therefore, the focus is upon reducing the noise influence of each use within the basin on other basin uses.

The interim ultralight and model airplane flying are the noisiest activities. The primary ways to reduce their noise are: require engine mufflers; limit hours and days of operation to eliminate early morning and evening conflicts with campers and other sensitive uses; confine the flight area to a relatively small location so the aircraft would not be exposing a large area to their noise; and site flight areas as far away from noise sensitive uses as possible so that distance attenuation would help reduce impacts.

The permanent facilities included in the physical plan of development will also influence other basin uses. To control kart racing noise impacts within the basin line-of-sight noise barriers may be necessary, to screen the noise from sensitive receptors. In addition, more effective and heavier muffler systems could be used. It is expected that solid berms and/or walls in the range of 10 to 12 feet in height or more would be necessary to develop enough shielding (at least a 10 dB loss) for increased compatibility with sensitive uses planned for nearby areas. The exact heights and design of screening elements would have to be investigated by an acoustical engineer. (The PKRA's responsibility). More effective muffling systems are feasible and could be required; according to the International Karting Federal, Inc., performance is not significantly affected. If the hours and days of operation are regulated to reduce the potential late evening and early morning conflicts with campers and other sensitive uses, an increase in compatibility could be obtained. It is the responsibility of the PKRA to assure that their facility produces noise within the EPA recommended levels at the nearby residential areas and at the boundary of other facilities within the basin.

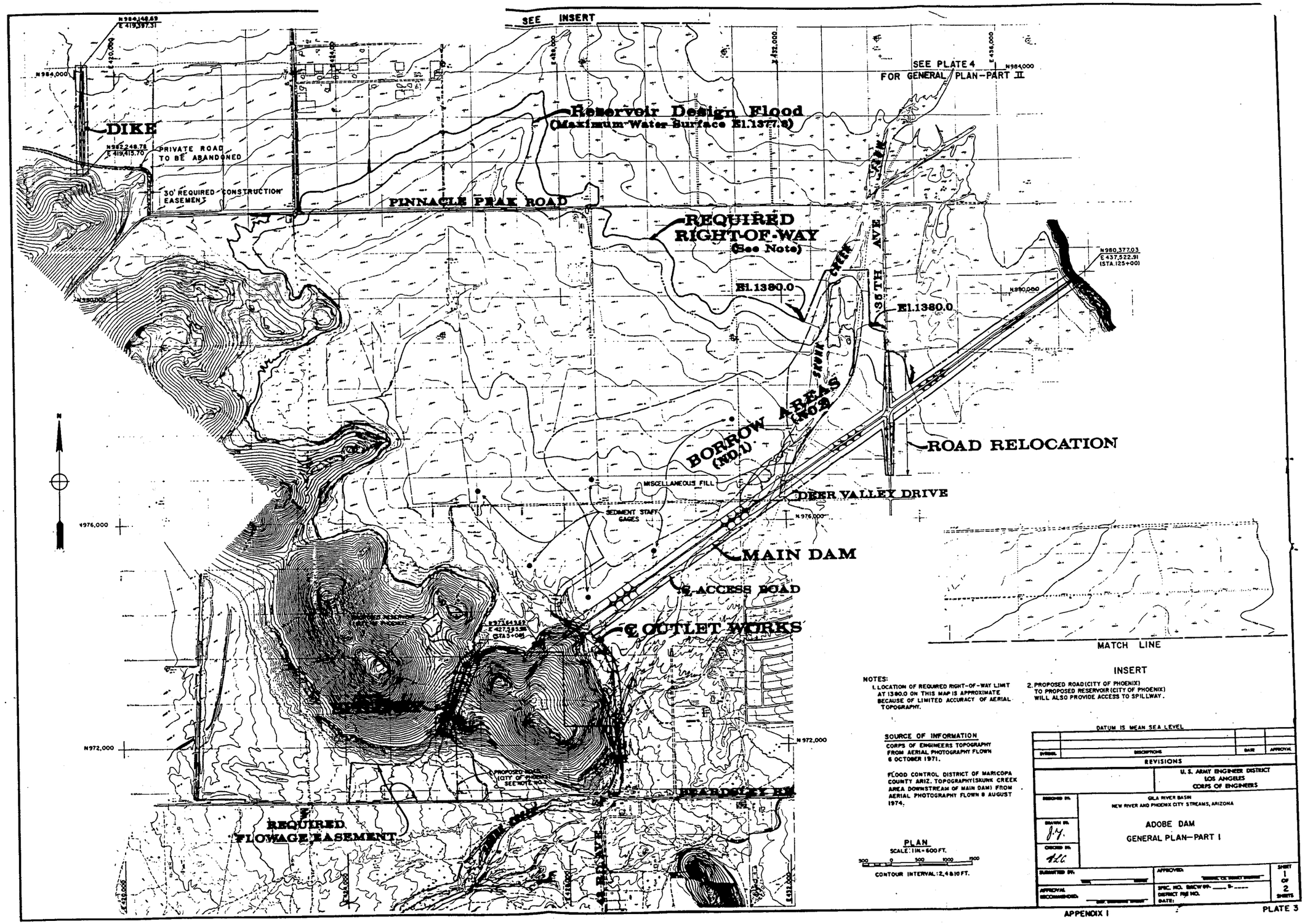
The major source of noise from the proposed equestrian facility would be the public address systems, which range between 72 to 78 dB(A) from 100 feet at a similar site. These impacts could be reduced by using a large number of low sound level, narrow range loudspeakers rather than a few very loud wide-

focused loudspeakers. Any public address system plans should be designed and reviewed by an acoustical engineer experienced in controlling or reducing sound dispersions to areas outside of audience areas. The use of illuminated, electronically controlled announcement displays could also be used to convey information about scores, event scheduling, etc., thereby eliminating some of the announcements for which public address systems are frequently used.

Noise impacts from the proposed aquatic park are not expected to be a problem, as long as all mechanical equipment is installed in noise-reducing enclosures and inlet and outlet noise suppressors are installed on all internal combustion-powered equipment and compressors. Public address systems will have to be controlled in the same manner as those used at the equestrian facility. Elevated waterslides are planned; these slides often prompt screams from participants. The water slides should be placed so that noise would be directed into the park and away from sensitive receivers (in particular, future homesites across Pinnacle Peak Road). If possible, the water slides should be shielded from direct line-of-sight exposure to sensitive residential receivers. The design, specification and review services of an acoustical engineer should be employed to reduce noise impacts arising from a specific facility design.

The public address systems for the sports complex should be controlled as recommended for the equestrian facility to reduce noise dispersion to other areas.

In the future, noise intensive land uses should be required to provide a noise study to demonstrate acceptable impact to other basin uses. It will be the responsibility of the MCPRD and the Maricopa County Health Department to ensure that unhealthful or annoying noise levels due to recreation development are avoided within and without of the project boundaries.



NOTES:

1. LOCATION OF REQUIRED RIGHT-OF-WAY LIMIT AT 1380.0 ON THIS MAP IS APPROXIMATE BECAUSE OF LIMITED ACCURACY OF AERIAL TOPOGRAPHY.
2. PROPOSED ROAD (CITY OF PHOENIX) TO PROPOSED RESERVOIR (CITY OF PHOENIX) WILL ALSO PROVIDE ACCESS TO SPILLWAY.

SOURCE OF INFORMATION

CORPS OF ENGINEERS TOPOGRAPHY FROM AERIAL PHOTOGRAPHY FLOWN 6 OCTOBER 1971.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ARIZ. TOPOGRAPHY (SKUNK CREEK AREA DOWNSTREAM OF MAIN DAM) FROM AERIAL PHOTOGRAPHY FLOWN 8 AUGUST 1974.

PLAN

SCALE: 1 IN = 600 FT.

500 0 500 1000 1500

CONTOUR INTERVAL: 2, 4 & 10 FT.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

ADOBE DAM
GENERAL PLAN—PART I

DESIGNED BY:
DRAWN BY: J.Y.
CHECKED BY: HLC
SUBMITTED BY:
APPROVAL RECOMMENDED:
APPROVED:
SPEC. NO. DACW 09-
DISTRICT FILE NO.
DATE:
SHEET 1 OF 2 SHEETS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Memorandum of Record

To: File, CG 3.2
E. Raleigh

From: M. Bressor

Date: February 16, 1994

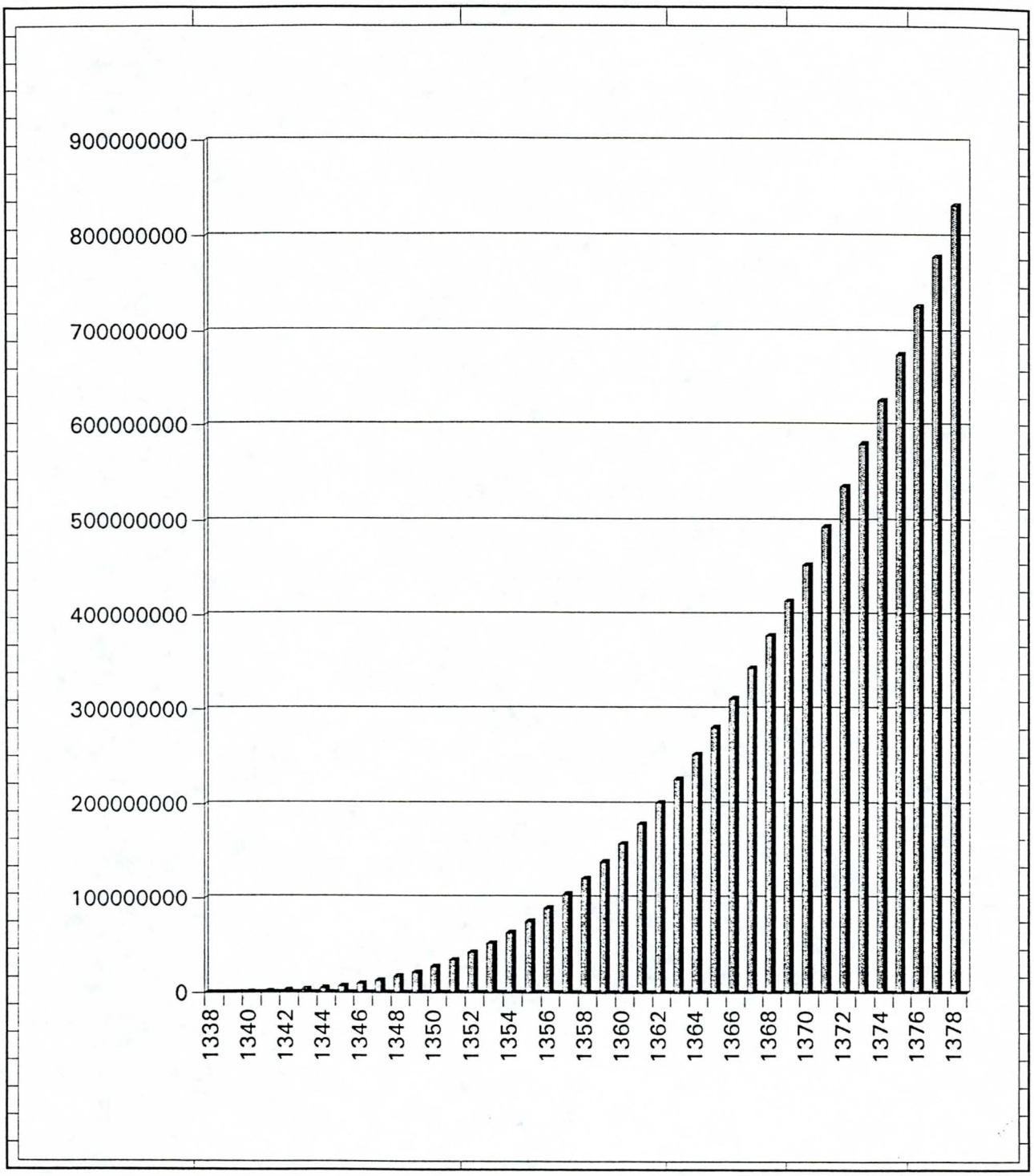
Subject: Adobe Dam Pool Volume

The pool volume of Adobe Dam was calculated by Marta Dent using ARCInfo and the contour information from the ACDC Area Drainage Mater Study. The pool storage volume at 1372.5 (the designed 100 year frequency event) is approximately 559 million cubic feet (12,834 acre-ft). The pool storage volume at 1377.8 (the emergency spillway crest elevation) is approximately 822 million cubic feet (18,874 acre-ft). The Corps of Engineers' Design Memorandum states the pool storage to be 18,350 acre-ft at the spillway crest elevation. The ADMS estimates 2.9% more volume at the spillway crest elevation.

A stage-storage curve and incremental volume data from the ACDC ADMS is attached for reference.

Adobe Dam Stage Storage Pool Volume
(From ACDC ADMS)

Water Surface Elevation	Volume (CF)	Volume (million CF)	Volume (Acre-ft)
1338	6	0	0.0
1339	46,768	0	1.1
1340	329,436	0	7.6
1341	993,370	1	22.8
1342	1,902,559	2	43.7
1343	3,108,943	3	71.4
1344	4,754,591	5	109.2
1345	6,929,230	7	159.1
1346	9,742,499	10	223.7
1347	13,133,182	13	301.5
1348	17,142,344	17	393.5
1349	21,925,648	22	503.3
1350	27,733,324	28	636.7
1351	34,729,076	35	797.3
1352	42,987,864	43	986.9
1353	52,596,200	53	1207.4
1354	63,615,384	64	1460.4
1355	76,064,904	76	1746.2
1356	89,871,368	90	2063.2
1357	104,963,280	105	2409.6
1358	121,299,192	121	2784.7
1359	139,020,656	139	3191.5
1360	158,322,544	158	3634.6
1361	179,353,824	179	4117.4
1362	202,123,280	202	4640.1
1363	226,646,272	227	5203.1
1364	253,043,792	253	5809.1
1365	281,367,936	281	6459.3
1366	311,701,664	312	7155.7
1367	344,090,816	344	7899.2
1368	378,629,440	379	8692.1
1369	415,259,488	415	9533.1
1370	453,801,600	454	10417.9
1371	494,215,424	494	11345.6
1372	**536,712,864**	**537**	**12321.2**
1373	581,346,368	581	13345.9
1374	628,024,384	628	14417.5
1375	676,643,968	677	15533.6
1376	727,096,384	727	16691.8
1377	779,286,080	779	17890.0
1378	**832,885,888**	**833**	**19120.4**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①

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Fill Volume Requirements PAGE ____ OF ____

DETAIL ____ COMPUTED MPB DATE 2/7

CHECKED BY ____ DATE ____

Fill Volume Required — 140179 cy

Fill Area Loss = 1"

$(\frac{1}{12})(1,821,738 \text{ sf})/27$ — 5623 cy

Clear & Grubbing = 4" loss

$(\frac{4}{12})'(704441 \text{ sf})/27$ — 8697 cy

154,499 cy

in-situ density 95% < ρ < 100% - no allowance for compaction

- no allowance for loss.

$\boxed{\text{Required Volume} = 154,500 \text{ cy}}$

Fill Volume Estimates

Total Requried Volume =	140178.9 CY
Total Area =	41.8 acres

Area 1- (51-49 & PP - Electra)

Total Area 381872 SF

Elevation	Existing Area (SF)	Intermediate Volume (CF)	Design Area (SF)	Design Volume (CF)		Total Required Volume (CF)
1377	374515		380102			
1378	316102	345308.5	371939	376020.5		
1379	175428	245765	258415	315177		
1380	50886	113157	101002	179708.5		
1381	8989	29937.5	8473	54737.5		
Totals		734168		925643.5		191475.5

Area 2- (49-47 & PP - Electra)

Total Area 374519 SF

Elevation	Area (SF)	Volume (CF)	Area (SF)	Volume (CF)		
1372	373916		374519			
1373	341569	357742.5	373224	373871.5		
1374	259844	300706.5	364958	369091		
1375	182398	221121	352804	358881		
1376	121290	151844	334974	343889		
1377	36949	79119.5	309835	322404.5		
1378	0	18474.5	281464	295649.5		
1379	0	0	87090	184277		
1379.5	0	0	0	21772.5		
Totals		1129008		2269836		1140828

Area 3- (49-47 & Electra-Creedance)

Total Area 727242 SF

Elevation	Area (SF)	Volume (CF)	Area (SF)	Volume (CF)		
1373.9	0		0			
1374	720160	36008	725568	36278.4		
1375	682462	701311	721694	723631		
1376	588844	635653	714117	717905.5		
1377	461002	524923	700148	707132.5		
1378	311567	386284.5	680448	690298		
1379	149795	230681	434131	557289.5		
1380	39277	94536	187613	310872		
1380.9	0	17674.65	0	84425.85		
Totals		2627071.15		3827832.75		1200762

Area 4- (E. of 47th)

Total Area 338105 SF

Elevation	Area (SF)	Volume (CF)	Area (SF)	Volume (CF)		
1371.3	0		0			
1372	320300	112105	336488	117770.8		
1373	248545	284422.5	331965	334226.5		
1374	199817	224181	324647	328306		
1375	167744	183780.5	311726	318186.5		
1376	136880	336697	297787	622434		
1377	108419	276163	281751	593477		
1378	70233	89326	262449	272100		
1379	20909	45571	96741	179595		
1380	1815	11362	1815	49278		
Totals		1563608		2815373.8		1251766

Volume Balances

Total Existing Area = 713550 SF
Depth = 6 FT
Total Existing Volume = 4281300 CF
158567 CY

Depth	Existing Void Area (SF)	Existing Void Volume (CF)		Design Topography Area (SF)	Design Topography Volume (CF)
1377.0	0			0	
1376.0	705131	352566		711159	355580
1375.0	668587	686859		706332	708746
1374.0	600132	634360		698903	702618
1373.0	502583	551358		688701	693802
1372.0	393010	447797		677357	683029
1371.0	295263	344137		657140	667249
1370.0	38117	166690		626282	641711
1369.0	0	19059		594175	610229
1368.0		0		562330	578253
1367.0		0		391480	476905
1366.0		0		227458	309469
1365.0		0		67730	147594
1364.2		0		0	27092

Existing Void = 118623 CY
Desgin Void = 244529 CY
Available Basin Material = 125906 CY

Outlet Channel

Sta.	Depth	Top Width	Area (SF)	Volume (CY)
0	9.2	120.4	599.8	
300	9.0	118.0	576.0	6532
640	7.4	98.8	402.6	6161
660	7.5	100.0	412.5	302
760	6.6	89.2	327.4	1370
940	6.7	90.4	336.3	2212
1000	6.4	86.8	309.8	718
1030	7.3	97.6	392.7	390
1100	4.4	62.8	160.2	717
1520	4.5	64.0	166.5	2541
1900	4.1	59.2	141.9	2170
2420	2.7	42.4	70.7	2047
2480	5.2	72.4	214.2	317
2860	3.4	50.8	103.4	2235
3340	0.0	10.0	0.0	919

28631

Total Channel & Basin = 154536.8 CY

Appendix 2

Culvert Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Adobe Dam Detention Basin PAGE 1 OF ____

DETAIL Culvert Sizing COMPUTED ____ DATE ____

CHECKED BY ____ DATE ____

Approximate Capacity of Detention Basin = 200 acre-ft

City of Phoenix - Draw Down Time = 36 Hours

Average Flow Rate

① Assume Infiltration is negligible

② Assume Evaporation is negligible

$$Q_{Avg} = \frac{200 \text{ acre-ft}}{36 \text{ Hours}} = 67.2 \text{ cfs.}$$

$Q = 67.2$ cfs

Culvert Sizing - Inlet Control

Culvert Length = Road Length = 25'

$L_c = 25'$

Try 36" ϕ culvert $n = 0.024$ ($2\frac{2}{3}" \times \frac{1}{2}"$, annular CMP)

$n = 0.024$

To maintain open channel flow at approximately 5 ft/s,

$S = 0.01$

Maximum Basin W.S.E.L = 1370

Pipe Invert = 1362 (Example)

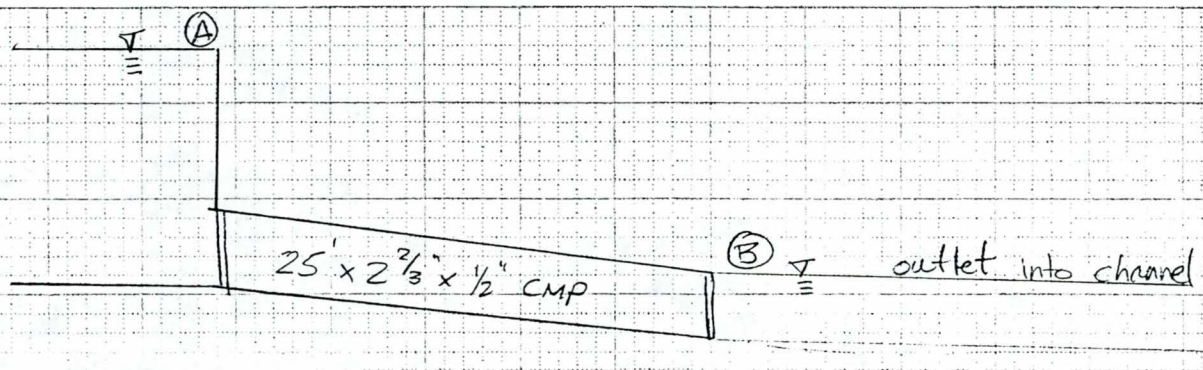
Use Bernoulli's Equation to determine the outflow at end of 25' culvert.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Adobe Dam Detention Basin PAGE 2 OF ____

DETAIL Culvert Sizing COMPUTED ____ DATE ____

CHECKED BY ____ DATE ____



$$\left(\frac{V^2}{2g}+\frac{P}{\gamma}+Z\right)_A = \left(\frac{V^2}{2g}+\frac{P}{\gamma}+Z\right)_B + h_c$$

$$h_c = h_e + h_f$$

$$h_e = K_e \frac{V_B^2}{2g}$$

$$h_f = \frac{2gn^2 x}{R^{4/3}} \frac{V_B^2}{2g}$$

where x = length of pipe A-B

- $K_e = 0.5$ for headwall & smooth side inlet
- Assume V_A is negligible

- For complete pressurized flow throughout the culvert, the tailwater depth must remain equivalent to pipe diameter.
- The friction loss term is evaluated at $x=25$, even for tailwater depths less than pipe diameter, and compensates by varying the hydraulic radius

$$Z_A = \frac{V_B^2}{2g} + Z_B + (K_e + K_f)\frac{V_B^2}{2g}$$

$$V_B = \left(\frac{(Z_A - Z_B)2g}{(1+K_e+K_f)}\right)^{1/2}$$

- For flow not pressurized for full length of pipe, determine a value of x such that HGL = top of pipe, where:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Adobe Dam Detention Basin PAGE 3 OF ____

DETAIL Culvert Sizing COMPUTED ____ DATE ____

CHECKED BY ____ DATE ____

$$HGL = W.S.E.L_A - (K_e + K_f)\frac{V_B^2}{2g} - X(\text{pipe slope})$$

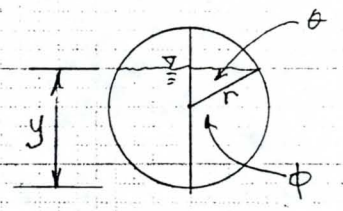
and (B) is now located at distance x from pipe.

(Use spreadsheet to solve for x, iteratively)

- For headwater less than the pipe diameter, use Manning's open channel flow equation

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

- In both cases, the area, wetted perimeter, and hydraulic radius are determined by the following:



$$\theta = \cos^{-1}\left(\frac{r-(d-y)}{r}\right) \quad \text{(radian measure)}.$$

$$\phi = \pi - \theta$$

$$\text{Area} = r^2\phi + r^2\cos\theta\sin\theta$$

$$\text{W Perimeter} = r\phi$$

$$\text{Hydraulic Radius} = \frac{A}{P}$$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Adobe Dam Detention Basin PAGE ____ OF ____

DETAIL Structural Culvert Dgn. COMPUTED ____ DATE ____

CHECKED BY ____ DATE ____

Pipe Structural Design 36"φ pipe – Backfill Density = 90% ±2%

Cover = 2' ⟹ LL(p.102) = 800 psf

DL = 2(120) = 240 psf

$P_V = DL + 0.75LL$

$P_V = 240 + 0.75(800)$ $P_V = 840$ psf

Ring Compression (C)

$C = P_V \frac{S}{2} = 840 \text{ psf} \times \frac{3'}{2} = 1260 \frac{lb}{ft}$ $C = 1260 \frac{lb}{ft}$

Allowable Stress (f_c) (p.105)

Pitch × Depth = 2⅔" × ½"

φ = 36" = 3'

Conservatively assume backfill density = 85% $f_c = 19{,}186$ psi

Wall Thickness

$A = \frac{C}{f_c} = \frac{1260 \frac{lb}{ft}}{19186 \text{ psi}} = 0.067 \frac{in^2}{ft}$ $t = 0.034"$

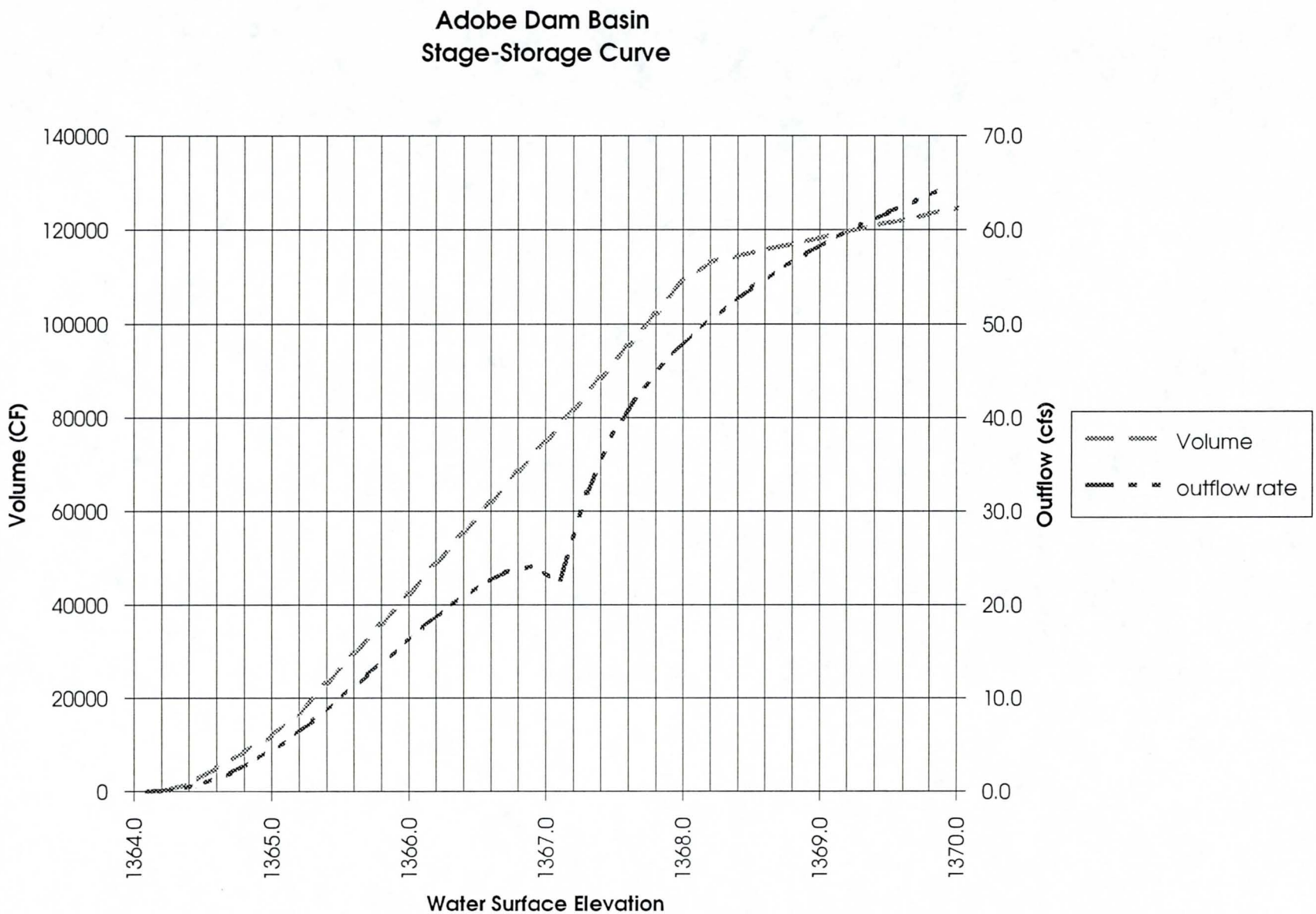
Handling Stiffness

$FF = \frac{D^2}{EI} = \frac{(36 in)^2}{(30\times10^6 psi)(\frac{0.0412}{12} in^3)} \leq 0.0433$

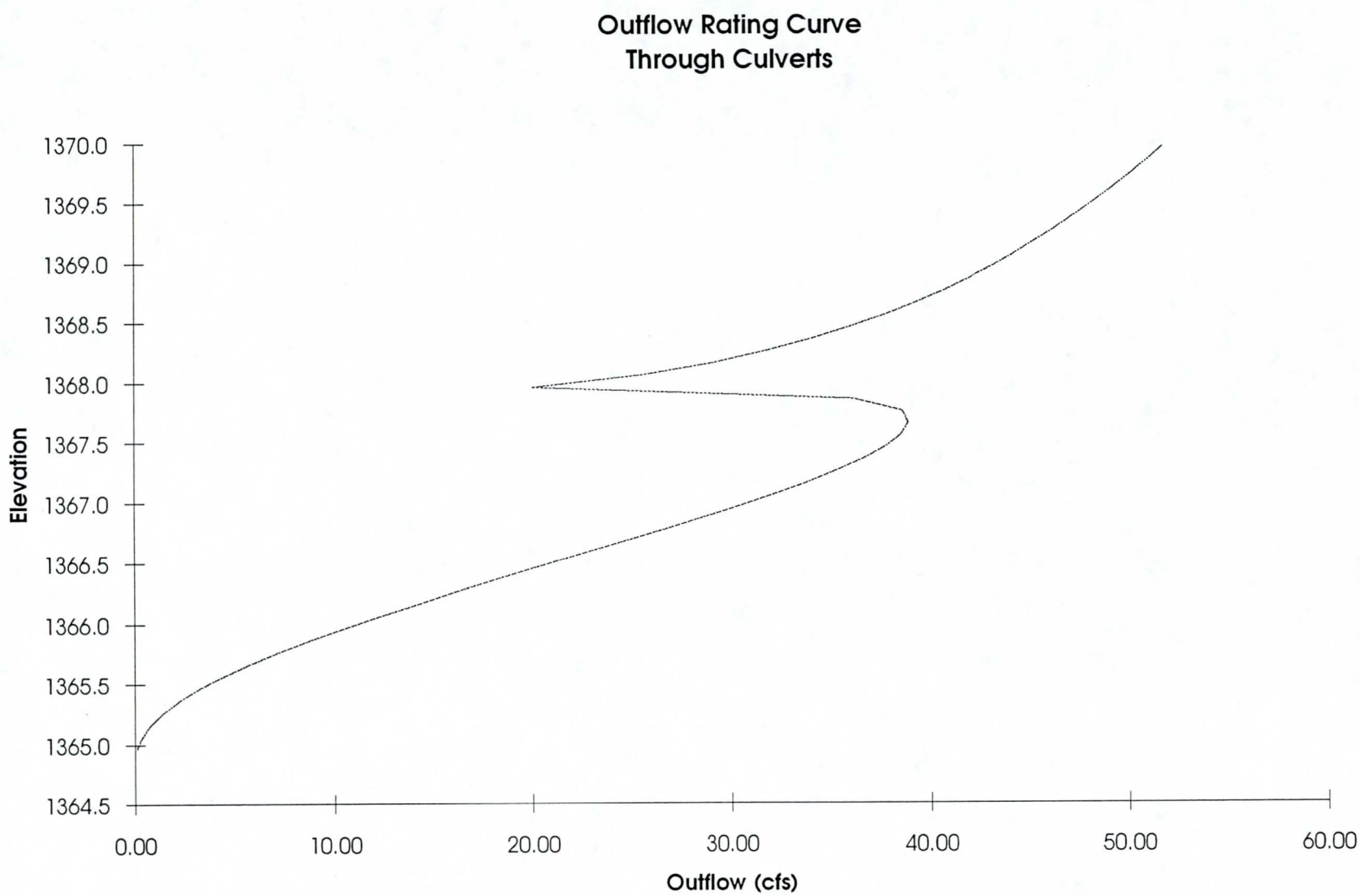
$= 0.0462 \geq 0.0433$

Try wall thickness = 0.040 $\frac{D^2}{EI} = \frac{(36 in)^2}{(30\times10^6 psi)(\frac{0.0135}{12} in^3)} = 0.0384 \leq 0.0433$ $t = 0.040$

Use 36"φ, 2⅔" × ½", 0.040" CMP



\adobe\STORAGE.XLS Chart 1 3/3/94


Outflow Rating Curve
Through Culverts
Elevation
1370.0
1369.5
1369.0
1368.5
1368.0
1367.5
1367.0
1366.5
1366.0
1365.5
1365.0
1364.5
0.00
10.00
20.00
30.00
40.00
50.00
60.00
Outflow (cfs)

Adobe Dam Outlet Channel
Stage-Storage-Rating Curve

Incremental Basin Volume (CF)	Cumulative Basin Volume (CF)	Channel Data OutfLow Rate (cfs)	Incremental Drainage Time (min)	Cumulative Drainage Time (min)
0	0	0.0	0	1743
1693	1693	0.2	282	1743
5080	6773	0.9	161	1461
8466	15239	2.0	100	1300
11853	27092	3.5	73	1199
16741	43833	5.4	63	1127
23130	66962	7.5	60	1064
29519	96481	9.9	56	1004
35908	132389	12.5	53	948
42297	174686	15.0	51	894
48772	223458	17.6	50	843
55333	278791	19.9	49	793
61894	340685	21.9	49	744
68455	409139	23.4	50	694
75016	484155	24.1	53	644
81713	565868	22.4	59	591
88547	654415	32.0	54	533
95381	749796	38.6	45	478
102215	852011	43.0	42	433
109049	961060	46.5	41	391
113103	1074163	49.2	39	351
114377	1188540	51.7	38	311
115650	1304190	53.8	37	274
116924	1421114	55.7	36	237
118198	1539313	57.4	35	202
119477	1658790	59.0	34	167
120761	1779551	60.5	34	132
122046	1901597	61.8	33	99
123330	2024927	63.1	33	65
124614	2149541	64.3	33	33

Total Volume : 79613 CY

Elevation	Headwater	V (ft/s)	Q (cfs)
1370.0	5.80	4.55	64.34
1369.8	5.60	4.46	63.12
1369.6	5.40	4.37	61.83
1369.4	5.20	4.28	60.46
1369.2	5.00	4.17	59.00
1369.0	4.80	4.06	57.41
1368.8	4.60	3.94	55.69
1368.6	4.40	3.81	53.80
1368.4	4.20	3.66	51.68
1368.2	4.00	3.48	49.24
1368.0	3.80	3.29	46.45
1367.8	3.60	3.04	43.02
1367.6	3.40	2.73	38.60
1367.4	3.20	2.26	31.95
1367.2	3.00	1.58	22.39
1367.0	2.80	1.75	24.08
1366.8	2.60	1.80	23.38
1366.6	2.40	1.80	21.88
1366.4	2.20	1.79	19.88
1366.2	2.00	1.75	17.55
1366.0	1.80	1.70	15.04
1365.8	1.60	1.63	12.47
1365.6	1.40	1.54	9.94
1365.4	1.20	1.43	7.54
1365.2	1.00	1.30	5.37
1365.0	0.80	1.15	3.48
1364.8	0.60	0.97	1.96
1364.6	0.40	0.76	0.85
1364.4	0.20	0.49	0.20
1364.2	0.00	0.00	0.00

Appendix 3

Geotechnical Report

SHB AGRA, INC.
Engineering & Environmental Services

3232 West Virginia Avenue
Phoenix, Arizona 85009
Phone: 602-272-6848
Fax: 602-272-7239

December 9, 1993

SHB Job No. E93-299

Maricopa County
Flood Control District
2801 Durango Street
Phoenix, Arizona 85009

Attention: Warren F. Rosebraugh, P.E.

Re: Adobe Dam Basin Fill & Channel
47th Avenue & Pinnacle Peak Road
Phoenix, Arizona

Gentlemen:

Our Geotechnical Investigation Report on the referenced project is herewith submitted. The report includes the results of test drilling and laboratory analysis, and presents recommendations for slope configuration and site grading.

Should any questions arise concerning this report, please do not hesitate to contact us.

Respectfully submitted,
SHB AGRA, Inc.

By _____
Jonathan A. Crystal, P.E.

Reviewed by _____
Norman H. Wetz, P.E.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
12176
NORMAN HAROLD
WETZ
Date Signed 12/9/93
ARIZONA U.S.A.

Copies: Addressee (3)
1d/J93-1/12-09-93

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
12176
NORMAN HAROLD
WETZ
Date Signed 12-7-93
ARIZONA, U.S.A.

SHB Job No. E93-299

AGRA
Earth & Environmental Group

1. INTRODUCTION

This report is submitted pursuant to a geotechnical investigation made by this firm of the site of a storm water retention pond to be located on the south side of Pinnacle Peak Road near its intersection with 47th Avenue in Phoenix, Arizona. The object of the investigation was to evaluate the physical properties of the soils underlying the site to provide recommendations for slope design and site grading.

2. PROJECT DESCRIPTION

It is understood that a storm water retention pond is to be constructed at the existing Adobe Dam Recreation Area golf course. The excavated material is to be used for engineered fill on a project located immediately north of the site. The basin is to be sized with regard to the permeability of the underlying soils.

Should details involved in final design vary significantly from those given above, this firm should be notified for review and possible revision of recommendations presented in this report.

3. INVESTIGATION

3.1 Subsurface Exploration

Three exploratory borings were drilled to depths of about 15 feet below existing grade utilizing 6 5/8-inch O.D. hollow stem auger. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings. The results of the field investigation are presented in Appendix A, which includes a brief description of drilling and sampling equipment and procedures, a site plan showing the boring locations and logs of the test borings.

An open well piezometer was installed in Boring No.1 to perform an in-place permeability test. The interval between 8 and 10 feet was screened and isolated. The test was performed in general accordance with the Bureau of Reclamation E-19 method.

The field investigation was supervised by Aaron J. Glass, E.I.T, staff engineer of this firm.

3.2 Laboratory Analysis

The moisture content of selected samples recovered were determined. The results of these tests are shown on the boring logs. Grain-size analysis and Atterberg limits tests were performed on selected samples to aid in classification. In addition, two moisture-density (Standard Proctor) tests were performed on a bulk sample recovered. The results of these tests are presented in Appendix B.

4. SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 Site Conditions

The site is located south of Pinnacle Peak Road, between 47th and 51st Avenues, in Phoenix, Arizona. The site is relatively flat with a moderate slope downward to the northeast. Vegetative cover consists of a sparse to moderate cover of native grasses and shrubs.

A golf course is located adjacent to the south of the site. The access road and a parking lot for the golf course provides the eastern boundary of the site.

4.2 Geotechnical Profile

As indicated by the exploratory borings, the soils underlying the site generally consist of high plasticity sandy silt which extended to the depths of the borings. The soils are weakly to moderately lime cemented and are very firm to hard with occasional surficial moderately firm and firm zones.

4.3 Groundwater & Soil Moisture Conditions

No free groundwater was encountered in the borings and moisture contents were relatively low, being well below the plastic limits of the soils encountered.

5. DISCUSSION & RECOMMENDATIONS

5.1 Borrow Material

The soils encountered at the site are considered moderately expansive and capable of excessive movement upon significant moisture increases. Use of the material as structural fill will require careful consideration regarding its potential expansion. Careful attention to site drainage and moisture protection will be necessary to minimize future expansion related problems. Even so, significant risk remains if the material is used for fill below structures, particularly residential and other lightly loaded structures.

5.2 Slopes

Slope stability analysis using methods presented by Singh (1970)* indicate that excavated slopes of 1.5:1 (horizontal to vertical) have a factor of safety of at least 2.5. This considers in situ conditions similar to those encountered with estimated parameters of 30° angle of internal friction (0), 200 psf cohesion (c), 100 pcf unit weight (γ), and 10 feet maximum slope height (H). Extremely long holding times allowing saturation of the slopes by steady-state seepage will necessitate flatter slopes.

Slopes probably will undergo long-term erosion if not protected. Vegetating the slopes or armoring them with riprap will provide suitable protection. The use of riprap will require the use of filter media between the riprap and the soil slope.

5.3 Permeability

Results of the field permeability test indicate a permeability of 1.42×10^{-8} cm/sec at a depth of about 10 feet. This value is considered to be quite low for a retention basin. It is our opinion that provisions for alternate methods of draining the basin should be considered.

Siltation of the pond bottoms will occur over time. Provisions for cleaning the bottoms periodically should be implemented. This should include monitoring the basins at least annually for siltation.

*Singh, A., "Shear Strength of Man-Made Slopes," Journal of Soil Mechanics and Foundations Division, ASCE, Vol. 96, No. SM6, Proc. Paper 7652, November 1970, pp. 1879-1892.

TEST DRILLING EQUIPMENT & PROCEDURES

Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 6 5/8" O.D., 3 1/4" I.D. hollow stem auger or 4 1/2" solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-55 or CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Ford industrial engines capable of delivering about 7,000 to 8,400 foot-pounds torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 16,000 to 20,000 pounds downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or river-run material, which normally requires other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42" diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Hammer Drill Drilling with the Hammer drill is accomplished with a Drill Systems AP1000 drill rig advancing a double-walled drive casing with a link-belt 180 diesel pile driving hammer, having a rated energy of 8,100 foot-pounds per blow. Where noted on the boring log, the hammer is equipped with a supercharger which can boost the energy to approximately 12,000 foot-pounds per blow. The supercharger is used only in portions of the boring where blow counts are relatively high. Cuttings are removed with compressed air by a reverse circulation process, and are collected in a cyclone from which grab samples are obtained. The drive casing is either 9" O.D. by 6" I.D. or 6 5/8" O.D. by 4" I.D. and employs an expendable bit of slightly larger diameter than the O.D. of the casing. Hammer blows required to advance the drive casing are recorded in 1' increments, as noted on the boring logs. Standard penetration tests or 2.42" diameter ring samples taken are noted on the boring logs.

Odex System The Odex (overburden drilling with the eccentric method) system, also referred to as the DTH (down-the-hole hammer) system, consists of a pneumatic-rotary percussion down-the-hole hammer operating at the bottom being drilled through a 5" diameter steel casing. The eccentric button percussion bit overreams the boreholes and allows advancement of the casing. The same compressed air or air-detergent (foam) mixture that operates the hammer also serves to expel the cuttings from the borehole, where they can be collected as grab samples. Retraction of the eccentric drill bit allows removal of the hammer from the center of the casing to facilitate standard penetration testing (ASTM D1586) where noted on the boring logs.

TEST DRILLING EQUIPMENT & PROCEDURES (CONT.)

Schramm Rotadrill The Schramm T64H truck-mounted drill rig is a top drive rotary rig capable of up to 85,500 inches/pounds of torque with a pulldown capacity of 35,000 lbs. Drilling is performed with either 4", or larger, diameter Tricone roller bits or 4" to 6" diameter down-the-hole hammer. Cutting removal is facilitated by compressed air or air/water mixtures and collected in a cyclone. Where noted on the boring logs, grab samples of the cuttings were collected. When casing is required to stabilize the borehole, an Aardvark drill through casing hammer is utilized, permitting simultaneous drilling and driving of the casing. Casing penetration is recorded on the boring logs in feet per minute. Standard penetration, 2.42" diameter ring samples, Shelby tubes, pitcher tube or Denison samples taken are noted on the boring logs.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

clj/M1-92/02-14-92

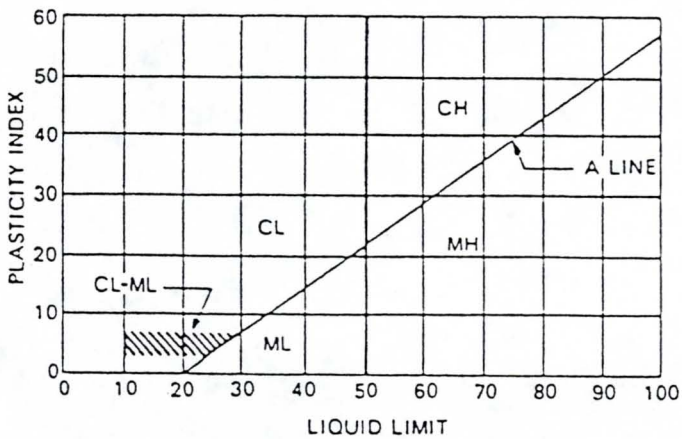
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits plot below "A" line & hatched zone on plasticity chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (Limits plot above "A" line & hatched zone on plasticity chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

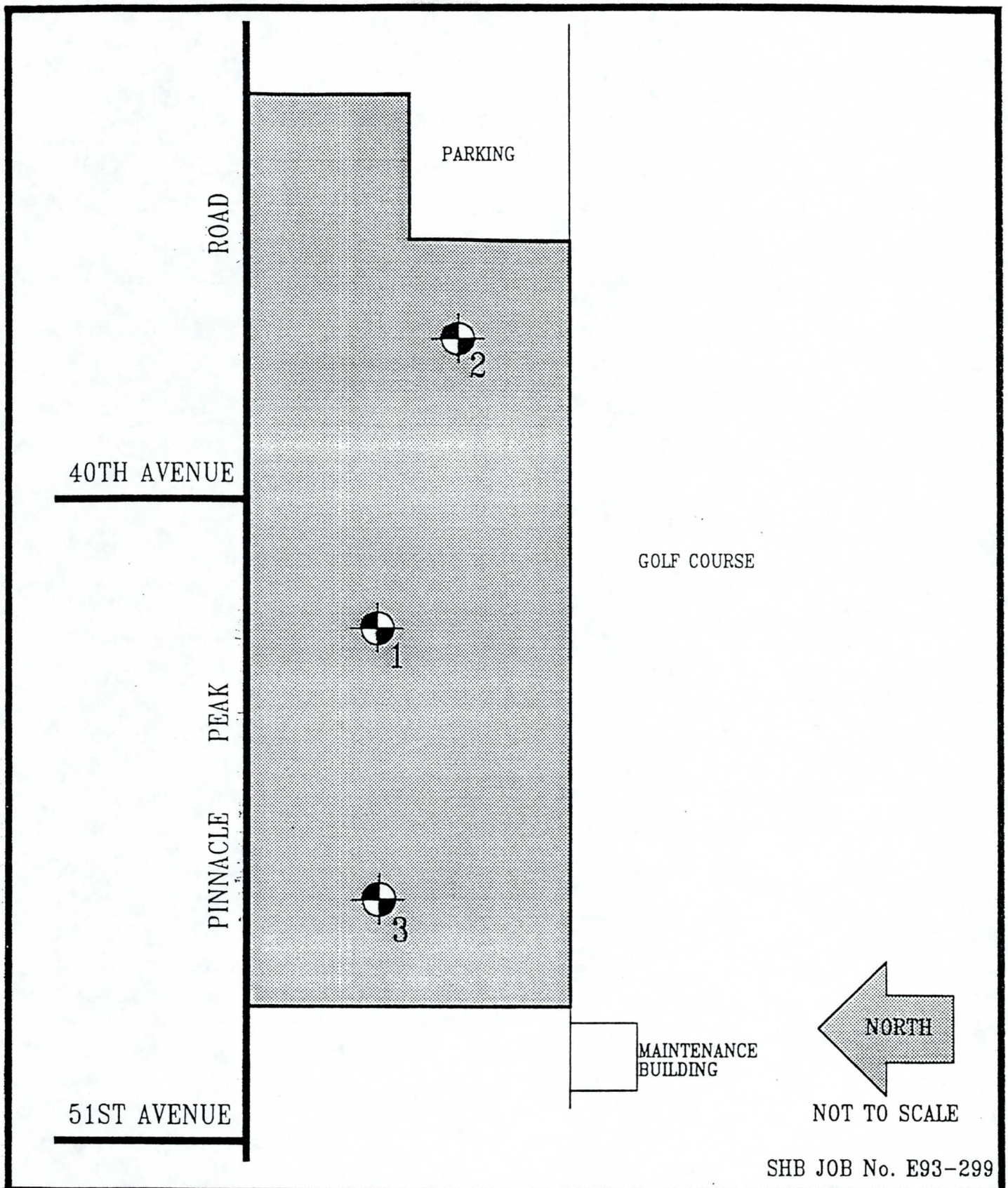
2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

elj/M1-92/02-14-92


PARKING
ROAD
2
40TH AVENUE
GOLF COURSE
1
PEAK
PINNACLE
3
MAINTENANCE
BUILDING
NORTH
51ST AVENUE
NOT TO SCALE
SHB JOB No. E93-299

SITE PLAN

PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 1

JOB NO. E93-299 DATE 11-18-93

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A					slightly moist	SANDY SILT, considerable clay, predominantly fine grained sand, strongly lime cemented, high plasticity, light brown
				S	16-28-43				hard	
				S	31-39-39					note: trace of fine grained angular gravel below 5'
										note: increase in medium to coarse grained subangular sand from 9' to 12'
5				S	17-			MH		
				A	50/6"					
							21			
10				S	24-50/5"					
15					31-35-					
				S	50/4 1/2"					
										Stopped Auger at 15' Sampler refused at 16'4 1/2"
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

SHB AGRA, INC.
ENGINEERING & ENVIRONMENTAL SERVICES
PHOENIX · TUCSON · ALBUQUERQUE
RENO/SPARKS · EL PASO · MEXICO
SALT LAKE CITY · LAKEWOOD/DENVER

PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 2

JOB NO. E93-299 DATE 11-18-93

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A					slightly moist	CLAYEY SILT, some fine grained sand, trace of coarse grained sand, some strongly lime cemented, medium plasticity, light brown
				S	1-2-8			ML	soft	
				S	36-50/4 1/2"				slightly moist	SANDY SILT, considerable clay, predominantly fine to medium grained sand, trace of fine grained gravel, strongly lime cemented, high plasticity, light brown
5				S	50/4"				hard	
				A				MH		note: increase in fine grained gravel from 10' to 15'
							10			
10				S	50/3"					
15				S	50/4"					
										Stopped Auger at 15' Sampler refused at 15'4"
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 3

JOB NO. E93-299 DATE 11-17-93

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A				ML	slightly moist	CLAYEY SILT, trace of fine to medium grained sand, strongly lime cemented, medium plasticity, light brown
				S	4-6-17				firm	
				S	48-50/6"			MH	slightly moist	SANDY SILT, some clay, fine to medium grained sand, some fine grained subangular gravel, moderately to strongly lime cemented, nonplastic, light brown
5				S	50/5 1/2"				hard	
				A						note: increase in lime cement with depth within silty sand
							13		slightly moist	SANDY SILT, considerable clay, predominantly fine grained sand, strongly lime cemented, high plasticity, light brown
10				S	18-50/6"			MH		
15				S	38-50/4"					
										Stopped Auger at 15' Sampler refused at 15'10"
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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SHB AGRA INC.
ENGINEERING & ENVIRONMENTAL SERVICES

PROJECT:	ADOBE DAM BASIN FILL AND CHANNEL	PROJECT NO:	E93-299
		W O NO:	1
LOCATION:	#1 @ 2.5'-4.0'	LAB NO:	4
		DATE:	12/29/93

MECHANICAL SIEVE ANALYSIS (ASTM C136)

SIEVE SIZE	% PASSING
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	100
1/4 IN	100
#4	99
#8	94
#10	93
#16	88
#30	83
#40	80
#50	78
#100	71
#200	58.2

L.L. = 60

P.I. = 23

MOISTURE CONTENT = 20.5%

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PROJECT: ADOBE DAM BASIN FILL AND CHANNEL

LOCATION: #2 @ 5.0'-5'4"

PROJECT NO: E93-299
W O NO: 1
LAB NO: 12
DATE: 12/29/93

MECHANICAL SIEVE ANALYSIS (ASTM C136)

SIEVE SIZE	% PASSING
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	100
1/4 IN	100
#4	99
#8	91
#10	89
#16	83
#30	77
#40	75
#50	73
#100	68
#200	59.7

L.L. = 63

P.I. = 23

MOISTURE CONTENT = 9.9%

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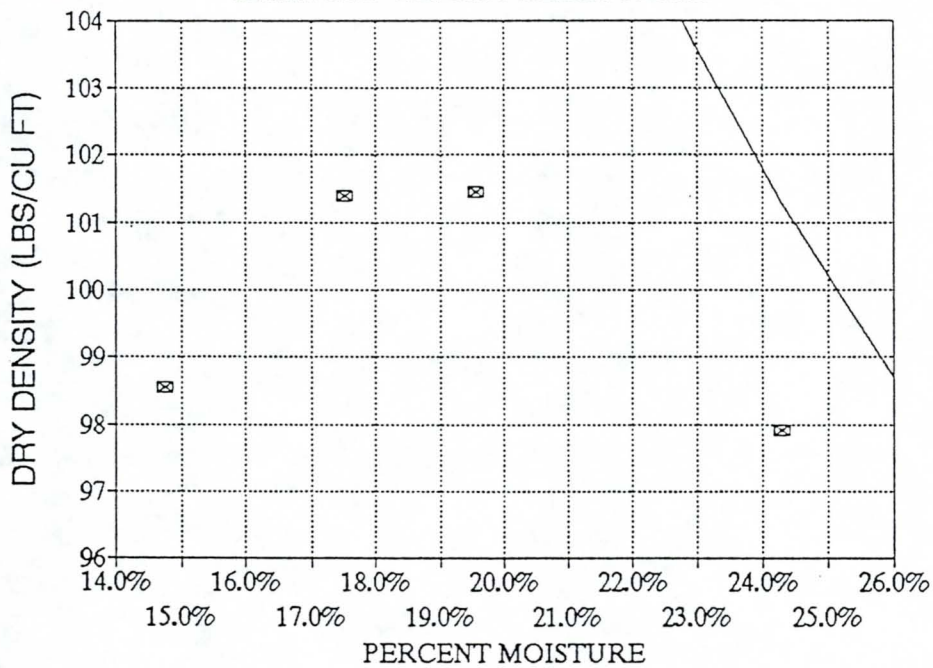
ENGINEERING & ENVIRONMENTAL SERVICES

PROJECT:	ADOBE DAM BASIN FILL AND CHANNEL	DATE	12/29/93
LOCATION:	#3 @ 5.0'-10.0'	JOB NO.	E93-299
		W.O.NO.	1
		LAB NO.	16

ASTM D698

MAXIMUM DRY DENSITY	101.8 PCF	METHOD	A
OPTIMUM MOISTURE CONTENT	18.4%	CURVE	A

MOISTURE - DENSITY RELATIONSHIP



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Earth & Environmental Group

SHB AGRA, INC.
Engineering & Environmental Services

3232 West Virginia Avenue
Phoenix, Arizona 85009
Phone: 602-272-6848
Fax: 602-272-7239

January 28, 1994

Maricopa County Flood Control District
2801 West Durango Street
Phoenix, Arizona 85009

SHB Job No. E93-299
Addendum No. 1

Attention: Warren F. Rosebraugh, P.E.

Re: **Adobe Dam Basin Fill & Channel**
47th Avenue & Pinnacle Peak Road
Phoenix, Arizona

Gentlemen:

We have performed an additional investigation at the referenced project to evaluate earthwork factors of the excavated soils and the swell potential of native soils in the disposal area and the compacted fill soils. In conjunction, we have reviewed the results of our previous investigation for the project.

The additional investigation included drilling two borings at the basin site and four borings at the disposal, or fill, site immediately north of the basin site on the opposite side of Pinnacle Peak Road. The borings were drilled to depths of 10 feet using a CME-55 drill rig equipped with 6 5/8-inch O.D. auger. Relatively undisturbed 2.42-inch I.D. drive samples were recovered at selected intervals in the borings. Bulk samples of the major material types from the drill cuttings also were recovered. Results of the field investigation are attached, including a site plan showing the boring locations and logs of the test borings.

The density of the drive samples determined, the results of which are shown on the boring logs, gradations and Atterberg limits tests were performed on selected samples to aid in classification. Further, expansion (swell)

tests were performed on selected samples from both sites. The results of these tests are attached.

The test results indicate that the in-place density of the soils in the stormwater retention basin ranges from about 91 to 99 pounds per cubic foot (pcf) with an average of about 96 pcf. If the soils are to be compacted to at least 95 percent of maximum density and at optimum moisture content, the range of compaction would be 95 to 100 percent, probably averaging about 97 percent at optimum moisture content. Since the maximum density of the excavated soils appears to be on the order of 101 pcf, calculations would indicate that a volume reduction, or shrinkage, of at least 2 percent but not over 10 percent should be considered. If consideration for spillage and wind erosion is included in this value, the value of 10 percent should then be used and is recommended.

Ground loss during site grading for compaction of the native soils in the fill areas is estimated to be 1 inch. This value is based on the upper 12 inches of soils being compacted during site preparation and the effect of the additional weight of fill and earthwork equipment traffic during fill placement. No consideration is given to loss due to clearing and grubbing.

It should be noted that the above values are estimated based on the data available at the time of our analysis as well as our experience with the soils in the area of the project. Some judgment should continue to be used by others when using these values.

The swell tests performed on the native soils in the fill area indicate a low swell potential of less than 1 percent. The results of the swell tests on the fill soils indicate their swell potential ranges from about 8 to 15 percent, or from medium to high when considering Uniform Building Code

standards. It is our opinion that, even if the fill soils are placed correctly, additional risk will be imposed by this construction. In addition, significant drying of the fill soils will further increase the expansive potential. The estimated heave of various thicknesses of the fill soils are presented in Table 1 which is attached, the estimates are based on Van Der Merwe's Method (1964).

The fill should be placed in lifts not more than 8 inches in loose thickness and compacted to at least 93 percent, but not more than 98 percent, of maximum density as determined by ASTM D698. The moisture content during placement should be between optimum moisture content and 3 percent above, as determined by ASTM D698.

This addendum should be attached to the original report and be made a part thereof. Should any questions arise regarding this addendum, we would be pleased to discuss them with you.

SHB AGRA, Inc.

Respectfully submitted,

Registered Professional Engineer (Civil) CERTIFICATE NO. 27640 JONATHAN A. CRYSTAL Date Signed 1/24/94 ARIZONA, U.S.A.

By _____
Jonathan A. Crystal, P.E.

Registered Professional Engineer (Civil) CERTIFICATE NO. 4336 B. DWAINE SERGENT Date Signed 1/24/94 ARIZONA, U.S.A.

Reviewed By _____
B. Dwaine Sergent, P.E.

Copies: Addressee (3)
mcb/J94-1/1-24-93

TABLE 1

Estimated Heave of Various Thicknesses of Expansive Fill from Adobe Dam Basin*

Thickness of Fill	ΣF_D	P.E. (in/ft)	Estimated Heave (inch)
1	.94	1/2	0.47
2	1.79	1/2	0.99
3	2.54	1/2	1.27
4	3.20	1/2	1.60
5	3.80	1/2	1.90

*Van Der Merwe, D.H., "The Prediction of Heave from the Plasticity Index and Percentage Clay Fraction of Soils", The Civil Engineer in South Africa, Volume 6, No. 6, June 1964.

TEST DRILLING EQUIPMENT & PROCEDURES

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clj/M1-92/02-14-92

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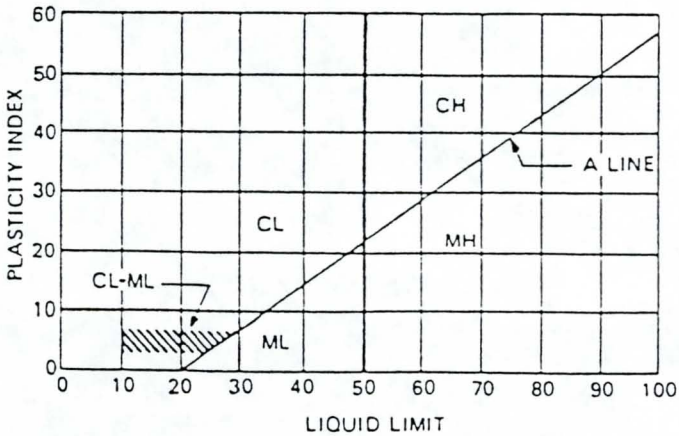
MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits plot below "A" line & hatched zone on plasticity chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (Limits plot above "A" line & hatched zone on plasticity chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

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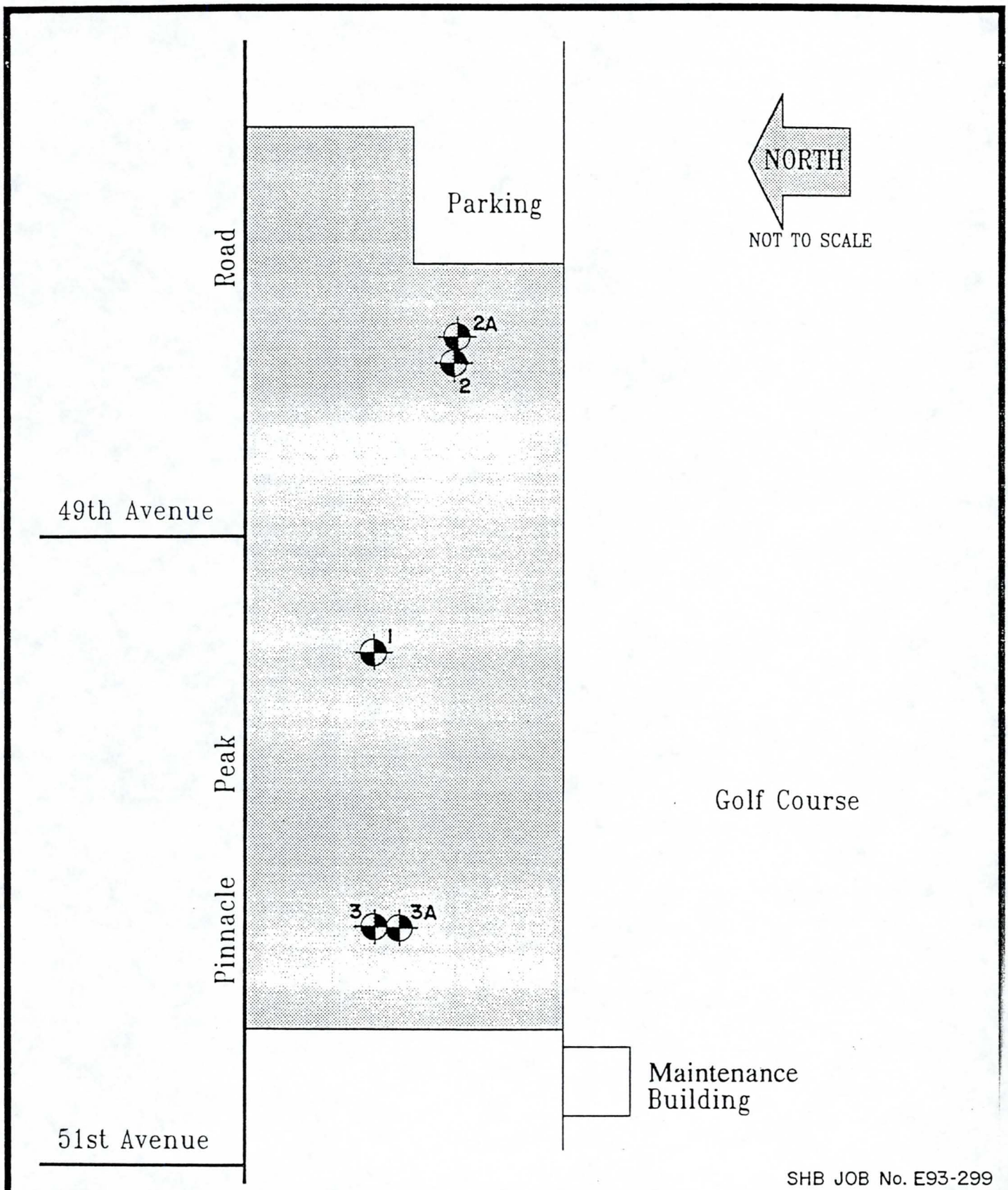
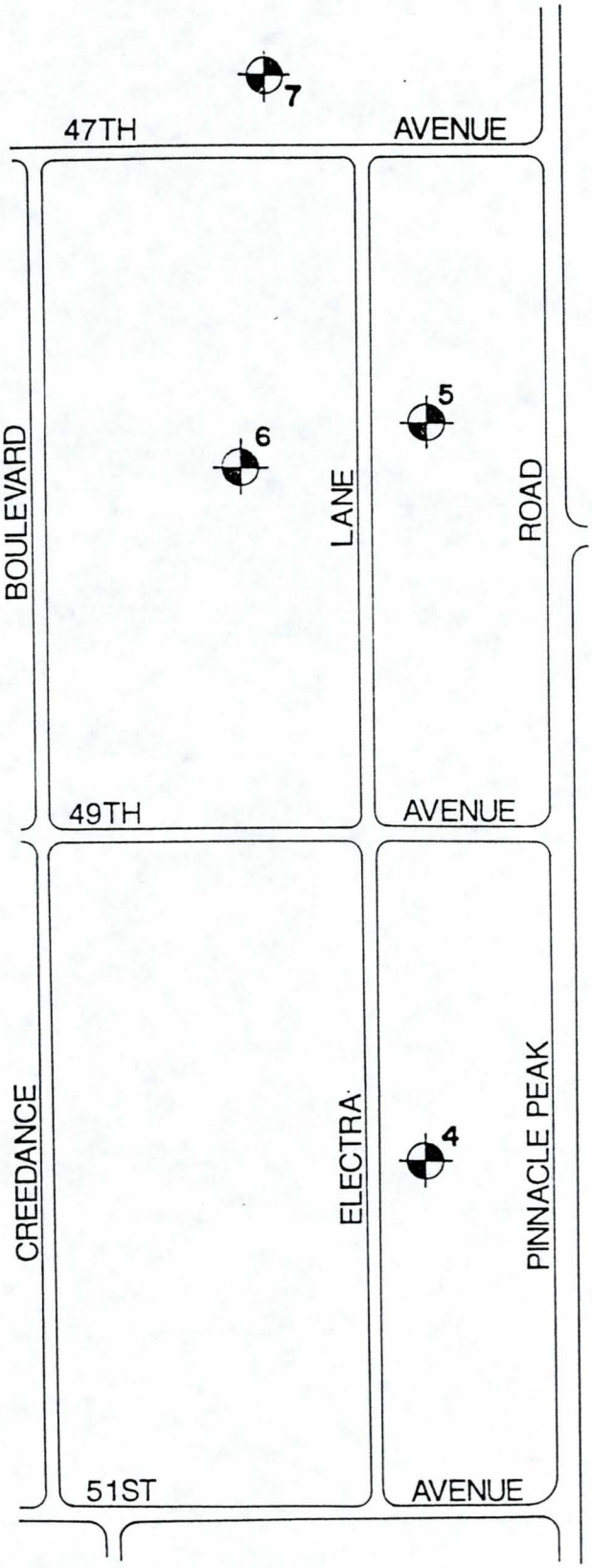


SHB JOB No. E93-299

SITE PLAN



NOT TO SCALE

SHB JOB No. E93-299

SITE PLAN

PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 2 A

JOB NO. E93-299 DATE 12-21-93

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist firm to hard	CLAYEY SILT, considerable medium to fine grained sand, trace of fine grained gravel, weakly lime cemented, high plasticity, light brown note: moderately to strongly lime cemented below 3'
								MH		
5				U	100/11"	91	9			
				S	100/3"					
10										Stopped Auger at 9'6" Sampler refused at 9'9"
15										
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

SHB AGRA, INC.

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PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 3 A

JOB NO. E93-299 DATE 12-21-93

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist firm to hard	CLAYEY SILT, considerable medium to fine grained sand, weakly to moderately lime cemented, high plasticity, light brown note: moderately to strongly lime cemented below 4'
								MH		
5				U	100/7"	97	14			
10				S	100/8"	99	11			Stopped Auger at 9'6" Sampler refused at 10'2"
15										
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 4

JOB NO. E93-299 DATE 12-21-93

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist	SANDY CLAY, weakly lime cemented, medium plasticity, brown
				S	8-7-8				moderately firm to hard	note: moderately to strongly lime cemented below 3'
				U	32	93	10			
								CL		
5				S	15-28-34					
				S	50/3" NR					
10										Stopped Auger at 9'6" Sampler refused at 9'9"
15										
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 5

JOB NO. E93-299 DATE 12-21-93

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-4-8			SC/ CL	moist moderately firm	**SANDY CLAY**, considerable silt, weakly lime cemented, medium plasticity, brown
				S	11-15-27				slightly moist	**SILTY SAND**, considerable clay, moderately to strongly lime cemented, high plasticity, light brown
5				U	100/8"	84	13	SM	very firm to hard	
				S	50/4"					
10										Stopped Auger at 9'6" Sampler refused at 9'10"
15										
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 6

JOB NO. E93-299 DATE 12-21-93

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist	SANDY CLAY, considerable fine to medium grained sand, weakly lime cemented, medium plasticity, brown
				S	7-6-11			CL	firm	
				U	36	90	8		moist	SANDY CLAY, moderately to strongly lime cemented, medium plasticity, light brown
				S	13-22-31			CL	very firm to hard	
				S	50/3"					
10										Stopped Auger at 9'6" Sampler refused at 9'9"
15										
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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PROJECT Adobe Dam Basin Fill & Channel

LOG OF TEST BORING NO. 7

JOB NO. E93-299 DATE 12-21-93

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	14-11-9			CL	moist, firm	**SANDY CLAY**, weakly lime cemented, low plasticity, brown
				U	59	114	9	SC	moist, hard	**CLAYEY SAND**, considerable silt & some fine grained gravel, poorly graded, subangular to angular, weakly to moderately lime cemented, medium plasticity, reddish brown
5				S	13-34-45					
								CL	moist, hard	**SILTY CLAY**, considerable medium to fine grained sand, moderately to strongly lime cemented, low plasticity, light brown
				S	50/3"					
10										Stopped Auger at 9'6" Sampler refused at 9'9"
15										
20										
25										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

SAMPLE TYPE

A - Drill cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.

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LABORATORY TESTING PROCEDURES

Consolidation Tests Soiltest or Clockhouse apparatus of the "floating-ring" type are employed for the one-dimensional consolidation tests. They are designed to receive 1 inch high 2.5 inch O.D. brass liner rings with soil specimens as secured in the field. Procedures for the tests generally are those outlined in ASTM D2435. Loads are applied in several increments to the upper surface of the test specimen and the resulting deformations are recorded at selected time intervals for each increment. For soils which are essentially saturated, each increment of load is maintained until the deformation versus log of time curve indicates completion of primary consolidation. For partially saturated soils, each increment of load is maintained until the rate of deformation is equal or less than 1/10,000 inch per hour. Applied loads are such that each new increment is equal to the total previously applied loading. Porous stones are placed in contact with the top and bottom of the specimens to permit free addition or expulsion of water. For partially saturated soils, the tests are normally performed at in situ moisture conditions until consolidation is complete under stresses approximately equal to those which will be imposed by the combined overburden and foundation loads. The samples are then submerged to show the effect of moisture increase and the tests continued under higher loadings. Generally, the tests are continued to about twice the anticipated curve due to overburden and structural loads with a rebound curve then being established by releasing loads.

Expansion Tests The same type of consolidometer apparatus described above is used in expansion testing. Undisturbed samples contained in brass liner rings are placed in the consolidometers, subjected to appropriate surcharge loads and submerged. The loads are maintained until the expansion versus log of time curve indicates the completion of "primary swell".

Direct Shear Tests Direct shear tests are run using a Clockhouse or Soiltest apparatus of the strain-control of approximately 0.05 inch per minute. The machine is designed to receive one of the 1 inch high 2.42 inch diameter specimens obtained by tube sampling. Generally, each sample is sheared under a normal load equivalent to the effective overburden pressure at the point of sampling. In some instances, samples are sheared at several normal loads to obtain the cohesion and angle of internal friction. When necessary, samples are saturated and/or consolidated before shearing in order to approximate the anticipated controlling field loading conditions.

clj/M1-92/03-03-92

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E93-299
W/O 3

HOLE NO	DEPTH	UNIFIED CLASS	L.L	P.I	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
2A	4'6"-5'5"	MH	52	18	52	62	69	72	75	82	88	89	96	98	99	100	3-299-24
3A	4'6"-5'1"	MH	54	23	55 100	63	68	69	71	76	80	81	87	90	94	95	3-299-26
4	2'6"-3'6"	CL	44	19	64 100	73	77	78	80	84	86	89	95	97	99	99	3-299-29
5	4'6"-5'2"	SM	59	18	30 100	38	44	47	51	60	68	72	86	91	98	99	3-299-33
6	2'6"-3'6"	CL	43	18	72	80	84	85	87	90	93	94	98	99	100		3-299-36
7	2'6"-3'6"	SC	41	19	26 100	29	33	35	36	44	52	56	81	90	97	98	3-299-40

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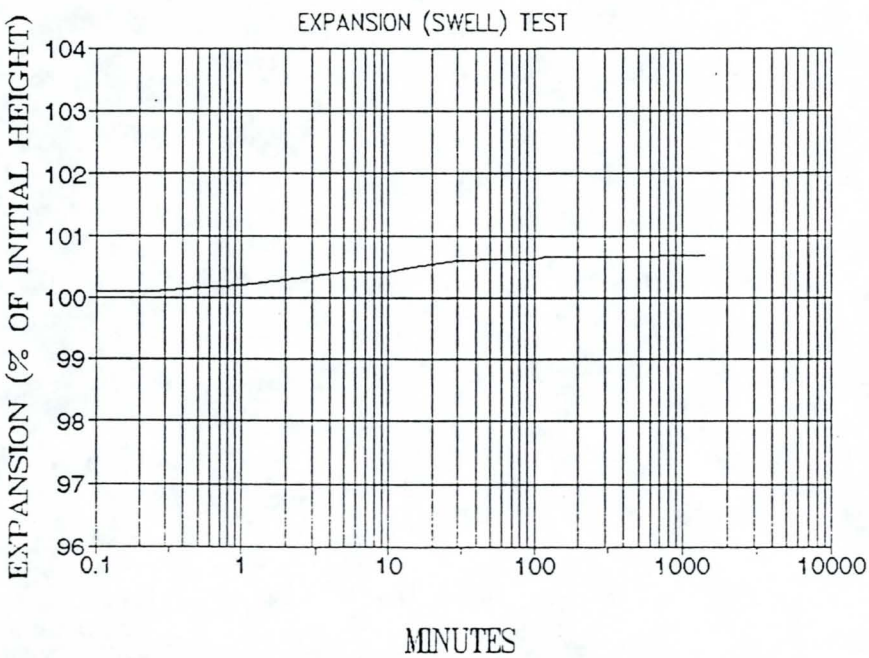
PROJECT:	ADOBE DAM BASIN	**JOB NO.**	E93-299
SAMPLE:	#4 @ 2'6" TO 3'6"	**W.O. NO.**	3
		LAB NO.	29
		DATE	1/10/94
METHOD :	B		
LOAD:	1 psi / INSITU		

ONE DIMENSIONAL SWELL OR SETTLEMENT OF SOILS (ASTM D-4546)

INITIAL DRY DENSITY	92.85 pcf
FINAL DRY DENSITY	92.22 pcf
INITIAL MOISTURE CONTENT	9.5%
FINAL MOISTURE CONTENT	31.6%
MOIST. PICK-UP (% DRY WT.)	22.1%
MOIST. PICK-UP (% IN. VOL.)	32.8%
SWELL (% INITAL HT.)	0.68%



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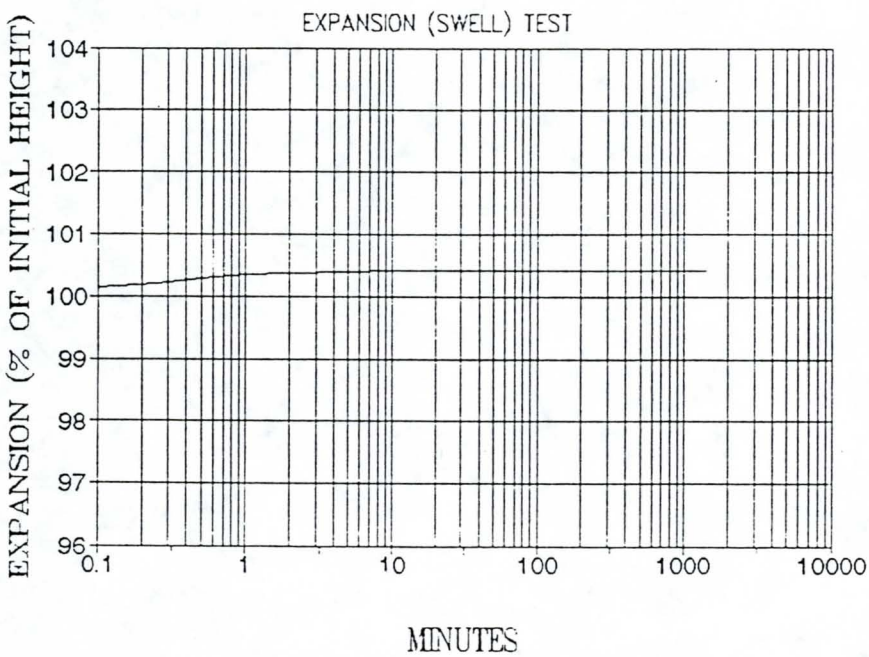
PROJECT:	ADOBE DAM BASIN	JOB NO.	E93-299
SAMPLE:	#6 @ 2'6" TO 3'6"	W.O. NO.	3
		LAB NO.	36
		DATE	1/10/94
METHOD :	B		
LOAD:	1 psi / INSITU		

ONE DIMENSIONAL SWELL OR SETTLEMENT OF SOILS (ASTM D-4546)

INITIAL DRY DENSITY	89.97 pcf
FINAL DRY DENSITY	89.60 pcf
INITIAL MOISTURE CONTENT	8.4%
FINAL MOISTURE CONTENT	29.9%
MOIST. PICK-UP (% DRY WT.)	21.4%
MOIST. PICK-UP (% IN. VOL.)	30.9%
SWELL (% INITAL HT.)	0.42%



AGRA
Earth & Environmental Group

BORING NO./SAMPLE NO.	E93-299-1			E93-299-3											
DESCRIPTION	Red brown SILTY CLAY			Red brown SILTY CLAY											
UNIFIED SOIL CLASSIFICATION															
DIRECT SHEAR TEST (type)															
Initial Moisture Content %															
Test Moisture Content %															
Normal Stress (lbs./sq.ft.)															
Peak Shear Stress (lbs./sq.ft.)															
Ultimate Shear Stress (lbs./sq.ft.)															
Angle of Internal Friction (degrees)															
Cohesion (lbs./sq.ft.)															
EXPANSION TEST	UBC-29-2			UBC-29-2											
Initial Dry Density (lbs./cu.ft.)	95.9			95.0											
Initial Moisture %	14.0			14.5											
Final Moisture %	33.6			28.6											
Pressure (lbs./sq.ft.)	144			144											
Expansion Index Swell %	153	15.3		78	7.8										
CORROSIVITY TEST															
Resistivity (ohm-cm)															
pH															
CHEMICAL TEST															
Soluble Sulphate %															

Appendix 4

Hydrology Report

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Interoffice Memorandum

Date : November 23, 1993

To : Amir Motamedi
Marty Bressor

From : Hasan Mushtaq

Re : Adobe Dam, Channel and Fill Project Hydrology Identification.

Following is a hydrologic report on the above mentioned project. Also attached are the necessary tables, figures, and HEC-1 hardcopy outputs. The input data are also available in diskettes. Please do not hesitate to contact me for further information.

Introduction :

The excavation of the detention basin project is located in between 51st Avenue and a vertical line some 300′ east of 47th Avenue. The project area is to the south of the Pinnacle Peak Road which lies within T4N and R2E.

Background Information :

The following is a comprehensive research effort for determining the hydrology on the project area based on the available information.

The earliest report compiled on the area (Adobe Dam) was prepared by the U.S. Army Engineer District, Los Angeles, Corps of Engineers (1965). The floodplain information from that report show that the project area was included in a bigger basin area for the purposes of the study (Figure 1). The design of the Adobe Dam was documented in *Adobe Dam (including Skunk Creek to the Arizona Canal, 1979).* The floodplain delineation reported in this study shows that a part of the project area lies within the Standard Project Flood (SPF) Flood Pool Level (Figure 2). The depth of SPF flood pool was set at 1377.80′ which follows the pattern shown in Figure 3.

HEC-1 Modeling Results :

A more recent study, *Little Deer Valley (Conceptual drainage plan, I & II, 1990),* which includes the area of interest, was performed as a part of the drainage and flood control plan for the area for the City of Phoenix areas C & D. Figure 4a shows the location of the project area and the boundary of the watershed. The watershed was broken into 8 smaller sub-basins for the purposes of modeling using HEC-1 (Figure 4b). Figure 4c shows the further division of the sub-basins which helped determine the flow paths and concentration points. These flow paths and concentration points are shown in Figure 4d. Three different cases were considered in this study.

(I) Existing conditions : Existing watershed condition for the 100-year 24-hour storm duration.

(II) Proposed conditions : Proposed watershed development conditions for the 100-year 24-hour storm.

(III) Existing conditions with the Proposed Improvements : Existing watershed condition with the implementation of both 100-year drainage plan and 2-year storm drain plan.

According to the report, Case III (Appendix C), is the most critical situation. This is based on the assumption that the City of Phoenix enforces it's on-site retention policy. In such cases, the existing conditions are the most critical conditions. Because, any modification of land use types resulting in any excess runoff volumes will be retained on-site.

Given the above facts, Case III accounts for the existing land use types while implementing the 100-year conceptual drainage plan and the 2-year storm drain plan for the Little Deer Valley watershed. The section of the Pinnacle Peak road of most interest is drained by both basins 5 and 6. The contributing area for basin 5 is 1.79 square miles; while the contributing area for basin 6 is 2.57 square miles. During the analysis of cases I and II, the 2-year storm drains were not included in the model; and the combined flow at CP 35.5 was diverted 50% into basin 6. This flow was retrieved and later added to the hydrograph at CP 46.

In the proposed 2-year storm drain plan, it was assumed that the combined flow at CP 35.5 will drain through the design storm drain located at CP 35.5. As a result, the flow diversion at CP 35.5 is no longer required, and so was the addition of the diverted flow at CP 46 in basin 6. On the other hand, flows from basin 6 concentrate at CP 46, which will be drained through a storm drain located at that point. Both the storm drains empty into the Adobe Dam recreation area. The hydrographs at these CP's are available from the HEC-1 analysis. Appendix 1 includes the HEC-1 outputs showing the hydrographs. Following Table 1 lists the 100-year 24-hour and 2-year 24-hour discharges for different concentration points in basins 5 & 6. Figures 5 & 6 show the project area with existing conditions and proposed improvements.

The associated results are based on case III (existing conditions and proposed improvements). The HEC-1 models were set up accordingly for a design storm of 100-year 24-hour (Appendix 1a & 1b). Later on, the HEC-1 modeling was extended to include the 2-year 24-hour storm (Appendix 1c & 1d). Both storms were treated as SCS Type IIA storms.

Further research show that if the future land use conditions (Case II) is combined with the Proposed Improvements, with the assumption that the City of Phoenix does not enforce it's on-site retention policy, the total runoff peak and volume are higher than that of Case III. The results are listed in Table 2.

References :

U.S. Army Engineer District, (1965), "Flood Plain Information Study for Maricopa County, Arizona (Skunk Creek Report, Volume III)", Report No. 23.1-00-8-04/65, March.

U.S. Army Engineer District, (1979), "New River and Phoenix City Streams, Arizona, Adobe Dam", Design memorandum No. 3, April.

Collar, Williams and White Engineering, (1990), "Area Drainage Master Study : Little Deer Valley (Volume I & II).", Report No. 23ldvcww0490, July.

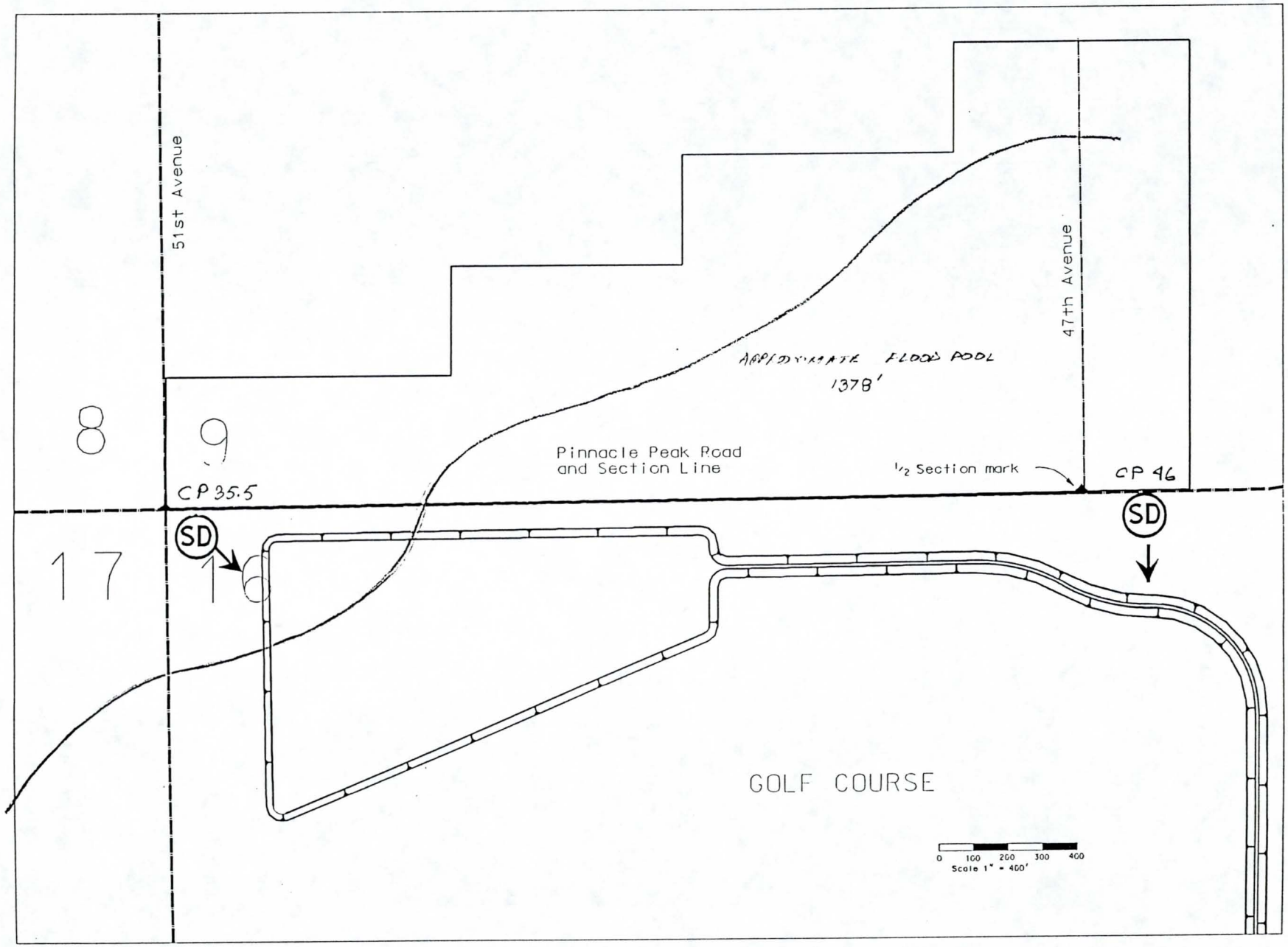
Table 1 Peak Discharges and Concentration Points.

			Existing Conditions and Proposed Improvements.	
Basin	Sub Basin	Concentration Points	2-year Discharges (cfs)	100-year Discharge (cfs)
5	5.1	29	39	357
	5.2	29.5	13	93
	5.1-5.2	30	40	400
	5.3	30.5	7	109
	5.1-5.3	31	43	440
	5.1-5.41	32	50	531
	5.4	33	89	693
	5.1-5.4	34	137	1091
	5.5	35	26	282
	5.1-5.5	35.5	155	1373
6	6.1	36	45	449
	6.1-6.2	37	30	390
	6.5	38	10	158
	6.1-6.2,6.5	39	43	579
	6.3	40	34	313
	6.3-6.4	41	38	395
	6.1-6.5	42	81	960
	6.1-6.6	43	83	988
	6.1-6.6	44	106	1137
	6.1-6.7	45	96	1118
	6.1-6.7	46	109	1340

Table 2 Peak Discharges and Concentration Points.

			Future Conditions and Proposed Improvements.	
Basin	Sub Basin	Concentration Points	2-year Discharges (cfs)	100-year Discharge (cfs)
5	5.1	29	65	398
	5.2	29.5	18	101
	5.1-5.2	30	69	447
	5.3	30.5	49	185
	5.1-5.3	31	105	540
	5.1-5.41	32	108	636
	5.4	33	146	799
	5.1-5.4	34	204	1286
	5.5	35	40	306
	5.1-5.5	35.5	238	1589
6	6.1	36	74	493
	6.1-6.2	37	56	439
	6.5	38	37	208
	6.1-6.2,6.5	39	131	737
	6.3	40	58	351
	6.3-6.4	41	96	494
	6.1-6.5	42	227	1217
	6.1-6.6	43	243	1274
	6.1-6.6	44	275	1437
	6.1-6.7	45	262	1418
	6.1-6.7	46	290	1684

FIRM PANNEL # 1185



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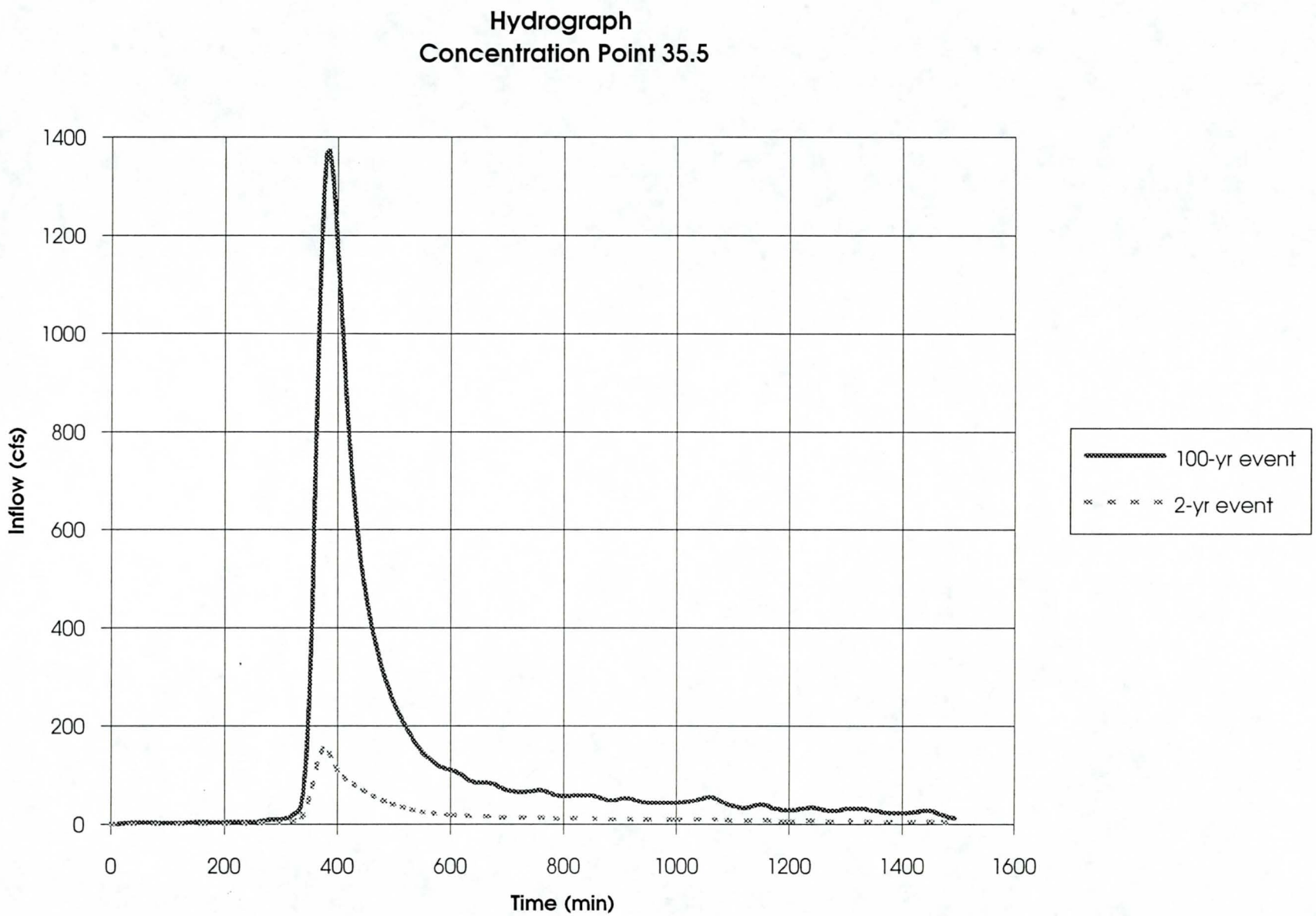
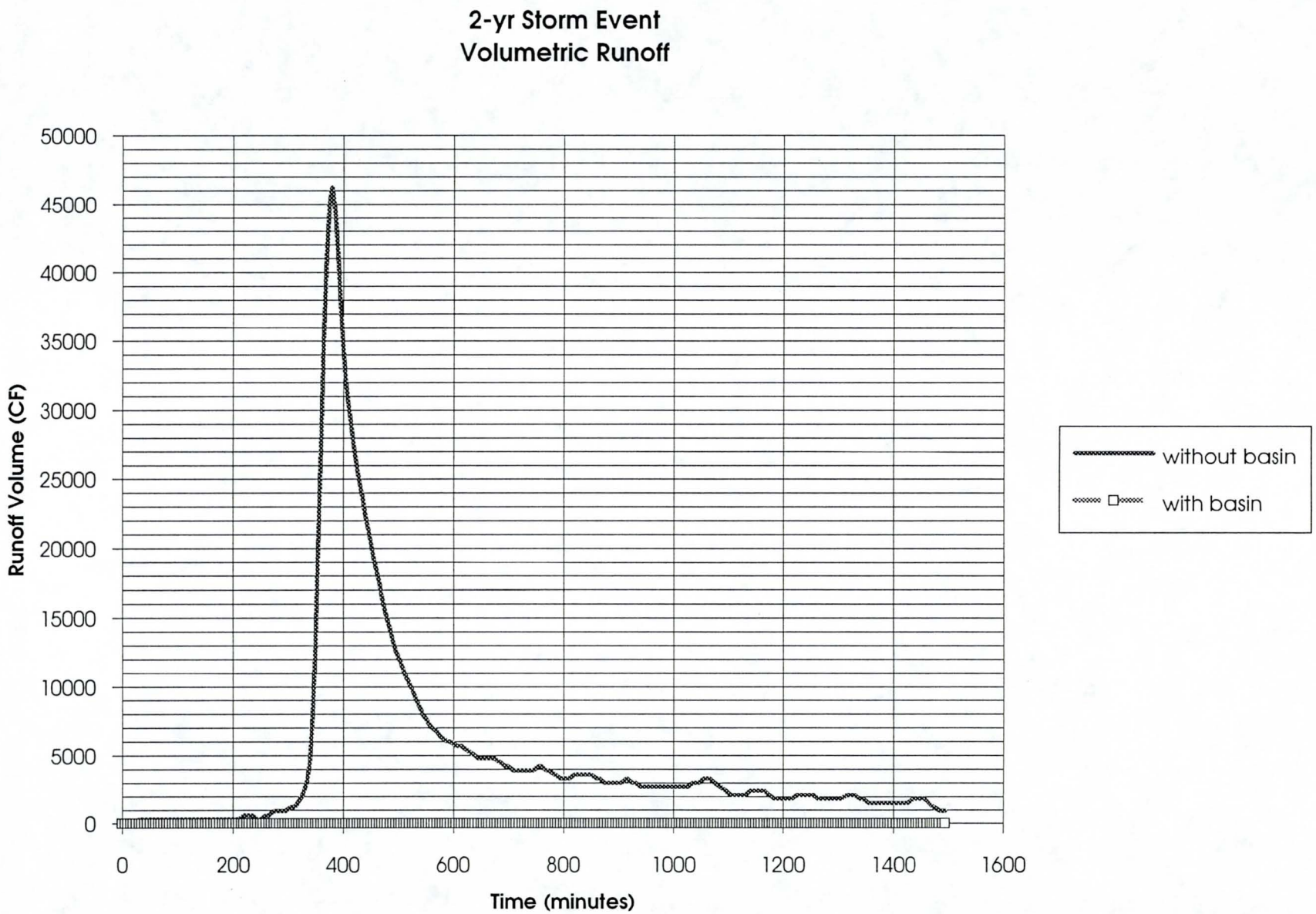
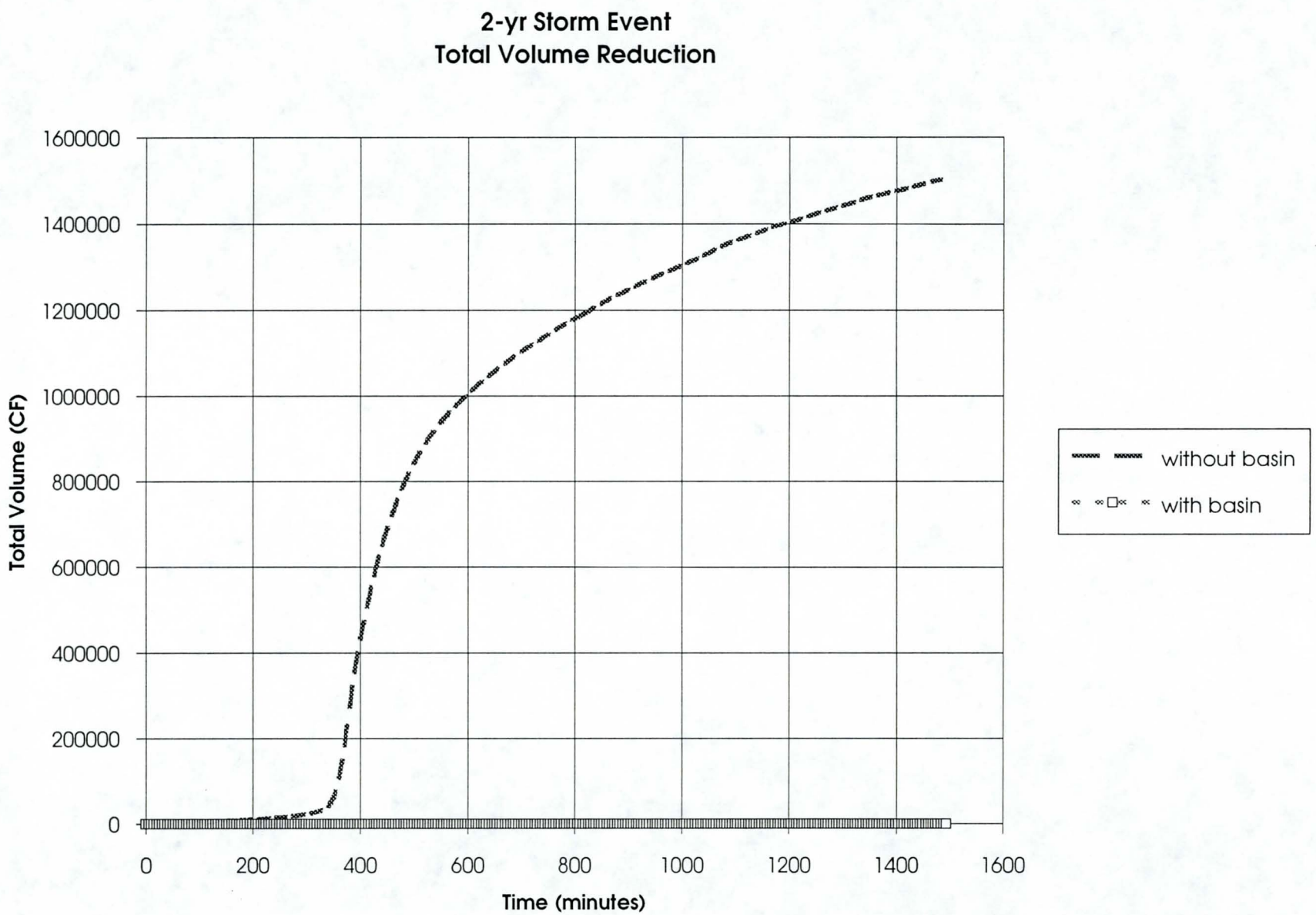


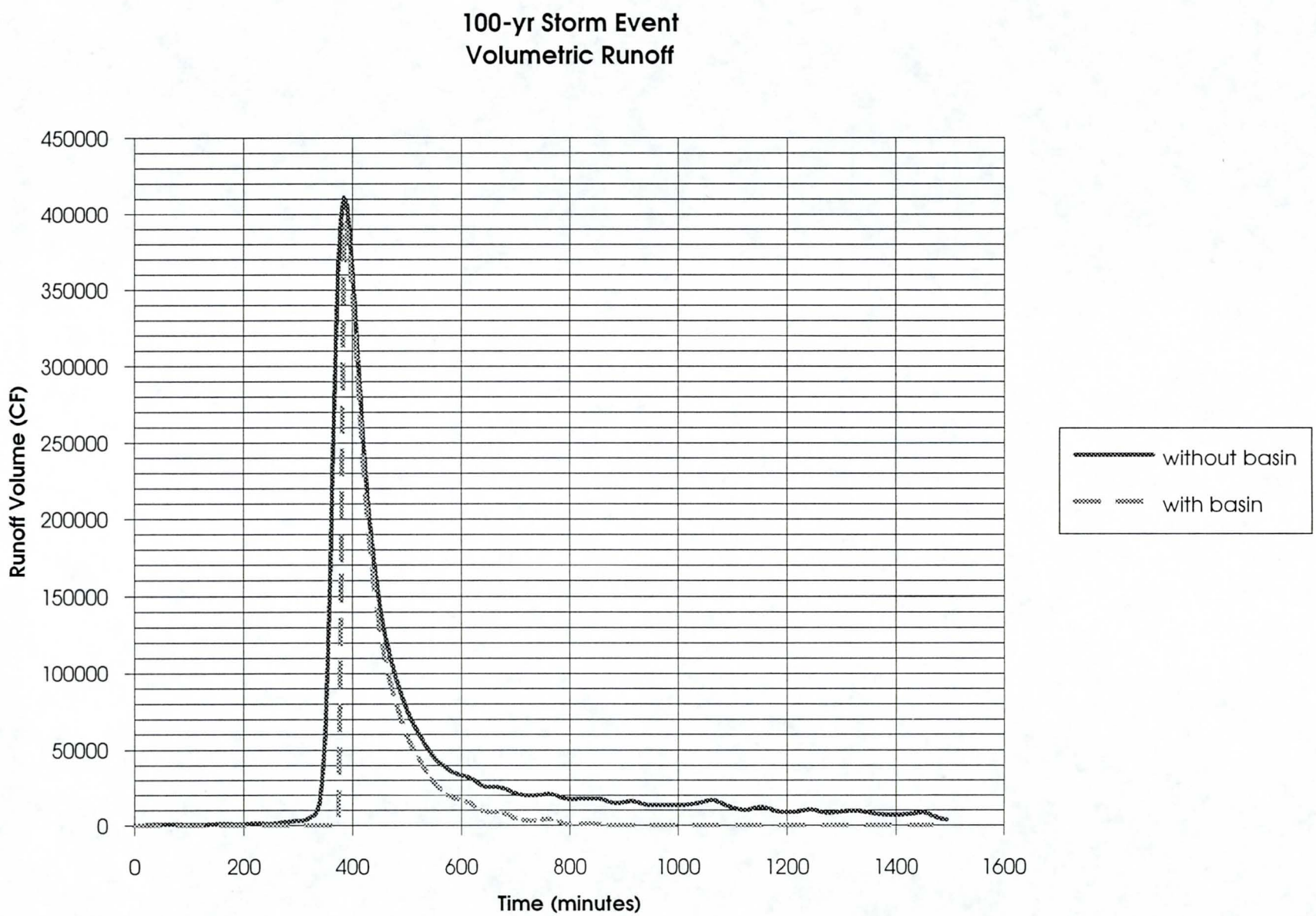
adobe\HYDROS.XLS Chart 1 3/3/94



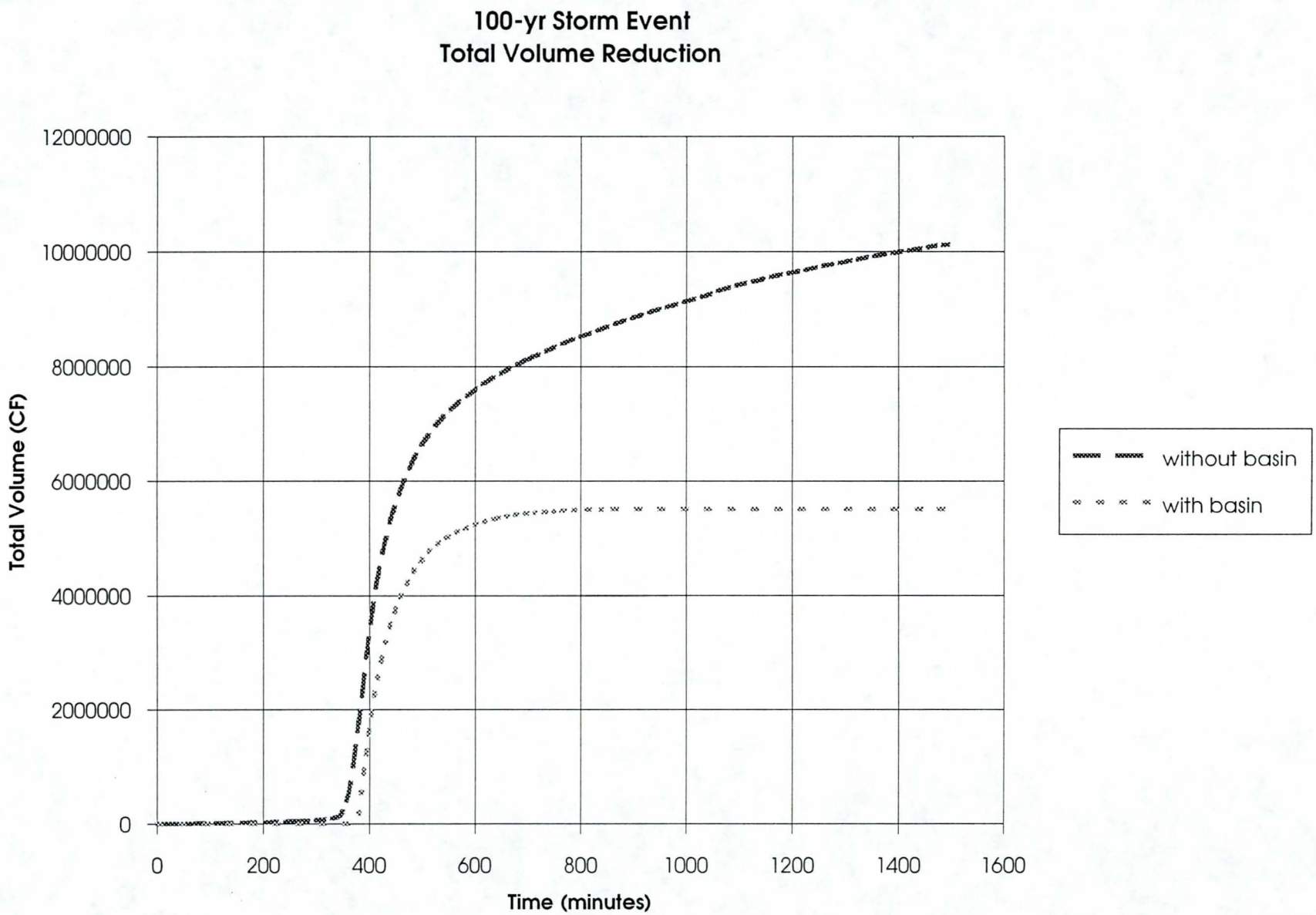
\adobe\HYDROS.XLS Chart 6 3/3/94



\adobe\HYDROS.XLS Chart 5 3/3/94



\adobe\HYDROS.XLS Chart 3 3/3/94



\adobe\HYDROS.XLS Chart 2 3/3/94

Concentration Point 35.5								
Time (min)	100-yr Q inflow (cfs)	Incremental Inflow Volume (CF)	Initial Cumulative Volume (CF)	Q outflow (cfs)	Secondary Cumulative Volume (CF)	True Volume (CF)	Overflow (cf)	Total Overflow Volume
0	0	0	0	0.0	0	0	0	0
5	0	0	0	0.0	0	0	0	0
10	0	0	0	0.0	0	0	0	0
15	1	150	150	0.0	150	150	0	0
20	1	300	450	0.0	450	450	0	0
25	2	450	900	0.0	900	900	0	0
30	2	600	1500	0.0	1500	1500	0	0
35	3	750	2250	0.0	2250	2250	0	0
40	3	900	3150	0.2	3120	3120	0	0
45	3	900	4050	0.2	3960	3960	0	0
50	3	900	4950	0.2	4800	4800	0	0
55	3	900	5850	0.2	5640	5640	0	0
60	3	900	6750	0.2	6480	6480	0	0
65	3	900	7650	0.2	7320	7320	0	0
70	3	900	8550	0.9	8063	8063	0	0
75	3	900	9450	0.9	8708	8708	0	0
80	3	900	10350	0.9	9353	9353	0	0
85	2	750	11100	0.9	9848	9848	0	0
90	2	600	11700	0.9	10193	10193	0	0
95	2	600	12300	0.9	10538	10538	0	0
100	2	600	12900	0.9	10883	10883	0	0
105	2	600	13500	0.9	11228	11228	0	0
110	2	600	14100	0.9	11573	11573	0	0
115	2	600	14700	0.9	11918	11918	0	0
120	2	600	15300	0.9	12263	12263	0	0
125	2	600	15900	0.9	12608	12608	0	0
130	2	600	16500	0.9	12953	12953	0	0
135	3	750	17250	0.9	13448	13448	0	0
140	3	900	18150	0.9	14093	14093	0	0
145	3	900	19050	0.9	14738	14738	0	0
150	4	1050	20100	0.9	15533	15533	0	0
155	4	1200	21300	2.0	16311	16311	0	0
160	4	1200	22500	2.0	16923	16923	0	0
165	4	1200	23700	2.0	17535	17535	0	0
170	4	1200	24900	2.0	18147	18147	0	0
175	3	1050	25950	2.0	18609	18609	0	0
180	3	900	26850	2.0	18921	18921	0	0
185	3	900	27750	2.0	19233	19233	0	0
190	3	900	28650	2.0	19545	19545	0	0
195	3	900	29550	2.0	19857	19857	0	0
200	3	900	30450	2.0	20169	20169	0	0
205	4	1050	31500	2.0	20631	20631	0	0
210	4	1200	32700	2.0	21243	21243	0	0
215	5	1350	34050	2.0	22005	22005	0	0
220	5	1500	35550	2.0	22917	22917	0	0
225	5	1500	37050	2.0	23829	23829	0	0
230	5	1500	38550	2.0	24741	24741	0	0
235	4	1350	39900	2.0	25503	25503	0	0

Concentration Point 35.5								
Time (min)	100-yr Q inflow (cfs)	Incremental Inflow Volume (CF)	Initial Cumulative Volume (CF)	Q outflow (cfs)	Secondary Cumulative Volume (CF)	True Volume (CF)	Overflow (cf)	Total Overflow Volume
240	4	1200	41100	2.0	26115	26115	0	0
245	4	1200	42300	2.0	26727	26727	0	0
250	4	1200	43500	2.0	27339	27339	0	0
255	5	1350	44850	3.5	27873	27873	0	0
260	5	1500	46350	3.5	28329	28329	0	0
265	6	1650	48000	3.5	28935	28935	0	0
270	7	1950	49950	3.5	29841	29841	0	0
275	8	2250	52200	3.5	31047	31047	0	0
280	9	2550	54750	3.5	32553	32553	0	0
285	9	2700	57450	3.5	34209	34209	0	0
290	10	2850	60300	3.5	36015	36015	0	0
295	10	3000	63300	3.5	37971	37971	0	0
300	10	3000	66300	3.5	39927	39927	0	0
305	11	3150	69450	3.5	42033	42033	0	0
310	12	3450	72900	3.5	44439	44439	0	0
315	14	3900	76800	5.4	47012	47012	0	0
320	18	4800	81600	5.4	50201	50201	0	0
325	21	5850	87450	5.4	54440	54440	0	0
330	25	6900	94350	5.4	59729	59729	0	0
335	35	9000	103350	5.4	67118	67118	0	0
340	64	14850	118200	7.5	80031	80031	0	0
345	134	29700	147900	7.5	107469	107469	0	0
350	259	58950	206850	9.9	163797	163797	0	0
355	442	105150	312000	12.5	265586	265586	0	0
360	677	167850	479850	17.6	428933	428933	0	0
365	921	239700	719550	23.4	662493	662493	0	0
370	1140	309150	1028700	32.0	963344	963344	0	0
375	1294	365100	1393800	46.5	1316684	1316684	0	0
380	1367	399150	1792950	53.8	1700796	1530195	170601	170601
385	1373	411000	2203950	55.7	1924772	1530195	394577	565178
390	1332	405750	2609700	55.7	1919238	1530195	389043	954221
395	1260	388800	2998500	55.7	1902288	1530195	372093	1326314
400	1170	364500	3363000	55.7	1877988	1530195	347793	1674107
405	1076	336900	3699900	55.7	1850388	1530195	320193	1994300
410	977	307950	4007850	55.7	1821438	1530195	291243	2285543
415	883	279000	4286850	55.7	1792488	1530195	262293	2547836
420	796	251850	4538700	55.7	1765338	1530195	235143	2782979
425	719	227250	4765950	55.7	1740738	1530195	210543	2993522
430	652	205650	4971600	55.7	1719138	1530195	188943	3182465
435	594	186900	5158500	55.7	1700388	1530195	170193	3352658
440	544	170700	5329200	55.7	1684188	1530195	153993	3506651
445	501	156750	5485950	55.7	1670238	1530195	140043	3646694
450	464	144750	5630700	55.7	1658238	1530195	128043	3774737
455	432	134400	5765100	55.7	1647888	1530195	117693	3892430
460	404	125400	5890500	55.7	1638888	1530195	108693	4001123
465	378	117300	6007800	55.7	1630788	1530195	100593	4101716
470	354	109800	6117600	55.7	1623288	1530195	93093	4194809
475	332	102900	6220500	55.7	1616388	1530195	86193	4281002

Concentration Point 35.5								
Time (min)	100-yr Q inflow (cfs)	Incremental Inflow Volume (CF)	Initial Cumulative Volume (CF)	Q outflow (cfs)	Secondary Cumulative Volume (CF)	True Volume (CF)	Overflow (cf)	Total Overflow Volume
480	311	96450	6316950	55.7	1609938	1530195	79743	4360745
485	293	90600	6407550	55.7	1604088	1530195	73893	4434638
490	276	85350	6492900	55.7	1598838	1530195	68643	4503281
495	260	80400	6573300	55.7	1593888	1530195	63693	4566974
500	246	75900	6649200	55.7	1589388	1530195	59193	4626167
505	232	71700	6720900	55.7	1585188	1530195	54993	4681160
510	221	67950	6788850	55.7	1581438	1530195	51243	4732403
515	210	64650	6853500	55.7	1578138	1530195	47943	4780346
520	199	61350	6914850	55.7	1574838	1530195	44643	4824989
525	189	58200	6973050	55.7	1571688	1530195	41493	4866482
530	179	55200	7028250	55.7	1568688	1530195	38493	4904975
535	170	52350	7080600	55.7	1565838	1530195	35643	4940618
540	161	49650	7130250	55.7	1563138	1530195	32943	4973561
545	154	47250	7177500	55.7	1560738	1530195	30543	5004104
550	147	45150	7222650	55.7	1558638	1530195	28443	5032547
555	141	43200	7265850	55.7	1556688	1530195	26493	5059040
560	136	41550	7307400	55.7	1555038	1530195	24843	5083883
565	131	40050	7347450	55.7	1553538	1530195	23343	5107226
570	126	38550	7386000	55.7	1552038	1530195	21843	5129069
575	122	37200	7423200	55.7	1550688	1530195	20493	5149562
580	119	36150	7459350	55.7	1549638	1530195	19443	5169005
585	116	35250	7494600	55.7	1548738	1530195	18543	5187548
590	114	34500	7529100	55.7	1547988	1530195	17793	5205341
595	112	33900	7563000	55.7	1547388	1530195	17193	5222534
600	111	33450	7596450	55.7	1546938	1530195	16743	5239277
605	109	33000	7629450	55.7	1546488	1530195	16293	5255570
610	107	32400	7661850	55.7	1545888	1530195	15693	5271263
615	104	31650	7693500	55.7	1545138	1530195	14943	5286206
620	101	30750	7724250	55.7	1544238	1530195	14043	5300249
625	97	29700	7753950	55.7	1543188	1530195	12993	5313242
630	93	28500	7782450	55.7	1541988	1530195	11793	5325035
635	89	27300	7809750	55.7	1540788	1530195	10593	5335628
640	87	26400	7836150	55.7	1539888	1530195	9693	5345321
645	85	25800	7861950	55.7	1539288	1530195	9093	5354414
650	85	25500	7887450	55.7	1538988	1530195	8793	5363207
655	85	25500	7912950	55.7	1538988	1530195	8793	5372000
660	85	25500	7938450	55.7	1538988	1530195	8793	5380793
665	85	25500	7963950	55.7	1538988	1530195	8793	5389586
670	84	25350	7989300	55.7	1538838	1530195	8643	5398229
675	83	25050	8014350	55.7	1538538	1530195	8343	5406572
680	81	24600	8038950	55.7	1538088	1530195	7893	5414465
685	78	23850	8062800	55.7	1537338	1530195	7143	5421608
690	75	22950	8085750	55.7	1536438	1530195	6243	5427851
695	72	22050	8107800	55.7	1535538	1530195	5343	5433194
700	70	21300	8129100	55.7	1534788	1530195	4593	5437787
705	69	20850	8149950	55.7	1534338	1530195	4143	5441930
710	68	20550	8170500	55.7	1534038	1530195	3843	5445773
715	67	20250	8190750	55.7	1533738	1530195	3543	5449316

Concentration Point 35.5								
Time (min)	100-yr	Incremental Inflow Volume	Initial Cumulative Volume		Secondary Cumulative Volume	True Volume	Overflow	Total Overflow Volume
	Q inflow (cfs)	(CF)	(CF)	Q outflow (cfs)	(CF)	(CF)	(cf)	
720	66	19950	8210700	55.7	1533438	1530195	3243	5452559
725	66	19800	8230500	55.7	1533288	1530195	3093	5455652
730	66	19800	8250300	55.7	1533288	1530195	3093	5458745
735	67	19950	8270250	55.7	1533438	1530195	3243	5461988
740	67	20100	8290350	55.7	1533588	1530195	3393	5465381
745	68	20250	8310600	55.7	1533738	1530195	3543	5468924
750	69	20550	8331150	55.7	1534038	1530195	3843	5472767
755	70	20850	8352000	55.7	1534338	1530195	4143	5476910
760	70	21000	8373000	55.7	1534488	1530195	4293	5481203
765	69	20850	8393850	55.7	1534338	1530195	4143	5485346
770	67	20400	8414250	55.7	1533888	1530195	3693	5489039
775	65	19800	8434050	55.7	1533288	1530195	3093	5492132
780	62	19050	8453100	55.7	1532538	1530195	2343	5494475
785	60	18300	8471400	55.7	1531788	1530195	1593	5496068
790	59	17850	8489250	55.7	1531338	1530195	1143	5497211
795	58	17550	8506800	55.7	1531038	1530195	843	5498054
800	58	17400	8524200	55.7	1530888	1530195	693	5498747
805	58	17400	8541600	55.7	1530888	1530195	693	5499440
810	58	17400	8559000	55.7	1530888	1530195	693	5500133
815	59	17550	8576550	55.7	1531038	1530195	843	5500976
820	59	17700	8594250	55.7	1531188	1530195	993	5501969
825	59	17700	8611950	55.7	1531188	1530195	993	5502962
830	59	17700	8629650	55.7	1531188	1530195	993	5503955
835	59	17700	8647350	55.7	1531188	1530195	993	5504948
840	59	17700	8665050	55.7	1531188	1530195	993	5505941
845	59	17700	8682750	55.7	1531188	1530195	993	5506934
850	59	17700	8700450	55.7	1531188	1530195	993	5507927
855	58	17550	8718000	55.7	1531038	1530195	843	5508770
860	56	17100	8735100	55.7	1530588	1530195	393	5509163
865	54	16500	8751600	55.7	1529988	1529988	0	5509163
870	52	15900	8767500	55.7	1529181	1529181	0	5509163
875	50	15300	8782800	55.7	1527774	1527774	0	5509163
880	49	14850	8797650	55.7	1525917	1525917	0	5509163
885	49	14700	8812350	55.7	1523910	1523910	0	5509163
890	49	14700	8827050	55.7	1521903	1521903	0	5509163
895	50	14850	8841900	55.7	1520046	1520046	0	5509163
900	52	15300	8857200	55.7	1518639	1518639	0	5509163
905	53	15750	8872950	55.7	1517682	1517682	0	5509163
910	53	15900	8888850	55.7	1516875	1516875	0	5509163
915	53	15900	8904750	55.7	1516068	1516068	0	5509163
920	52	15750	8920500	55.7	1515111	1515111	0	5509163
925	50	15300	8935800	55.7	1513704	1513704	0	5509163
930	48	14700	8950500	55.7	1511697	1511697	0	5509163
935	47	14250	8964750	55.7	1509240	1509240	0	5509163
940	45	13800	8978550	55.7	1506333	1506333	0	5509163
945	45	13500	8992050	55.7	1503126	1503126	0	5509163
950	44	13350	9005400	55.7	1499769	1499769	0	5509163
955	44	13200	9018600	55.7	1496262	1496262	0	5509163

Concentration Point 35.5								
Time (min)	100-yr Q inflow (cfs)	Incremental Inflow Volume (CF)	Initial Cumulative Volume (CF)	Q outflow (cfs)	Secondary Cumulative Volume (CF)	True Volume (CF)	Overflow (cf)	Total Overflow Volume
960	44	13200	9031800	55.7	1492755	1492755	0	5509163
965	44	13200	9045000	55.7	1489248	1489248	0	5509163
970	44	13200	9058200	55.7	1485741	1485741	0	5509163
975	44	13200	9071400	55.7	1482234	1482234	0	5509163
980	44	13200	9084600	55.7	1478727	1478727	0	5509163
985	44	13200	9097800	55.7	1475220	1475220	0	5509163
990	44	13200	9111000	55.7	1471713	1471713	0	5509163
995	44	13200	9124200	55.7	1468206	1468206	0	5509163
1000	44	13200	9137400	55.7	1464699	1464699	0	5509163
1005	45	13350	9150750	55.7	1461342	1461342	0	5509163
1010	45	13500	9164250	55.7	1458135	1458135	0	5509163
1015	46	13650	9177900	55.7	1455078	1455078	0	5509163
1020	46	13800	9191700	55.7	1452171	1452171	0	5509163
1025	47	13950	9205650	55.7	1449414	1449414	0	5509163
1030	48	14250	9219900	55.7	1446957	1446957	0	5509163
1035	49	14550	9234450	55.7	1444800	1444800	0	5509163
1040	51	15000	9249450	55.7	1443093	1443093	0	5509163
1045	52	15450	9264900	55.7	1441836	1441836	0	5509163
1050	54	15900	9280800	55.7	1441029	1441029	0	5509163
1055	55	16350	9297150	55.7	1440672	1440672	0	5509163
1060	56	16650	9313800	55.7	1440615	1440615	0	5509163
1065	55	16650	9330450	55.7	1440558	1440558	0	5509163
1070	53	16200	9346650	55.7	1440051	1440051	0	5509163
1075	50	15450	9362100	55.7	1438794	1438794	0	5509163
1080	47	14550	9376650	55.7	1436637	1436637	0	5509163
1085	45	13800	9390450	55.7	1433730	1433730	0	5509163
1090	42	13050	9403500	55.7	1430073	1430073	0	5509163
1095	40	12300	9415800	55.7	1425666	1425666	0	5509163
1100	38	11700	9427500	55.7	1420659	1420659	0	5509163
1105	37	11250	9438750	53.8	1415486	1415486	0	5509163
1110	35	10800	9449550	53.8	1410146	1410146	0	5509163
1115	34	10350	9459900	53.8	1404356	1404356	0	5509163
1120	33	10050	9469950	53.8	1398266	1398266	0	5509163
1125	34	10050	9480000	53.8	1392176	1392176	0	5509163
1130	35	10350	9490350	53.8	1386386	1386386	0	5509163
1135	37	10800	9501150	53.8	1381046	1381046	0	5509163
1140	39	11400	9512550	53.8	1376306	1376306	0	5509163
1145	40	11850	9524400	53.8	1372016	1372016	0	5509163
1150	41	12150	9536550	53.8	1368026	1368026	0	5509163
1155	40	12150	9548700	53.8	1364036	1364036	0	5509163
1160	39	11850	9560550	53.8	1359746	1359746	0	5509163
1165	37	11400	9571950	53.8	1355006	1355006	0	5509163
1170	34	10650	9582600	53.8	1349516	1349516	0	5509163
1175	32	9900	9592500	53.8	1343276	1343276	0	5509163
1180	31	9450	9601950	53.8	1336586	1336586	0	5509163
1185	30	9150	9611100	53.8	1329596	1329596	0	5509163
1190	29	8850	9619950	53.8	1322306	1322306	0	5509163
1195	29	8700	9628650	53.8	1314866	1314866	0	5509163

Concentration Point 35.5								
Time (min)	100-yr Q inflow (cfs)	Incremental Inflow Volume (CF)	Initial Cumulative Volume (CF)	Q outflow (cfs)	Secondary Cumulative Volume (CF)	True Volume (CF)	Overflow (cf)	Total Overflow Volume
1200	29	8700	9637350	53.8	1307426	1307426	0	5509163
1205	29	8700	9646050	53.8	1299986	1299986	0	5509163
1210	29	8700	9654750	51.7	1292864	1292864	0	5509163
1215	30	8850	9663600	51.7	1286210	1286210	0	5509163
1220	31	9150	9672750	51.7	1279856	1279856	0	5509163
1225	32	9450	9682200	51.7	1273802	1273802	0	5509163
1230	33	9750	9691950	51.7	1268048	1268048	0	5509163
1235	34	10050	9702000	51.7	1262594	1262594	0	5509163
1240	35	10350	9712350	51.7	1257440	1257440	0	5509163
1245	34	10350	9722700	51.7	1252286	1252286	0	5509163
1250	33	10050	9732750	51.7	1246832	1246832	0	5509163
1255	32	9750	9742500	51.7	1241078	1241078	0	5509163
1260	30	9300	9751800	51.7	1234874	1234874	0	5509163
1265	29	8850	9760650	51.7	1228220	1228220	0	5509163
1270	28	8550	9769200	51.7	1221266	1221266	0	5509163
1275	27	8250	9777450	51.7	1214012	1214012	0	5509163
1280	28	8250	9785700	51.7	1206758	1206758	0	5509163
1285	28	8400	9794100	51.7	1199654	1199654	0	5509163
1290	29	8550	9802650	51.7	1192700	1192700	0	5509163
1295	30	8850	9811500	51.7	1186046	1186046	0	5509163
1300	31	9150	9820650	49.2	1180058	1180058	0	5509163
1305	31	9300	9829950	49.2	1174586	1174586	0	5509163
1310	32	9450	9839400	49.2	1169264	1169264	0	5509163
1315	32	9600	9849000	49.2	1164092	1164092	0	5509163
1320	32	9600	9858600	49.2	1158920	1158920	0	5509163
1325	32	9600	9868200	49.2	1153748	1153748	0	5509163
1330	32	9600	9877800	49.2	1148576	1148576	0	5509163
1335	32	9600	9887400	49.2	1143404	1143404	0	5509163
1340	30	9300	9896700	49.2	1137932	1137932	0	5509163
1345	29	8850	9905550	49.2	1132010	1132010	0	5509163
1350	28	8550	9914100	49.2	1125788	1125788	0	5509163
1355	27	8250	9922350	49.2	1119266	1119266	0	5509163
1360	26	7950	9930300	49.2	1112444	1112444	0	5509163
1365	25	7650	9937950	49.2	1105322	1105322	0	5509163
1370	24	7350	9945300	49.2	1097900	1097900	0	5509163
1375	24	7200	9952500	49.2	1090328	1090328	0	5509163
1380	23	7050	9959550	49.2	1082606	1082606	0	5509163
1385	23	6900	9966450	49.2	1074734	1074734	0	5509163
1390	23	6900	9973350	49.2	1066862	1066862	0	5509163
1395	23	6900	9980250	46.5	1059408	1059408	0	5509163
1400	23	6900	9987150	46.5	1052373	1052373	0	5509163
1405	23	6900	9994050	46.5	1045338	1045338	0	5509163
1410	24	7050	10001100	46.5	1038453	1038453	0	5509163
1415	24	7200	10008300	46.5	1031718	1031718	0	5509163
1420	25	7350	10015650	46.5	1025133	1025133	0	5509163
1425	25	7500	10023150	46.5	1018698	1018698	0	5509163
1430	26	7650	10030800	46.5	1012413	1012413	0	5509163
1435	27	7950	10038750	46.5	1006428	1006428	0	5509163

Concentration Point 35.5								
Time (min)	100-yr	Incremental Inflow Volume	Initial Cumulative Volume		Secondary Cumulative Volume	True Volume	Overflow	Total Overflow Volume
	Q inflow (cfs)	(CF)	(CF)	Q outflow (cfs)	(CF)	(CF)	(cf)	
1440	28	8250	10047000	46.5	1000743	1000743	0	5509163
1445	28	8400	10055400	46.5	995208	995208	0	5509163
1450	28	8400	10063800	46.5	989673	989673	0	5509163
1455	27	8250	10072050	46.5	983988	983988	0	5509163
1460	25	7800	10079850	46.5	977853	977853	0	5509163
1465	23	7200	10087050	46.5	971118	971118	0	5509163
1470	20	6450	10093500	46.5	963633	963633	0	5509163
1475	18	5700	10099200	46.5	955398	955398	0	5509163
1480	16	5100	10104300	43.0	947078	947078	0	5509163
1485	14	4500	10108800	43.0	938672	938672	0	5509163
1490	13	4050	10112850	43.0	929816	929816	0	5509163
1495	12	3750	10116600	43.0	920660	920660	0	5509163
S =			10116600				5509163	

```
*                                        *                                        *      DAVIS, CALIFORNIA 95616      *
*  RUN DATE  11/22/1993  TIME  15:05:28  *                                        *        (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


```
      LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

        1           ID   LITTLE DEER VALLEY CONCEPTUAL DRAINAGE STUDY
        2           ID   100 YEAR - 24 HOUR TYPE IIA STORM DISTRIBUTION
        3           ID   FILE NAME B65100 (AREA 6, CASE 5, 24 HOUR STORM)
*** FREE ***
                    *DIAGRAM
        4           IT       5       0       0     300
        5           IN      30
        6           IO       5

        7           KK   DA6.1
        8           BA  0.3688
        9           PB     4.1
       10           PC       0    .005    .009    .010    .013    .019    .021    .028    .032    .044
       11           PC    .057    .100    .660    .745    .776    .800    .816    .830    .840    .850
       12           PC    .861    .868    .878    .884    .891    .900    .905    .912    .919    .923
       13           PC    .930    .934    .939    .944    .950    .958    .961    .963    .969    .971
       14           PC    .974    .979    .981    .985    .989    .991    .993    .996   1.000
       15           LS       0      82
       16           UD    0.36

       17           KKCP6.1>6.2-ROUTING
       18           KM   PROPOSED 26-FT TRAP CHANNEL
       19           KM   UNLINED
       20           RS       1    STOR      -1
       21           RC     .05     .05     .05    2400   .0045
       22           RX      10      11      12      24      50      62      63      64
       23           RY       4       4       4       1       1       4       4       4

       24           KK  DA6.50
       25           KM   PROPOSED 17-FT TRAP CHANNEL
       26           KM   ALONG HAPPY VALLEY ROAD
       27           BA   .3125
       28           LS       0      77 .
       29           UD    0.93

       30           KK   DA6.2
       31           KM   PROPOSED 20-FT TRAP CHANNEL DOWNSTREAM
       32           KM   OF BASIN 6.1
       33           BA   .3266
       34           LS       0      76
       35           UD    1.02

       36           KKCP6A-COMBINE 6.1+6.2+6.5
       37           KM   EXISTING 45-FT TRAP CHANNEL
       38           HC       3

       39           KK   DA6.3
       40           KM   PROPOSED CROSSING
       41           KM   UNDER LOOP FROM 39TH TO 43RD AVE
       42           BA   .3688
       43           LS       0      83
       44           UD    0.88
```

```
 45          KKCP6.3>6.31-ROUTING
 46          KM   NATURAL WASH
 47          RS       1    STOR      -1
 48          RC     .04     .04     .04    1500    .010
 49          RX      10     200     300     306     316     322     420     620
 50          RY      12      10       9       6       6       9      10      12

 51          KK  DA6.31
 52          BA   .0781
 53          LS       0      74
 54          UD    0.67

 55          KK     6.4
 56          BA   .0953
 57          LS       0      78
 58          UD     1.0

 59          KKCP6A-COMBINE 6.2+6.3+6.4
 60          KM   EXISTING 45-FT TRAP CHANNEL
 61          KM   EXISTING CULVERT UNDER HAPPY VALLEY ROAD
 62          KM   TO UPLAND HILLS DEVELOPMENT
 63          HC       3

 64          KK      NEALL
 65          HC       2

 66          KK   DA6.6
 67          BA   0.125
 68          LS       0      75
 69          UD    1.21

 70          KKCP6.6-COMBINE 6A+6.6
 71          HC       2

 72          KKCP6.6>6.5-ROUTING
 73          KM   PROPOSED 80-FT TRAP CHANNEL
 74          KM   UNLINED
 75          RS       1    STOR      -1
 76          RC     .05     .05     .05    1400    .004
 77          RX     200     201     202     214     294     306     307     308
 78          RY       4       4       4       1       1       4       4       4

 79          KK    6.51
 80          BA   .2578
 81          LS       0      74      25
 82          UD    0.92

 83          KKCP6.5-COMBINE 6.6+6.5
 84          HC       2
1                                          HEC-1 INPUT                                          PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 85          KKCP6.5>6.7A-ROUTING
 86          RS       1    STOR      -1
 87          RC    .035    .022    .035    1700   .0018
 88          RX      80      80     100     124     204     228     325     425
 89          RY      11    10.5      10       4       4      10    10.5      11

 90          KK6.7A>6.7-ROUTING
 91          KM   FROM OUTLET OF CHANNEL TO P.P. RD.
 92          RS       1    STOR      -1
 93          RC     .04     .04     .04    1000    .004
 94          RX     200     300     400     500     600     700     800     900
 95          RY      11      10       9       8       8       9      10      11

 96          KK   DA6.7
 97          BA   .6359
 98          LS       0      74      14
 99          UD     .34

100          KK   CP6.0COMBINE 6.7+6.5
101          KO       1       2
102          KM   CULVERT UNDER PINNACLE PEAK ROAD
103          HC       2
104          ZZ
1
             SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   7       DA6.1
              V
              V
```

```
                V
 17    CP6.1>6.
                .
                .
 24             .      DA6.50
                .          .
                .          .
 30             .          .      DA6.2
                .          .          .
                .          .          .
 36    CP6A-COM.......................
                .
                .
 39             .      DA6.3
                .          V
                .          V
 45             .    CP6.3>6.
                .          .
                .          .
 51             .          .     DA6.31
                .          .          .
                .          .          .
 55             .          .          .        6.4
                .          .          .          .
                .          .          .          .
 59             .    CP6A-COM.......................
                .          .
                .          .
 64           NE............
                .
                .
 66             .      DA6.6
                .          .
                .          .
 70    CP6.6-CO............
                V
                V
 72    CP6.6>6.
                .
                .
 79             .       6.51
                .          .
                .          .
 83    CP6.5-CO............
                V
                V
 85    CP6.5>6.
                V
                V
 90    6.7A>6.7
                .
                .
 96             .      DA6.7
                .          .
                .          .
100       CP6.0............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
*  RUN DATE  11/22/1993  TIME  15:05:28 *
*                                      *
****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

LITTLE DEER VALLEY CONCEPTUAL DRAINAGE STUDY
100 YEAR - 24 HOUR TYPE IIA STORM DISTRIBUTION
FILE NAME B65100 (AREA 6, CASE 5, 24 HOUR STORM)

```
 6 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  GSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                   NMIN          5  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME       0000  STARTING TIME
                     NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      2   0  ENDING DATE
                 NDTIME       0055  ENDING TIME
                  ICENT         19  CENTURY MARK
```

```
                    ICENT          19  CENTURY MARK

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE   24.92 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

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            ***************
            *             *
100 KK      *    CP6.0    *     COMBINE 6.7+6.5
            *             *
            ***************

101 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          2  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                        CULVERT UNDER PINNACLE PEAK ROAD

103 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

*****************************************************************************************************************************

                                   HYDROGRAPH AT STATION    CP6.0
                                     SUM OF  2 HYDROGRAPHS

*****************************************************************************************************************************
```

BA	MON	HRMN	ORD	FLOW	*	BA	MON	HRMN	ORD	FLOW	*	BA	MON	HRMN	ORD	FLOW	*	BA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	778.	*	1		1230	151	84.	*	1		1845	226	53.
1		0005	2	0.	*	1		0620	77	873.	*	1		1235	152	84.	*	1		1850	227	53.
1		0010	3	0.	*	1		0625	78	1015.	*	1		1240	153	83.	*	1		1855	228	54.
1		0015	4	0.	*	1		0630	79	1160.	*	1		1245	154	81.	*	1		1900	229	54.
1		0020	5	1.	*	1		0635	80	1263.	*	1		1250	155	80.	*	1		1905	230	54.
1		0025	6	1.	*	1		0640	81	1324.	*	1		1255	156	78.	*	1		1910	231	53.
1		0030	7	2.	*	1		0645	82	1340.	*	1		1300	157	77.	*	1		1915	232	51.
1		0035	8	2.	*	1		0650	83	1320.	*	1		1305	158	76.	*	1		1920	233	49.
1		0040	9	2.	*	1		0655	84	1279.	*	1		1310	159	76.	*	1		1925	234	47.
1		0045	10	2.	*	1		0700	85	1225.	*	1		1315	160	76.	*	1		1930	235	45.
1		0050	11	2.	*	1		0705	86	1162.	*	1		1320	161	76.	*	1		1935	236	43.
1		0055	12	2.	*	1		0710	87	1096.	*	1		1325	162	76.	*	1		1940	237	42.
1		0100	13	2.	*	1		0715	88	1025.	*	1		1330	163	76.	*	1		1945	238	42.
1		0105	14	2.	*	1		0720	89	954.	*	1		1335	164	76.	*	1		1950	239	41.
1		0110	15	2.	*	1		0725	90	885.	*	1		1340	165	76.	*	1		1955	240	41.
1		0115	16	2.	*	1		0730	91	819.	*	1		1345	166	75.	*	1		2000	241	41.
1		0120	17	2.	*	1		0735	92	755.	*	1		1350	167	74.	*	1		2005	242	41.
1		0125	18	2.	*	1		0740	93	696.	*	1		1355	168	74.	*	1		2010	243	41.
1		0130	19	1.	*	1		0745	94	642.	*	1		1400	169	73.	*	1		2015	244	41.
1		0135	20	1.	*	1		0750	95	591.	*	1		1405	170	73.	*	1		2020	245	42.
1		0140	21	1.	*	1		0755	96	544.	*	1		1410	171	72.	*	1		2025	246	42.
1		0145	22	2.	*	1		0800	97	502.	*	1		1415	172	71.	*	1		2030	247	42.
1		0150	23	2.	*	1		0805	98	468.	*	1		1420	173	70.	*	1		2035	248	42.
1		0155	24	2.	*	1		0810	99	436.	*	1		1425	174	68.	*	1		2040	249	42.
1		0200	25	2.	*	1		0815	100	405.	*	1		1430	175	67.	*	1		2045	250	41.
1		0205	26	2.	*	1		0820	101	377.	*	1		1435	176	66.	*	1		2050	251	39.
1		0210	27	2.	*	1		0825	102	352.	*	1		1440	177	66.	*	1		2055	252	38.
1		0215	28	2.	*	1		0830	103	332.	*	1		1445	178	66.	*	1		2100	253	37.
1		0220	29	3.	*	1		0835	104	313.	*	1		1450	179	67.	*	1		2105	254	36.
1		0225	30	3.	*	1		0840	105	295.	*	1		1455	180	67.	*	1		2110	255	36.
1		0230	31	3.	*	1		0845	106	277.	*	1		1500	181	67.	*	1		2115	256	36.
1		0235	32	3.	*	1		0850	107	261.	*	1		1505	182	67.	*	1		2120	257	37.
1		0240	33	3.	*	1		0855	108	246.	*	1		1510	183	66.	*	1		2125	258	38.
1		0245	34	3.	*	1		0900	109	232.	*	1		1515	184	65.	*	1		2130	259	38.
1		0250	35	3.	*	1		0905	110	220.	*	1		1520	185	64.	*	1		2135	260	39.
1		0255	36	3.	*	1		0910	111	209.	*	1		1525	186	62.	*	1		2140	261	39.
1		0300	37	2.	*	1		0915	112	198.	*	1		1530	187	61.	*	1		2145	262	39.
1		0305	38	2.	*	1		0920	113	189.	*	1		1535	188	60.	*	1		2150	263	39.
1		0310	39	2.	*	1		0925	114	180.	*	1		1540	189	59.	*	1		2155	264	39.
1		0315	40	3.	*	1		0930	115	172.	*	1		1545	190	59.	*	1		2200	265	39.
1		0320	41	3.	*	1		0935	116	165.	*	1		1550	191	59.	*	1		2205	266	39.
1		0325	42	3.	*	1		0940	117	160.	*	1		1555	192	59.	*	1		2210	267	38.
1		0330	43	4.	*	1		0945	118	155.	*	1		1600	193	59.	*	1		2215	268	38.
1		0335	44	4.	*	1		0950	119	150.	*	1		1605	194	58.	*	1		2220	269	37.

1	0335	44	4.	*	1	0950	119	150.	*	1	1605	194	58.	*	1	2220	269	37.
1	0340	45	4.	*	1	0955	120	145.	*	1	1610	195	58.	*	1	2225	270	36.
1	0345	46	4.	*	1	1000	121	141.	*	1	1615	196	57.	*	1	2230	271	36.
1	0350	47	4.	*	1	1005	122	137.	*	1	1620	197	57.	*	1	2235	272	35.
1	0355	48	4.	*	1	1010	123	133.	*	1	1625	198	57.	*	1	2240	273	35.
1	0400	49	4.	*	1	1015	124	129.	*	1	1630	199	56.	*	1	2245	274	35.
1	0405	50	4.	*	1	1020	125	125.	*	1	1635	200	56.	*	1	2250	275	34.
1	0410	51	4.	*	1	1025	126	121.	*	1	1640	201	56.	*	1	2255	276	34.
1	0415	52	4.	*	1	1030	127	117.	*	1	1645	202	56.	*	1	2300	277	34.
1	0420	53	5.	*	1	1035	128	114.	*	1	1650	203	56.	*	1	2305	278	34.
1	0425	54	5.	*	1	1040	129	112.	*	1	1655	204	56.	*	1	2310	279	34.
1	0430	55	6.	*	1	1045	130	111.	*	1	1700	205	56.	*	1	2315	280	34.
1	0435	56	6.	*	1	1050	131	109.	*	1	1705	206	57.	*	1	2320	281	33.
1	0440	57	7.	*	1	1055	132	108.	*	1	1710	207	57.	*	1	2325	282	33.
1	0445	58	7.	*	1	1100	133	107.	*	1	1715	208	58.	*	1	2330	283	33.
1	0450	59	7.	*	1	1105	134	106.	*	1	1720	209	59.	*	1	2335	284	33.
1	0455	60	7.	*	1	1110	135	104.	*	1	1725	210	60.	*	1	2340	285	33.
1	0500	61	8.	*	1	1115	136	102.	*	1	1730	211	61.	*	1	2345	286	33.
1	0505	62	8.	*	1	1120	137	99.	*	1	1735	212	61.	*	1	2350	287	33.
1	0510	63	9.	*	1	1125	138	97.	*	1	1740	213	61.	*	1	2355	288	33.
1	0515	64	11.	*	1	1130	139	94.	*	1	1745	214	61.	*	2	0000	289	33.
1	0520	65	13.	*	1	1135	140	93.	*	1	1750	215	60.	*	2	0005	290	33.
1	0525	66	16.	*	1	1140	141	91.	*	1	1755	216	59.	*	2	0010	291	32.
1	0530	67	18.	*	1	1145	142	90.	*	1	1800	217	58.	*	2	0015	292	31.
1	0535	68	24.	*	1	1150	143	89.	*	1	1805	218	58.	*	2	0020	293	29.
1	0540	69	45.	*	1	1155	144	88.	*	1	1810	219	58.	*	2	0025	294	28.
1	0545	70	95.	*	1	1200	145	87.	*	1	1815	220	57.	*	2	0030	295	26.
1	0550	71	181.	*	1	1205	146	86.	*	1	1820	221	57.	*	2	0035	296	25.
1	0555	72	302.	*	1	1210	147	86.	*	1	1825	222	56.	*	2	0040	297	25.
1	0600	73	447.	*	1	1215	148	85.	*	1	1830	223	55.	*	2	0045	298	24.
1	0605	74	585.	*	1	1220	149	85.	*	1	1835	224	54.	*	2	0050	299	24.
1	0610	75	695.	*	1	1225	150	84.	*	1	1840	225	53.	*	2	0055	300	24.
				*					*					*				

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1340.	6.75		442.	141.	136.	136.
		(INCHES)	1.600	2.042	2.043	2.043
		(AC-FT)	219.	280.	280.	280.

CUMULATIVE AREA = 2.57 SQ MI

1 STATION CP6.0

(O) OUTFLOW

	0.	200.	400.	600.	800.	1000.	1200.	1400.	0.	0.	0.	0.	0.
DAHRMN	PER												
10000	10												
10005	20												
10010	30												
10015	40												
10020	50												
10025	60												
10030	70												
10035	80												
10040	90												
10045	100												
10050	110												
10055	120												
10100	130												
10105	140												
10110	150												
10115	160												
10120	170												
10125	180												
10130	190												
10135	200												
10140	210												
10145	220												
10150	230												
10155	240												
10200	250												
10205	260												
10210	270												
10215	280												
10220	290												
10225	300												
10230	310												
10235	320												
10240	330												
10245	340												
10250	350												
10255	360												
10300	370												
10305	380												
10310	390												

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	DA6.1	449.	6.25	74.	23.	22.	.37		
ROUTED TO	CP6.1>6.	390.	6.33	73.	23.	22.	.37	4.00	6.33
HYDROGRAPH AT	DA6.50	158.	6.92	50.	16.	15.	.31		
HYDROGRAPH AT	DA6.2	147.	7.00	50.	16.	15.	.33		
3 COMBINED AT	CP6A-COM	579.	6.50	172.	54.	52.	1.01		
HYDROGRAPH AT	DA6.3	313.	6.58	76.	23.	23.	.37		
ROUTED TO	CP6.3>6.	310.	6.67	76.	23.	23.	.37	9.08	6.67
HYDROGRAPH AT	DA6.31	43.	6.58	11.	3.	3.	.08		
HYDROGRAPH AT	6.4	48.	7.00	16.	5.	5.	.10		
3 COMBINED AT	CP6A-COM	395.	6.67	103.	32.	31.	.54		
2 COMBINED AT	NE	960.	6.58	275.	86.	83.	1.55		
HYDROGRAPH AT	DA6.6	47.	7.25	18.	6.	6.	.13		
2 COMBINED AT	CP6.6-CO	988.	6.58	293.	92.	89.	1.68		
ROUTED TO	CP6.6>6.	979.	6.67	292.	92.	88.	1.68	3.98	6.67
HYDROGRAPH AT	6.51	164.	6.83	50.	16.	15.	.26		
2 COMBINED AT	CP6.5-CO	1137.	6.67	341.	107.	103.	1.93		
ROUTED TO	CP6.5>6.	1130.	6.75	340.	107.	103.	1.93	6.53	6.75
ROUTED TO	6.7A>6.7	1118.	6.83	338.	107.	103.	1.93	9.62	6.83
HYDROGRAPH AT	DA6.7	654.	6.17	109.	34.	33.	.64		
2 COMBINED AT	CP6.0	1340.	6.75	442.	141.	136.	2.57		

*** NORMAL END OF HEC-1 ***

```
                                                                                                                                  *
 RUN DATE  11/22/1993  TIME  15:05:56 *                                                                                          *       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   LITTLE DEER VALLEY CONCEPTUAL DRAINAGE STUDY
        2           ID   2-YEAR - 24 HOUR TYPE IIA STORM DISTRIBUTION
        3           ID   FILE NAME B652 (AREA 6, CASE 5, 24 HOUR STORM)
*** FREE ***
                    *DIAGRAM
        4           IT       5       0       0     300
        5           IN      30
        6           IO       5

        7           KK   DA6.1
        8           BA   .3688
        9           PB    1.44
       10           PC       0    .005    .009    .010    .013    .019    .021    .028    .032    .044
       11           PC    .057    .100    .660    .745    .776    .800    .816    .830    .840    .850
       12           PC    .861    .868    .878    .884    .891    .900    .905    .912    .919    .923
       13           PC    .930    .934    .939    .944    .950    .958    .961    .963    .969    .971
       14           PC    .974    .979    .981    .985    .989    .991    .993    .996   1.000
       15           LS       0      82
       16           UD    0.36

       17           KKCP6.1>6.2-ROUTING
       18           KM   PROPOSED 26-FT TRAP CHANNEL
       19           KM   UNLINED
       20           RS       1    STOR      -1
       21           RC     .05     .05     .05    2400   .0045
       22           RX      10      11      12      24      50      62      63      64
       23           RY       4       4       4       1       1       4       4       4

       24           KK  DA6.50
       25           KM   PROPOSED 17-FT TRAP CHANNEL
       26           KM   ALONG HAPPY VALLEY ROAD
       27           BA   .3125
       28           LS       0      77
       29           UD    0.93

       30           KK   DA6.2
       31           KM   PROPOSED 20-FT TRAP CHANNEL DOWNSTREAM
       32           KM   OF BASIN 6.1
       33           BA   .3266
       34           LS       0      76
       35           UD    1.02

       36           KKCP6A-COMBINE 6.1+6.2+6.5
       37           KM   EXISTING 45-FT TRAP CHANNEL
       38           HC       3

       39           KK   DA6.3
       40           KM   PROPOSED CROSSING
       41           KM   UNDER LOOP FROM 39TH TO 43RD AVE
       42           BA   .3688
       43           LS       0      83
       44           UD    0.68
1                                                   HEC-1 INPUT                                                          PAGE  2
      LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

       45           KKCP6.3>6.31-ROUTING
```

```
 45          KKCP6.3>6.31-ROUTING
 46          KM   NATURAL WASH
 47          RS       1    STOR      -1
 48          RC     .04     .04     .04    1500    .010
 49          RX      10     200     300     306     316     322     420     620
 50          RY      12      10       9       6       6       9      10      12

 51          KK  DA6.31
 52          BA   .0781
 53          LS       0      74
 54          UD    0.67

 55          KK     6.4
 56          BA   .0953
 57          LS       0      78
 58          UD     1.0

 59          KKCP6A-COMBINE 6.2+6.3+6.4
 60          KM   EXISTING 45-FT TRAP CHANNEL
 61          KM   EXISTING CULVERT UNDER HAPPY VALLEY ROAD
 62          KM   TO UPLAND HILLS DEVELOPMENT
 63          HC       3

 64          KKOCOMBINE ALL
 65          HC       2

 66          KK   DA6.6
 67          BA   0.125
 68          LS       0      75
 69          UD    1.21

 70          KKCP6.6-COMBINE 6A+6.6
 71          HC       2

 72          KKCP6.6>6.5-ROUTING
 73          KM   PROPOSED 80-FT TRAP CHANNEL
 74          KM   UNLINED
 75          RS       1    STOR      -1
 76          RC     .05     .05     .05    1400    .004
 77          RX     200     201     202     214     294     306     307     308
 78          RY       4       4       4       1       1       4       4       4

 79          KK    6.51
 80          BA   .2578
 81          LS       0      74      25
 82          UD    0.92

 83          KKCP6.5-COMBINE 6.6+6.5
 84          HC       2
1                                        HEC-1 INPUT                                          PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 85          KKCP6.5>6.7A-ROUTING
 86          RS       1    STOR      -1
 87          RC    .035    .022    .035    1700   .0018
 88          RX      80      80     100     124     204     228     325     425
 89          RY      11    10.5      10       4       4      10    10.5      11

 90          KK6.7A>6.7-ROUTING
 91          KM   FROM OUTLET OF CHANNEL TO P.P. RD.
 92          RS       1    STOR      -1
 93          RC     .04     .04     .04    1000    .004
 94          RX     200     300     400     500     600     700     800     900
 95          RY      11      10       9       8       8       9      10      11

 96          KK   DA6.7
 97          BA   .6359
 98          LS       0      74      14
 99          UD     .34

100          KK   CP6.0COMBINE 6.7+6.5
101          KO       1       2
102          KM   CULVERT UNDER PINNACLE PEAK ROAD
103          HC       2
104          ZZ
1
        SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE   (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.    (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  7      DA6.1
          V
          9
```

```
                V
 17    CP6.1>6.
                .
 24             .      DA6.50
                .          .
 30             .          .      DA6.2
                .          .          .
 36    CP6A-COM.......................
                .
 39             .      DA6.3
                .          V
                .          V
 45             .    CP6.3>6.
                .          .
 51             .          .      DA6.31
                .          .          .
 55             .          .          .        6.4
                .          .          .          .
 59             .    CP6A-COM.......................
                .          .
 64    DCOMBINE............
                .
 66             .      DA6.6
                .          .
 70    CP6.6-CO............
                V
                V
 72    CP6.6>6.
                .
 79             .       6.51
                .          .
 83    CP6.5-CO............
                V
                V
 85    CP6.5>6.
                V
                V
 90    6.7A>6.7
                .
 96             .      DA6.7
                .          .
100       CP6.0............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  11/22/1993  TIME  15:05:56 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

LITTLE DEER VALLEY CONCEPTUAL DRAINAGE STUDY
2-YEAR - 24 HOUR TYPE IIA STORM DISTRIBUTION
FILE NAME B652 (AREA 6, CASE 5, 24 HOUR STORM)

```
 6 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        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2    0  ENDING DATE
                   NDTIME       0055  ENDING TIME
                    ICENT         19  CENTURY MARK
```

```
                    ICENT          19  CENTURY MARK

          COMPUTATION INTERVAL     .08 HOURS
               TOTAL TIME BASE   24.92 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

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          ***************
          *             *
100 KK    *    CP6.0    *     COMBINE 6.7+6.5
          *             *
          ***************

101 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          1  PRINT CONTROL
                    IPLOT          2  PLOT CONTROL
                    GSCAL         0.  HYDROGRAPH PLOT SCALE
                       CULVERT UNDER PINNACLE PEAK ROAD

103 HC         HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

*****************************************************************************************************************************

                                   HYDROGRAPH AT STATION    CP6.0
                                      SUM OF  2 HYDROGRAPHS

*****************************************************************************************************************************
```

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	84.	1		1230	151	16.	1		1845	226	10.
1		0005	2	0.	1		0620	77	78.	1		1235	152	16.	1		1850	227	10.
1		0010	3	0.	1		0625	78	70.	1		1240	153	15.	1		1855	228	11.
1		0015	4	0.	1		0630	79	62.	1		1245	154	15.	1		1900	229	11.
1		0020	5	0.	1		0635	80	59.	1		1250	155	15.	1		1905	230	11.
1		0025	6	0.	1		0640	81	60.	1		1255	156	14.	1		1910	231	11.
1		0030	7	1.	1		0645	82	64.	1		1300	157	14.	1		1915	232	10.
1		0035	8	1.	1		0650	83	72.	1		1305	158	14.	1		1920	233	10.
1		0040	9	1.	1		0655	84	82.	1		1310	159	14.	1		1925	234	10.
1		0045	10	1.	1		0700	85	91.	1		1315	160	14.	1		1930	235	9.
1		0050	11	1.	1		0705	86	98.	1		1320	161	14.	1		1935	236	9.
1		0055	12	1.	1		0710	87	104.	1		1325	162	14.	1		1940	237	9.
1		0100	13	1.	1		0715	88	108.	1		1330	163	14.	1		1945	238	9.
1		0105	14	1.	1		0720	89	109.	1		1335	164	14.	1		1950	239	9.
1		0110	15	1.	1		0725	90	107.	1		1340	165	14.	1		1955	240	9.
1		0115	16	1.	1		0730	91	105.	1		1345	166	14.	1		2000	241	9.
1		0120	17	1.	1		0735	92	101.	1		1350	167	14.	1		2005	242	9.
1		0125	18	1.	1		0740	93	97.	1		1355	168	14.	1		2010	243	9.
1		0130	19	1.	1		0745	94	92.	1		1400	169	14.	1		2015	244	9.
1		0135	20	0.	1		0750	95	87.	1		1405	170	14.	1		2020	245	9.
1		0140	21	0.	1		0755	96	83.	1		1410	171	14.	1		2025	246	9.
1		0145	22	1.	1		0800	97	78.	1		1415	172	13.	1		2030	247	9.
1		0150	23	1.	1		0805	98	73.	1		1420	173	13.	1		2035	248	9.
1		0155	24	1.	1		0810	99	69.	1		1425	174	13.	1		2040	249	9.
1		0200	25	1.	1		0815	100	65.	1		1430	175	13.	1		2045	250	8.
1		0205	26	1.	1		0820	101	61.	1		1435	176	12.	1		2050	251	8.
1		0210	27	1.	1		0825	102	58.	1		1440	177	12.	1		2055	252	8.
1		0215	28	1.	1		0830	103	55.	1		1445	178	12.	1		2100	253	8.
1		0220	29	1.	1		0835	104	52.	1		1450	179	12.	1		2105	254	7.
1		0225	30	1.	1		0840	105	50.	1		1455	180	13.	1		2110	255	7.
1		0230	31	1.	1		0845	106	48.	1		1500	181	13.	1		2115	256	7.
1		0235	32	1.	1		0850	107	46.	1		1505	182	13.	1		2120	257	7.
1		0240	33	1.	1		0855	108	44.	1		1510	183	13.	1		2125	258	8.
1		0245	34	1.	1		0900	109	42.	1		1515	184	13.	1		2130	259	8.
1		0250	35	1.	1		0905	110	40.	1		1520	185	12.	1		2135	260	8.
1		0255	36	1.	1		0910	111	39.	1		1525	186	12.	1		2140	261	8.
1		0300	37	1.	1		0915	112	37.	1		1530	187	12.	1		2145	262	8.
1		0305	38	1.	1		0920	113	36.	1		1535	188	12.	1		2150	263	8.
1		0310	39	1.	1		0925	114	35.	1		1540	189	11.	1		2155	264	8.
1		0315	40	1.	1		0930	115	33.	1		1545	190	11.	1		2200	265	8.
1		0320	41	1.	1		0935	116	32.	1		1550	191	11.	1		2205	266	8.
1		0325	42	1.	1		0940	117	31.	1		1555	192	11.	1		2210	267	8.
1		0330	43	1.	1		0945	118	30.	1		1600	193	11.	1		2215	268	7.
1		0335	44	1.	1		0950	119	29.	1		1605	194	11.	1		2220	269	7.
1		[illegible]	[illegible]	[illegible]	1		[illegible]	[illegible]	[illegible]	1		[illegible]	[illegible]	[illegible]	1		[illegible]	[illegible]	7.

1	0335	44	1.	*	1	0950	119	29.	*	1	1605	194	11.	*	1	2220	269	7.
1	0340	45	1.	*	1	0955	120	28.	*	1	1610	195	11.	*	1	2225	270	7.
1	0345	46	1.	*	1	1000	121	27.	*	1	1615	196	11.	*	1	2230	271	7.
1	0350	47	1.	*	1	1005	122	27.	*	1	1620	197	11.	*	1	2235	272	7.
1	0355	48	1.	*	1	1010	123	26.	*	1	1625	198	11.	*	1	2240	273	7.
1	0400	49	1.	*	1	1015	124	25.	*	1	1630	199	11.	*	1	2245	274	7.
1	0405	50	1.	*	1	1020	125	24.	*	1	1635	200	11.	*	1	2250	275	7.
1	0410	51	1.	*	1	1025	126	23.	*	1	1640	201	11.	*	1	2255	276	7.
1	0415	52	1.	*	1	1030	127	22.	*	1	1645	202	11.	*	1	2300	277	7.
1	0420	53	2.	*	1	1035	128	22.	*	1	1650	203	11.	*	1	2305	278	7.
1	0425	54	2.	*	1	1040	129	21.	*	1	1655	204	11.	*	1	2310	279	7.
1	0430	55	2.	*	1	1045	130	21.	*	1	1700	205	11.	*	1	2315	280	7.
1	0435	56	2.	*	1	1050	131	20.	*	1	1705	206	11.	*	1	2320	281	7.
1	0440	57	2.	*	1	1055	132	20.	*	1	1710	207	11.	*	1	2325	282	7.
1	0445	58	2.	*	1	1100	133	20.	*	1	1715	208	11.	*	1	2330	283	7.
1	0450	59	3.	*	1	1105	134	20.	*	1	1720	209	11.	*	1	2335	284	7.
1	0455	60	3.	*	1	1110	135	19.	*	1	1725	210	11.	*	1	2340	285	7.
1	0500	61	3.	*	1	1115	136	19.	*	1	1730	211	11.	*	1	2345	286	7.
1	0505	62	3.	*	1	1120	137	18.	*	1	1735	212	11.	*	1	2350	287	7.
1	0510	63	3.	*	1	1125	138	18.	*	1	1740	213	11.	*	1	2355	288	7.
1	0515	64	4.	*	1	1130	139	17.	*	1	1745	214	11.	*	2	0000	289	7.
1	0520	65	5.	*	1	1135	140	17.	*	1	1750	215	11.	*	2	0005	290	7.
1	0525	66	6.	*	1	1140	141	17.	*	1	1755	216	11.	*	2	0010	291	7.
1	0530	67	6.	*	1	1145	142	17.	*	1	1800	217	10.	*	2	0015	292	6.
1	0535	68	9.	*	1	1150	143	16.	*	1	1805	218	10.	*	2	0020	293	6.
1	0540	69	14.	*	1	1155	144	16.	*	1	1810	219	10.	*	2	0025	294	6.
1	0545	70	25.	*	1	1200	145	16.	*	1	1815	220	10.	*	2	0030	295	5.
1	0550	71	39.	*	1	1205	146	16.	*	1	1820	221	10.	*	2	0035	296	5.
1	0555	72	53.	*	1	1210	147	16.	*	1	1825	222	10.	*	2	0040	297	5.
1	0600	73	67.	*	1	1215	148	16.	*	1	1830	223	10.	*	2	0045	298	5.
1	0605	74	79.	*	1	1220	149	16.	*	1	1835	224	10.	*	2	0050	299	5.
1	0610	75	85.	*	1	1225	150	16.	*	1	1840	225	10.	*	2	0055	300	5.
				*					*					*				

****

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW	6-HR	24-HR	72-HR	24.92-HR
+ 109.	7.33	(CFS)	52.	19.	18.	18.
		(INCHES)	.187	.274	.274	.274
		(AC-FT)	26.	38.	38.	38.

CUMULATIVE AREA = 2.57 SQ MI

STATION CP6.0

(O) OUTFLOW

```
          0.       10.       20.       30.       40.       50.       60.       70.       80.       90.      100.      110.        0.
DAHRMN PER
 10000  10---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.
 10005  20         .         .         .         .         .         .         .         .         .         .         .         .
 10010  30         .         .         .         .         .         .         .         .         .         .         .         .
 10015  40         .         .         .         .         .         .         .         .         .         .         .         .
 10020  50         .         .         .         .         .         .         .         .         .         .         .         .
 10025  60         .         .         .         .         .         .         .         .         .         .         .         .
 10030  7.0        .         .         .         .         .         .         .         .         .         .         .         .
 10035  8.0        .         .         .         .         .         .         .         .         .         .         .         .
 10040  9.0        .         .         .         .         .         .         .         .         .         .         .         .
 10045  10.0       .         .         .         .         .         .         .         .         .         .         .         .
 10050  11.0.......................................................................................................................
 10055  12.0       .         .         .         .         .         .         .         .         .         .         .         .
 10100  13.0       .         .         .         .         .         .         .         .         .         .         .         .
 10105  14.0       .         .         .         .         .         .         .         .         .         .         .         .
 10110  15.0       .         .         .         .         .         .         .         .         .         .         .         .
 10115  16.0       .         .         .         .         .         .         .         .         .         .         .         .
 10120  17.0       .         .         .         .         .         .         .         .         .         .         .         .
 10125  18.0       .         .         .         .         .         .         .         .         .         .         .         .
 10130  19.0       .         .         .         .         .         .         .         .         .         .         .         .
 10135  200        .         .         .         .         .         .         .         .         .         .         .         .
 10140  210 ......................................................................................................................
 10145  22.0       .         .         .         .         .         .         .         .         .         .         .         .
 10150  23.0       .         .         .         .         .         .         .         .         .         .         .         .
 10155  24.0       .         .         .         .         .         .         .         .         .         .         .         .
 10200  25.0       .         .         .         .         .         .         .         .         .         .         .         .
 10205  26.0       .         .         .         .         .         .         .         .         .         .         .         .
 10210  27.0       .         .         .         .         .         .         .         .         .         .         .         .
 10215  28.0       .         .         .         .         .         .         .         .         .         .         .         .
 10220  29.0       .         .         .         .         .         .         .         .         .         .         .         .
 10225  30.0       .         .         .         .         .         .         .         .         .         .         .         .
 10230  31.0.......................................................................................................................
 10235  32.0       .         .         .         .         .         .         .         .         .         .         .         .
 10240  33.0       .         .         .         .         .         .         .         .         .         .         .         .
 10245  34.0       .         .         .         .         .         .         .         .         .         .         .         .
 10250  35.0       .         .         .         .         .         .         .         .         .         .         .         .
 10255  36.0       .         .         .         .         .         .         .         .         .         .         .         .
 10300  37.0       .         .         .         .         .         .         .         .         .         .         .         .
 10305  38.0       .         .         .         .         .         .         .         .         .         .         .         .
 10310  39.0       .         .         .         .         .         .         .         .         .         .         .         .
 10315  40.0       .         .         .         .         .         .         .         .         .         .         .         .
```

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	DA6.1	45.	6.33	9.	3.	3.	.37		
ROUTED TO	CP6.1>6.	30.	6.67	9.	3.	3.	.37	1.70	6.67
HYDROGRAPH AT	DA6.50	10.	7.08	4.	2.	1.	.31		
HYDROGRAPH AT	DA6.2	8.	7.25	4.	1.	1.	.33		
3 COMBINED AT	CP6A-COM	43.	6.75	16.	6.	6.	1.01		
HYDROGRAPH AT	DA6.3	34.	6.67	10.	3.	3.	.37		
ROUTED TO	CP6.3>6.	34.	6.83	10.	3.	3.	.37	6.91	6.83
HYDROGRAPH AT	DA6.31	2.	6.92	1.	0.	0.	.08		
HYDROGRAPH AT	6.4	3.	7.17	1.	1.	1.	.10		
3 COMBINED AT	CP6A-COM	38.	6.83	12.	4.	4.	.54		
2 COMBINED AT	0COMBINE	81.	6.83	28.	10.	10.	1.55		
HYDROGRAPH AT	DA6.6	2.	7.58	1.	0.	0.	.13		
2 COMBINED AT	CP6.6-CO	83.	6.83	29.	11.	10.	1.68		
ROUTED TO	CP6.6>6.	77.	7.08	29.	11.	10.	1.68	1.66	7.08
HYDROGRAPH AT	6.51	31.	6.75	10.	3.	3.	.26		
2 COMBINED AT	CP6.5-CO	106.	7.00	38.	14.	13.	1.93		
ROUTED TO	CP6.5>6.	101.	7.17	38.	14.	13.	1.93	4.59	7.17
ROUTED TO	6.7A>6.7	96.	7.33	37.	14.	13.	1.93	8.51	7.33
HYDROGRAPH AT	DA6.7	82.	6.17	16.	5.	5.	.64		
2 COMBINED AT	CP6.0	109.	7.33	52.	19.	18.	2.57		

*** NORMAL END OF HEC-1 ***

10220 29.0
10225 30.0

```
*                                          *                                                    *          DAVIS, CALIFORNIA 95616          *
* RUN DATE  11/22/1993  TIME  15:04:14 *                                                    *              (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   LITTLE DEER VALLEY CONCEPTUAL DRAINAGE STUDY
        2           ID   100 YEAR - 24 HOUR TYPE IIA STORM DISTRIBUTION
        3           ID   FILE NAME B55100 (AREA 5, CASE 5, 24 HOUR STORM)
*** FREE ***
                    *DIAGRAM
        4           IT       5       0       0     300
        5           IN      30
        6           ID       5

        7           KK   BA5.1
        8           BA  0.3234
        9           PQ     4.1
       10           PC       0    .005    .009    .010    .013    .019    .021    .028    .032    .044
       11           PC    .057    .100    .660    .745    .776    .800    .816    .830    .840    .850
       12           PC    .861    .868    .878    .884    .891    .900    .905    .912    .919    .923
       13           PC    .930    .934    .939    .944    .950    .958    .961    .963    .969    .971
       14           PC    .974    .979    .981    .985    .989    .991    .993    .996   1.000
       15           LS       0      83
       16           UD    0.46

       17           KKCP5.1>5A-ROUTING
       18           KM   ROUTE CP5.1 TO CP5A
       19           KM   PROPOSED 27-FT CHANNEL ALONG 51ST STREET
       20           RS       1    STOR      -1
       21           RC     .05     .05     .05    3100   .0105
       22           RX      80      81      82      94     121     133     134     135
       23           RY       4       4       4       1       1       4       4       4

       24           KK   BA5.2
       25           KM   MASONRY WALL WITH V-DITCH
       26           BA  0.1172
       27           LS       0      86
       28           UD    0.90

       29           KKCP5.2-COMBINE 5.1+5.2
       30           HC       2

       31           KKCP5.1>5.3-ROUTING
       32           KM   ROUTE CP5.1 TO CP5A
       33           KM   PROPOSED 27-FT CHANNEL ALONG 51ST STREET
       34           RS       1    STOR      -1
       35           RC     .05     .05     .05    1400   .0105
       36           RX      80      81      82      94     121     133     134     135
       37           RY       4       4       4       1       1       4       4       4

       38           KK   BA5.3
       39           KM   PROPOSED 2-FT UNLINED CHANNEL
       40           KM   ALONG HAPPY VALLEY ROAD
       41           BA   .3156
       42           LS       0      77
       43           UD    1.53
1                                                HEC-1 INPUT                                                                    PAGE  2

      LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

       44           KK 1.7-1.3
```

```
44          KK 1.3+1.2
45          KM   PROPOSED CULVERT UNDER HAPPY VALLEY ROAD
46          KM   AT 51ST STREET
47          HC       2

48          KK CP5A>5BROUTING
49          KM   ROUTE CP5A TO CP5B
50          KM   PROPOSED 19-FT CONCRETE CHANNEL
51          RS       1    STOR      -1
52          RC     .02     .02     .02    5300   .0083
53          RX      55      56      57      67      86      96      97      98
54          RY       5       5       5       1       1       5       5       5

55          KK  DA5.41
56          BA   .2303
57          LS       0      74      25
58          UD    0.35

59          KK5.53+5.41
60          HC       2

61          KK   DA5.4
62          BA  0.7266
63          LS       0      75      14
64          UD    0.42

65          KKCP5B-COMBINE 5B+5.4
66          KM   PROPOSED CULVERT UNDER PINNACLE PEAK ROAD
67          HC       2

68          KK   DA5.5
69          BA   .3078
70          LS       0      81
71          UD    0.53

72          KK5.0-COMBINE 5B+5.5
73          KO       1       2
74          HC       2
75          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   7        DA5.1
                V
                V
  17     CP5.1>5A
                .
                .
  24            .       DA5.2
                .           .
                .           .
  29     CP5.2-CO............
                V
                V
  31     CP5.1>5.
                .
                .
  38            .       DA5.3
                .           .
                .           .
  44      1.3+1.2............
                V
                V
  48      CP5A>5B
                .
                .
  55            .      DA5.41
                .           .
                .           .
  59     5.53+5.4............
                .
                .
  61            .       DA5.4
                .           .
                .           .
  65     CP5B-COM............
                .
                .
  68            .       DA5.5
                .           .
                .           .
  72     5.0-COMB............
```

```
(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
*                                        *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990              *
*             VERSION 4.0                *
*                                        *
*  RUN DATE  11/22/1993  TIME  15:04:14  *
*                                        *
******************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
                    LITTLE DEER VALLEY CONCEPTUAL DRAINAGE STUDY
                    100 YEAR - 24 HOUR TYPE IIA STORM DISTRIBUTION
                    FILE NAME B55100 (AREA 5, CASE 5, 24 HOUR STORM)

  6 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  GSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                   NMIN          5  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME       0000  STARTING TIME
                     NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      2   0  ENDING DATE
                 NDTIME       0055  ENDING TIME
                  ICENT         19  CENTURY MARK

             COMPUTATION INTERVAL     .08 HOURS
                  TOTAL TIME BASE   24.92 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            ***************
            *             *
 72 KK      *  5.0-COMB   *     INE 5B+5.5
            *             *
            ***************

 73 KO         OUTPUT CONTROL VARIABLES
                  IPRNT          1  PRINT CONTROL
                  IPLOT          2  PLOT CONTROL
                  GSCAL         0.  HYDROGRAPH PLOT SCALE

 74 HC         HYDROGRAPH COMBINATION
                  ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                          ***

*****************************************************************************************************************************************

                                   HYDROGRAPH AT STATION 5.0-COMB
                                       SUM OF  2 HYDROGRAPHS

*****************************************************************************************************************************************
```

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	1294.	1		1230	151	69.	1		1845	226	34.
1		0005	2	0.	1		0620	77	1367.	1		1235	152	70.	1		1850	227	35.
1		0010	3	0.	1		0625	78	1373.	1		1240	153	70.	1		1855	228	37.
1		0015	4	1.	1		0630	79	1332.	1		1245	154	69.	1		1900	229	39.
1		0020	5	1.	1		0635	80	1260.	1		1250	155	67.	1		1905	230	40.
1		0025	6	2.	1		0640	81	1170.	1		1255	156	65.	1		1910	231	41.
1		0030	7	2.	1		0645	82	1076.	1		1300	157	62.	1		1915	232	40.
1		0035	8	3.	1		0650	83	977.	1		1305	158	60.	1		1920	233	39.
1		0040	9	3.	1		0655	84	883.	1		1310	159	59.	1		1925	234	37.
1		0045	10	3.	1		0700	85	796.	1		1315	160	58.	1		1930	235	34.
1		0050	11	3.	1		0705	86	719.	1		1320	161	58.	1		1935	236	32.
1		0055	12	3.	1		0710	87	652.	1		1325	162	58.	1		1940	237	31.
1		0100	13	3.	1		0715	88	594.	1		1330	163	58.	1		1945	238	30.
1		0105	14	3.	1		0720	89	544.	1		1335	164	59.	1		1950	239	29.

1	0105	14	3.	*	1	0720	89	544.	*	1	1335	164	59.	*	1	1950	239	29.
1	0110	15	3.	*	1	0725	90	501.	*	1	1340	165	59.	*	1	1955	240	29.
1	0115	16	3.	*	1	0730	91	464.	*	1	1345	166	59.	*	1	2000	241	29.
1	0120	17	3.	*	1	0735	92	432.	*	1	1350	167	59.	*	1	2005	242	29.
1	0125	18	2.	*	1	0740	93	404.	*	1	1355	168	59.	*	1	2010	243	29.
1	0130	19	2.	*	1	0745	94	378.	*	1	1400	169	59.	*	1	2015	244	30.
1	0135	20	2.	*	1	0750	95	354.	*	1	1405	170	59.	*	1	2020	245	31.
1	0140	21	2.	*	1	0755	96	332.	*	1	1410	171	59.	*	1	2025	246	32.
1	0145	22	2.	*	1	0800	97	311.	*	1	1415	172	58.	*	1	2030	247	33.
1	0150	23	2.	*	1	0805	98	293.	*	1	1420	173	56.	*	1	2035	248	34.
1	0155	24	2.	*	1	0810	99	276.	*	1	1425	174	54.	*	1	2040	249	35.
1	0200	25	2.	*	1	0815	100	260.	*	1	1430	175	52.	*	1	2045	250	34.
1	0205	26	2.	*	1	0820	101	246.	*	1	1435	176	50.	*	1	2050	251	33.
1	0210	27	2.	*	1	0825	102	232.	*	1	1440	177	49.	*	1	2055	252	32.
1	0215	28	3.	*	1	0830	103	221.	*	1	1445	178	49.	*	1	2100	253	30.
1	0220	29	3.	*	1	0835	104	210.	*	1	1450	179	49.	*	1	2105	254	29.
1	0225	30	3.	*	1	0840	105	199.	*	1	1455	180	50.	*	1	2110	255	28.
1	0230	31	4.	*	1	0845	106	189.	*	1	1500	181	52.	*	1	2115	256	27.
1	0235	32	4.	*	1	0850	107	179.	*	1	1505	182	53.	*	1	2120	257	28.
1	0240	33	4.	*	1	0855	108	170.	*	1	1510	183	53.	*	1	2125	258	29.
1	0245	34	4.	*	1	0900	109	161.	*	1	1515	184	53.	*	1	2130	259	29.
1	0250	35	4.	*	1	0905	110	154.	*	1	1520	185	52.	*	1	2135	260	30.
1	0255	36	3.	*	1	0910	111	147.	*	1	1525	186	50.	*	1	2140	261	31.
1	0300	37	3.	*	1	0915	112	141.	*	1	1530	187	48.	*	1	2145	262	31.
1	0305	38	3.	*	1	0920	113	136.	*	1	1535	188	47.	*	1	2150	263	32.
1	0310	39	3.	*	1	0925	114	131.	*	1	1540	189	45.	*	1	2155	264	32.
1	0315	40	3.	*	1	0930	115	126.	*	1	1545	190	45.	*	1	2200	265	32.
1	0320	41	3.	*	1	0935	116	122.	*	1	1550	191	44.	*	1	2205	266	32.
1	0325	42	4.	*	1	0940	117	119.	*	1	1555	192	44.	*	1	2210	267	32.
1	0330	43	4.	*	1	0945	118	116.	*	1	1600	193	44.	*	1	2215	268	32.
1	0335	44	5.	*	1	0950	119	114.	*	1	1605	194	44.	*	1	2220	269	30.
1	0340	45	5.	*	1	0955	120	112.	*	1	1610	195	44.	*	1	2225	270	29.
1	0345	46	5.	*	1	1000	121	111.	*	1	1615	196	44.	*	1	2230	271	28.
1	0350	47	5.	*	1	1005	122	109.	*	1	1620	197	44.	*	1	2235	272	27.
1	0355	48	4.	*	1	1010	123	107.	*	1	1625	198	44.	*	1	2240	273	26.
1	0400	49	4.	*	1	1015	124	104.	*	1	1630	199	44.	*	1	2245	274	25.
1	0405	50	4.	*	1	1020	125	101.	*	1	1635	200	44.	*	1	2250	275	24.
1	0410	51	4.	*	1	1025	126	97.	*	1	1640	201	44.	*	1	2255	276	24.
1	0415	52	5.	*	1	1030	127	93.	*	1	1645	202	45.	*	1	2300	277	23.
1	0420	53	5.	*	1	1035	128	89.	*	1	1650	203	45.	*	1	2305	278	23.
1	0425	54	6.	*	1	1040	129	87.	*	1	1655	204	46.	*	1	2310	279	23.
1	0430	55	7.	*	1	1045	130	85.	*	1	1700	205	46.	*	1	2315	280	23.
1	0435	56	8.	*	1	1050	131	85.	*	1	1705	206	47.	*	1	2320	281	23.
1	0440	57	9.	*	1	1055	132	85.	*	1	1710	207	48.	*	1	2325	282	23.
1	0445	58	9.	*	1	1100	133	85.	*	1	1715	208	49.	*	1	2330	283	24.
1	0450	59	10.	*	1	1105	134	85.	*	1	1720	209	51.	*	1	2335	284	24.
1	0455	60	10.	*	1	1110	135	84.	*	1	1725	210	52.	*	1	2340	285	25.
1	0500	61	10.	*	1	1115	136	83.	*	1	1730	211	54.	*	1	2345	286	25.
1	0505	62	11.	*	1	1120	137	81.	*	1	1735	212	55.	*	1	2350	287	26.
1	0510	63	12.	*	1	1125	138	78.	*	1	1740	213	56.	*	1	2355	288	27.
1	0515	64	14.	*	1	1130	139	75.	*	1	1745	214	55.	*	2	0000	289	28.
1	0520	65	18.	*	1	1135	140	72.	*	1	1750	215	53.	*	2	0005	290	28.
1	0525	66	21.	*	1	1140	141	70.	*	1	1755	216	50.	*	2	0010	291	28.
1	0530	67	25.	*	1	1145	142	69.	*	1	1800	217	47.	*	2	0015	292	27.
1	0535	68	35.	*	1	1150	143	68.	*	1	1805	218	45.	*	2	0020	293	25.
1	0540	69	64.	*	1	1155	144	67.	*	1	1810	219	42.	*	2	0025	294	23.
1	0545	70	134.	*	1	1200	145	66.	*	1	1815	220	40.	*	2	0030	295	20.
1	0550	71	259.	*	1	1205	146	66.	*	1	1820	221	38.	*	2	0035	296	18.
1	0555	72	442.	*	1	1210	147	66.	*	1	1825	222	37.	*	2	0040	297	16.
1	0600	73	677.	*	1	1215	148	67.	*	1	1830	223	35.	*	2	0045	298	14.
1	0605	74	921.	*	1	1220	149	67.	*	1	1835	224	34.	*	2	0050	299	13.
1	0610	75	1140.	*	1	1225	150	68.	*	1	1840	225	33.	*	2	0055	300	12.
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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1373.	6.42	371.	117.	113.	113.
		(INCHES) 1.706	2.154	2.155	2.155
		(AC-FT) 184.	232.	232.	232.

CUMULATIVE AREA = 2.02 SQ MI

1 STATION 5.0-COMB

(O) OUTFLOW

DAHRMN	PER	0.	200.	400.	600.	800.	1000.	1200.	1400.	0.	0.	0.	0.	0.
10000	10													
10005	20													
10010	30													
10015	40													
10020	50													
10025	60													
10030	70													
10035	80													

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12240 273.0
12245 274.0
12250 275.0
12255 276.0
12300 277.0
12305 278.0
12310 279.0
12315 280.0
12320 281.0
12325 282.0
12330 283.0
12335 284.0
12340 285.0
12345 286.0
12350 287.0
12355 288.0
20000 289.0
20005 290.0
20010 291.0
20015 292.0
20020 293.0
20025 294.0
20030 295.0
20035 296.0
20040 297.0
20045 298.0
20050 299.0
20055 300.0
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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	DA5.1	357.	6.33	68.	21.	20.	.32		
+	ROUTED TO	CP5.1>5A	321.	6.50	67.	20.	20.	.32		
+									3.10	6.50
+	HYDROGRAPH AT	DA5.2	93.	6.83	27.	8.	8.	.12		
+	2 COMBINED AT	CP5.2-CO	400.	6.50	94.	29.	28.	.44		
+	ROUTED TO	CP5.1>5.	395.	6.58	93.	29.	28.	.44		
+									3.36	6.58
+	HYDROGRAPH AT	DA5.3	109.	7.58	49.	16.	15.	.32		
+	2 COMBINED AT	1.3+1.2	440.	6.67	142.	45.	43.	.76		
+	ROUTED TO	CP5A>5B	425.	6.75	141.	44.	43.	.76		
+									2.94	6.75
+	HYDROGRAPH AT	DA5.41	269.	6.17	45.	14.	14.	.23		
+	2 COMBINED AT	5.53+5.4	531.	6.67	183.	58.	56.	.99		
+	HYDROGRAPH AT	DA5.4	693.	6.25	129.	40.	39.	.73		
+	2 COMBINED AT	CP5B-COM	1091.	6.33	312.	99.	95.	1.71		
+	HYDROGRAPH AT	DA5.5	282.	6.42	59.	18.	18.	.31		
+	2 COMBINED AT	5.0-COMB	1373.	6.42	371.	117.	113.	2.02		

*** NORMAL END OF HEC-1 ***