City of Orlando
Public Works Department
Stormwater Utility Bureau

LAKE ADAIR DIAGNOSTIC STUDY

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Section 1. - Introduction

1.1 Objectives

The purpose of this research was to perform a diagnostic study of Lake Adair to determine factors which contribute to water quality problems associated with excessive planktonic algae growth. This study involved collecting data so that a hydrologic and nutrient budget could be developed for Lake Adair. Hydrologic inputs to Lake Adair which were evaluated included stormwater runoff, stormline base flows, an open channel ditch, overflow discharges from Spring Lake, groundwater seepage through the lake bottom and underdrain discharges. Data was also collected to provide nutrient loading estimates associated with all of the hydrologic inputs evaluated. Nutrient loading from a large colony of migratory cormorants which roosts on the lake was also evaluated. Mathematical modeling of the lake was performed using data collected to develop strategies for improving water quality.

1.2 General Lake Description

Lake Adair is a 10 hectare (25 acre) lake located near downtown Orlando with the entire watershed located in Orlando City limits. The lake is part of the Howell Branch chain of lakes which ultimately flows to the St. Johns River. Lake Adair is the second lake in the chain, receiving upstream flows from Spring Lake and discharging to Lake Concord (Figure 1). A lake overflow drainwell is located on the northeast corner of the lake.

Water quality data collected on Lake Adair indicates hypereutrophic conditions. The Florida Trophic State Index value of the lake was 73 based on 1995 annual average data. Hypereutrophic conditions in Lake Adair are characterized by extremely high levels of productivity in the water column resulting from high concentrations of nutrients. During 1995, Lake Adair was ranked 88 out of 90 City of Orlando lakes for water quality using Trophic State Index values as a rating criteria (McCann and Olson, 1995).

Adair during 1992 was identified in a veterinary pathology report as the most likely cause of death for numerous waterfowl due to exposure to toxins produced by the algae.

Lake Adair has a mean depth of 3.9 m (12.9 ft) and a maximum depth of 4.5 m (14.8 ft). The bottom contours of the lake can be generally characterized by slow gradual slopes along the north and south shoreline with steep slopes along the east and west shoreline. The lake bottom slopes to a depth of 12 ft and then levels off with the central portions being relatively flat and 12 - 14 feet deep. The bottom of the lake consists of a mixture of loose sand along the shoreline with the amount of organic matter slowly increasing with depth. The bottom in the central areas of the lake consist of a surface layer of loose flocculent organic material underlaid by approximately three feet of consolidated black organic sediment.

Despite the fact that a formal wildlife survey has not been conducted, it can be concluded that the lake supports a diverse wildlife community. During the study period wildlife observed included an alligator, water snakes, turtles and several species of fish and wading birds. In winter months the lake supports a large number of migratory waterfowl.

The floral community includes a band of emergent vegetation with submerged plants being absent. Emergent plants consist of mainly giant bulrush (*Scirpus californicus*), pickerel weed (*Pontederia cordata*), Duck potato (*Sagittaria lancifolia*), Wild Taro (*Colocasia esculenta*), Umbrella Flatsedge (*Cyperus alternifolius*) and Egyptian Paspalidium (*Paspalidium geminatum*). The lake bank is rimmed with a band of large cypress trees (*Taxodium distichum*).

1.3 General Watershed Description

Lake Adair receives drainage from a 226 acre watershed. The majority (85%) of the land use in the Lake Adair watershed is residential with the remaining 15% being commercial. The residential land use can be generally described as low density with drainage occurring over brick streets. The soils in the watershed are predominantly well drained which result in low runoff volumes from pervious areas. Dense ground cover resulting from well maintained residential lawns and a heavy oak tree canopy also result in relatively low runoff volumes from the watershed. The commercial land use is located predominantly along Edgewater Drive north of Lake Adair. Drainage for most of the watershed consist of a curb and gutter stormwater drainage system.

Lake Adair also receives discharges from Spring Lake via a culvert under Highway 441 which connects to a free flowing stream that discharges to the SW corner of Lake Adair. Spring Lake overflows to Lake Adair at an elevation of approximately 88.2 ft. M.S.L. It appears that the natural hydrology of the connection between Spring Lake and Lake Adair was altered over one hundred years ago by a railroad as indicated on a 1890 Orange County survey map. The entire potential drainage area of Lake Adair, including Spring Lake drainage, is 706 acres. The 480 acres of drainage area associated with Spring Lake is discharged to a lake side drainage well during normal lake elevations.

Lake Adair flows to Lake Concord via one 42" and two 20" pipes which are located in the SE corner of Lake Adair and run under Edgewater Drive. Water levels in Lake Adair are also controlled by a drainwell located in the NE corner of Lake Adair which conveys lake water to the upper Floridan aquifer.

Section 2. Chemical and Physical Characteristics of Lake Adair

2.1 Current Water Quality

The water quality of Lake Adair has been monitored since late 1989 when the City of Orlando began testing the lake on a quarterly basis. Beginning in 1992, the lake was tested by citizen volunteers on a monthly basis through the University of Florida's LAKEWATCH program. All of the water quality data collected by the City and the LAKEWATCH program is compiled in a database consisting of 75 sampling events since 1989.

Lake Adair is a highly productive system characterized by very high nutrient levels which result in high densities of planktonic algae and low water transparency. High algae densities in the lake result in elevated pH values due to high rates of photosynthesis in the water column. The average pH during 1995 was 8.5 standard units. The high densities of planktonic algae is a result of elevated nutrient levels, particularly phosphorus and nitrogen.

Lake Adair can be classified as a hypereutrophic system based on Florida Trophic State Index values. The trophic state is a measure of the amount of productivity in a lake with hypereutrophic conditions indicating a very high degree of productivity. The parameters used to calculate the Florida Trophic State Index are total phosphorus, total nitrogen, chlorophyll-a and secchi depth. The City of Orlando uses Trophic State Index values to rank lakes by water quality and detect changes over time since eutrophication (the process of a lake increasing in productivity) is a common problem in urban lakes. During 1995, Trophic State Index values in 90 City lakes ranged from 29 to 82 with Lake Adair having a value of 73. The Trophic State Index value for Lake Adair was only exceeded by two other City lakes.

Nutrient levels in Lake Adair are much higher than most City lakes. Phosphorus levels ranged from 0.033 mg/l to 0.399 mg/l with a median value of 0.096 mg/l. Florida lakes are considered to have a potential for trophic related problems such as algae blooms when phosphorus levels exceed 0.050 mg/l (Brezonic 1984). Ortho phosphates, the component of total phosphorus which is readily available for biological uptake, ranged from < 0.005 mg/l to 0.232 mg/l with a median value of 0.009 mg/l. Lake Adair also has elevated levels of nitrogen when compared to other Orlando lakes with concentrations ranging from 0.56 mg/l to 3.72 mg/l and a median concentration of 1.12 mg/l. Most of the nitrogen was in an inorganic form with nitrate and nitrite levels below the detection limit of 0.02 mg/ l for the majority of data. Ammonia levels ranged from < 0.02 mg/l to 0.47 mg/l with a median value of 0.03 mg/l.

Chlorophyll-a, which is used to indicate the biomass of algae present, ranged from 4.3mg/m^3 to 202 mg/m^3 with a median value of 49 mg/m^3 (Table 1). Algae is generally considered to be in a bloom or at nuisance levels when chlorophyll-a concentrations exceed 20 mg/m^3. High planktonic algae concentrations in Lake Adair has resulted in low water transparencies. Secchi depths, which measures water transparency, in Lake Adair ranged from 0.26 m (0.85 ft.) to 1.77 m (5.8 ft.) with a median value of 0.81 m (2.6 ft.) . High rates of carbon dioxide uptake from excessive algal photosynthesis in the water column has resulted in elevated pH values in the lakes water column. Maximum pH values reach 10 standard units and the lake has a median value of 8.0 standard units based on data collected between 1989 and 1996. Mean pH values have shown an increasing trend with annual mean values of 7.5 standard units in 1990 and 9.0 standard units in 1996. The elevated pH in the water column exacerbates the eutrophic conditions by increasing release rates of phosphorus from sediments to the water column.

Lake Adair has much higher total suspended solids than most Orlando lakes, with an average 1996 value of 11.1 mg/l. The vast majority of the solids is organic with a mean volatile suspended solids value of 10.7 mg/l during 1996. The organic nature of the solids indicates that planktonic algae make up the majority of solids found in the lake.

A review of quarterly field data collected since 1990 indicates that dissolved oxygen concentrations in Lake Adair are typically supersaturated on the surface during the daytime due to photosynthetic oxygen production in the water column. Surface dissolved oxygen levels ranged from 3.8 mg/l to 13.94 mg/l with a median value of 8.47 mg/l. The lowest surface dissolved oxygen reading of 3.8 mg/l occurred during a overcast day which indicates a potential for fish kills during low light periods.

Table 1. Summary of Chemical Data for Lake Adair From 1989 to 1996.

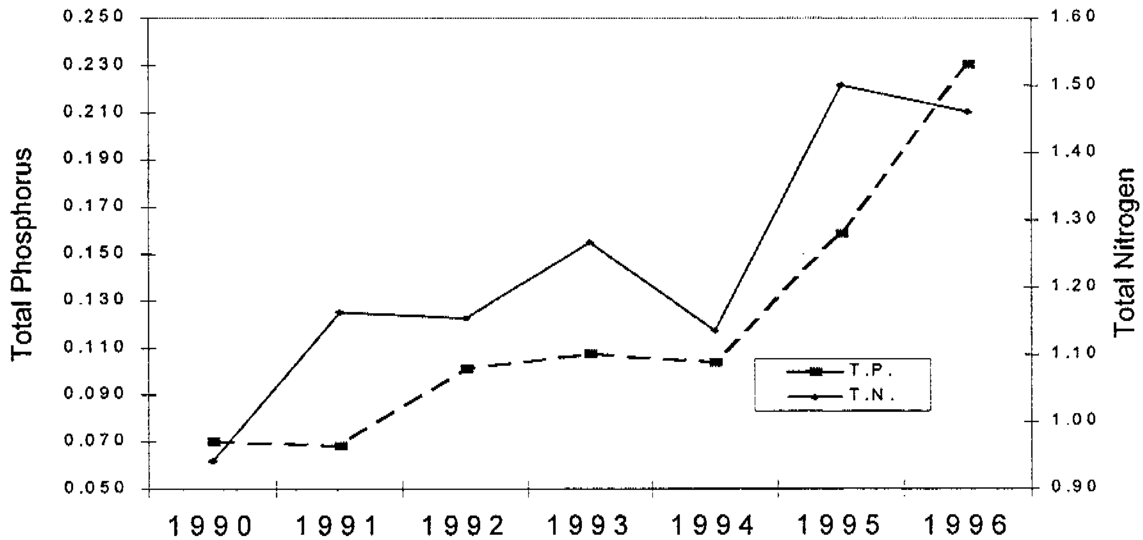
Parameter	Minimum	Maximum	Median
Alkalinity (mg/l)	38	80	59
pH	6.9	10.0	8.0
Specific Conductivity (µmhos @ 25 C)	162	233	203
Total Phosphorus (mg/l)	0.033	0.399	0.096
Ortho Phosphate (mg/l)	<0.005	0.232	0.009
Total Nitrogen (mg/l)	0.56	3.72	1.12
Ammonia (mg/l)	<0.02	0.47	0.03
Nitrate (mg/l)	<0.01	0.07	<0.02
Total Kjeldahl Nitrogen (mg/l)	0.60	3.72	1.28
Total Suspended Solids (mg/l)	2	38	10
Volatile Suspended Solids (mg/l)	2	38	9
Total Dissolved Solids (mg/l)	92	150	124
Fecal Coliform (Col/100ml)	2	1200	66
Secchi Depth (m)	0.26	1.77	0.81
Chlorophyll-a (mg/m^3)	4.3	200	48

2.2 Water Quality Trends

A review of historical water quality data indicates increasing nutrient levels in Lake Adair. Annual average phosphorus concentrations have increased from 0.071 mg/l in 1990 to 0.231 mg/l in 1996. Total nitrogen concentrations also appear to have increased in Lake Adair over time with 1996 data indicating average annual concentrations of 1.46 mg/l compared to 0.94 mg /l in 1990. (Figure 2).

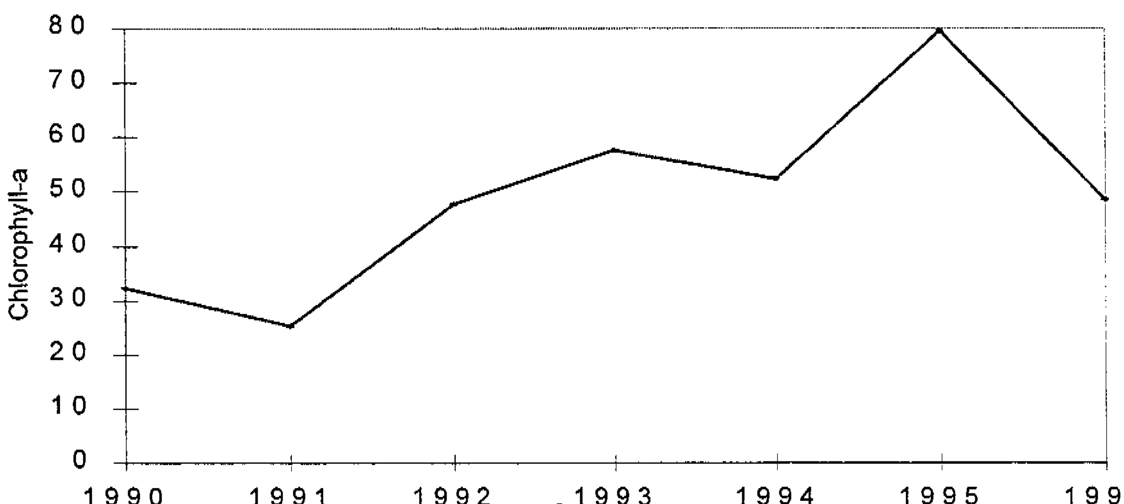
Increasing nutrient levels in Lake Adair has resulted in an increase over time in planktonic algae concentrations.

Figure 2. **Annual Average concentrations (mg/l) of Total Phosphorus and Total Nitrogen in Lake Adair from 1990 to 1996**



Chlorophyll-a concentrations have increased from annual average concentrations of below 35 mg/m³ in 1990 and 1991 to concentrations between 50 mg/m³ to 60 mg/m³ during the 1992 to 1994 time period. Very high Chlorophyll-a concentrations were recorded in 1995 with an average annual value of 80 mg/m³ (Figure 3).

Figure 3. **Annual Average concentrations** (mg/m³) **of chlorophyll-a in Lake Adair from 1990 to 1996.**



2.3 Potential for Stratification and Effect on Dissolved Oxygen

Lake Adair commonly stratifies with the presence of a well defined thermocline present 13 of 33 or 39 % of the times temperature profiles were taken. Stratification is the process where colder water forms a layer underneath warmer surface water and the two layers don't readily mix. The water below the thermocline, which was identified as a change of > 1° C per meter, would typically become anoxic with dissolved oxygen concentrations falling below 1.00 mg/l at the thermocline and falling to near zero at the bottom. The bottom waters of Lake Adair are typically anoxic with dissolved oxygen values ranging from 0.00 mg/l to 9.02 mg/l and a median value of 0.34 mg/l. Since the average depth of the thermocline was 2.6 m and the average depth of Lake Adair is 3.9 m, a large portion of the lake bottom was subjected to anoxic conditions during stratified conditions. Even though the bottom waters in Lake Adair tended to go anoxic during stratified conditions, dissolved oxygen levels still fell below 1.00 mg/l in the lower water column on several occasions during non-stratified conditions.

Section 3. Hydrology of Lake Adair

3.1 Stormwater Runoff

The first step in estimating stormwater runoff quantities was to delineate the watershed and sub-basins for Lake Adair. This was done using existing stormline maps, previously collected watershed data and field surveys. The entire watershed was then divided into twelve sub-basins. All watershed and sub-basin boundaries were verified in the field during rain events by observing flow paths of runoff. Area determinations were made by digitizing boundary locations for input to a microstation program which was then used to produce stormline maps and calculate sub-basin areas.

3.1a Sub-Basin Descriptions

Sub-basin 1 - This is the second largest sub-basin in the watershed at 38.7 acres (Figure 4). This basin consist almost entirely of single family homes except for a small amount of commercial land use on Colonial Drive. The approximate boundary for this basin is Country Club Drive south to Colonial Drive and from Westmoreland Dr. west to North Orange Blossom Trail. Sub-basin 1 discharges by overland flow to the open channel ditch which connects Spring Lake to Lake Adair.

During high lake levels in Spring Lake, an additional 38.0 acres of runoff which flows to Spring Lake under normal water elevations, can discharge into this sub-basin. The 38.0 additional acres is located along North Orange Blossom Trail north of Spring Lake and discharges into a box culvert which connects Spring Lake to Lake Adair. Water flows between Spring Lake and Lake Adair when Spring Lake reaches an elevation of approximately 88.2 ft. M.S.L. When Spring Lake is flowing to Lake Adair part or all of the runoff along a section of North Orange Blossom Trail will flow to Lake Adair, depending on the amount of flow between the lakes.

Figure 4. Sub-basins in the Lake Adair Watershed.

Sub-basin 2 - This sub-basin consists of 10.9 acres of single family residential land use on the southwest corner of Lake Adair. The approximate boundary for this sub-basin is South Lake Adair Blvd., south along Westmoreland Dr. to Alhambra Ct. and east to Cordova Drive. Runoff from this sub-basin flows over land to three catch basins on North Lake Adair Boulevard. This sub-basin was not delineated in the typical manner with a single outfall to the lake because portions of the runoff would bypass catch basins during intense storm events and flow down gradient to the next catch basin.

Sub-basin 3 - This sub-basin consists of 6.0 acres of single family residential land use around the intersection of Seville Pl. And Cordova Drive. Runoff in this sub-basin is collected and discharged to the lake in a 15" outfall pipe.

Sub-basin 4 - This sub-basin consists of 1.3 acres of single family residential land use along South Lake Adair Blvd., east of Cordova Drive. This runoff is discharged to the lake through an 8" outfall pipe.

Sub-basin 5 - This sub-basin consists of 1.3 acres of single family residential land use along Edgewater Dr. adjacent to the east shore of the lake. This runoff is discharged to the lake through an 12" outfall pipe.

Sub-basin 6 - This sub-basin consists of 26.3 acres of single family residential land use along the northwest portions of the lake's watershed. The approximate drainage area for this sub-basin is from Westmoreland Dr. along Reading Dr. to Guernsey St. and back east to Westmoreland Dr. along Golfview St. and Shady Lane Drive. This runoff is collected in a

24" pipe which runs along Reading Dr. and discharges to the lake on the west shoreline through a 12" outfall pipe.

Sub-basin 7 - This sub-basin consists of 8.3 acres of single family residential land use on the northwest corner of the lake along Belleaire Cr. and Westmoreland Drive. This runoff is discharged to the lake through a 12" outfall pipe.

Sub-basin 8 - This sub-basin consists of 8.3 acres of single family residential land use along the north shore of Lake Adair. This runoff is discharged to the lake through a 12" pipe.

Sub-basin 9 - This sub-basin consists of 1.24 acres of single family residential land use on the northeast corner of Lake Adair. This runoff is discharged to the lake through a 15" pipe.

Sub-basin 10 - This sub-basin consists of 14.3 acres of mixed multifamily and single family residential land use. The approximate boarder for this basin is from Eastin Ave., east to Edwards Ln. and from Lakeview St. north to Sheridan Boulevard. This runoff is discharged to the lake through a 30" pipe.

Sub-basin 11 - This sub-basin consists of 17.3 acres of single family residential land use. The approximate border for this basin is from Westmoreland Dr., east to Edgewater Dr. and from Oak St. north to Golfveiw Boulevard. This runoff is discharged to the lake through a 12" outfall pipe.

Sub-basin 12 - This is the largest sub-basin in the Lake Adair watershed at 68.7 acres. This sub-basin consists of approximately half single family residential land use and half commercial. The commercial areas extend from the northeast corner of the lake, north to

Bryn Mawr St. along Edgewater Drive. The approximate boundary for the residential portions is from Westmoreland Dr., east to Edgewater Dr. and from Golfview St., north to Yates St. Runoff for this sub-basin is collected in a deep 48" stormline which runs down the middle of Edgewater Dr.

3.1b Estimation of Runoff Volumes

Annual runoff volumes for each Lake Adair sub-basin was estimated using a model developed by Dr. Harvey Harper which calculates runoff using the Santa Barbara Urban Hydrograph Method for each sub-basin over a number of common rainfall event intervals (Herr, 1995). Runoff volume was modeled based on the number of annual rain events which fell into each of eleven rainfall intervals. The number of rain events which fell in each interval was determined from probability distribution of rainfall data collected at the Orlando International Airport from 1973 - 1992. An annual runoff volume and weighted runoff coefficient was determined from the sum of runoff from each rainfall interval and based on an average annual rainfall of 50.0 inches. This method was used to avoid overestimating runoff volumes using literature based runoff coefficients or modeling which is typically used for design purposes such as estimating volumes or peak flows for large design storms.

Since flow and rainfall data was collected at sub-basin 1, sub-basin 6 and sub-basin 12 an evaluation could be made to evaluate the accuracy of the modeling method by comparing modeling results to empirical data. Flows and rainfall data from 35 rain events were collected at sub-basin 1 and runoff coefficients were calculated for each event. The average runoff coefficient for the 35 events in sub-basin 1 was measured at 0.148 which compared well to the value of 0.114 predicted by runoff modeling. At sub-basin 6, data from 24 rain events was collected and an average runoff coefficient of 0.205 was measured which also agreed well with the value of 0.183 predicted by modeling. Empirical data collected from sub-basin 12 resulted in a mean runoff coefficient of 0.102 which did not agree with the model value of 0.338. Due to the commercial land use in sub-basin 6 it appears that the measured runoff coefficient of 0.102 was the result of inaccurate flow measurements and one would expect a value closer the model value of 0.338. The decision that the flow measuring equipment at sub-basin 12 produced less accurate flow determinations than the model was also based on the fact that equipment calibration occurred infrequently due to limited access to the flow sensor as well as the potential for error with the flow equation used (Manning). The fact that the runoff coefficients predicted by the model were slightly lower than the measured values at sub-basin 1 and 2 would be expected since rainfall events which were too small to produce runoff were accounted for with the model but not with the flow measuring equipment. Due to the close agreement between empirical and modeled data at sub-basin 1 and 6, it was concluded that the Santa Barbara method calculated over several rainfall intervals, provided good estimates of runoff volumes in the Lake Adair watershed

The total runoff from the Lake Adair watershed was estimated at 171.6 acre feet using the Santa Barbara model (Table 2). Sub-basin 12 produced the majority of runoff with an estimated 94.7 ac-ft or 55.2% of the total runoff. Sub-basin 6 and 1 produced an estimated 11.4% and 10.5% of the total runoff, respectively. The remaining nine sub-basins produced a combined total of 22.9% of the total runoff.

Table 2. Annual Runoff Volumes From Lake Adair Sub-Basin

Sub-Basin	Acreage	Runoff Coefficient	Runoff Volume (ac-ft)	Sub-Basin % Runoff
1	38.7	0.114	18.0	10.5
2	10.9	0.135	6.0	3.5
3	6.0	0.168	4.1	2.4
4	1.3	0.214	1.1	0.6
5	2.3	0.239	2.2	1.3
6	26.3	0.183	19.6	11.4
7	8.3	0.163	5.5	3.2
8	6.5	0.100	2.6	1.5
9	1.2	0.192	0.9	0.5
10	14.3	0.157	9.2	5.4
11	17.3	0.110	7.7	4.5
12	68.7	0.338	94.7	55.2
Total	201.8		171.6	100.0

3.2 Stormline Baseflows

Significant dry weather inflows to Lake Adair originate from sub-basins 1, 6 and 12 due to groundwater seepage into stormwater conveyance systems. The baseflow in sub-basin 1 is due to groundwater seepage into the stream located between Westmoreland Dr. and Edgewater Court. Baseflows to the lake from sub-basin 6 originates from groundwater seepage into the 24" stormline located along Reading Dr. which discharges to the lake. Baseflows to the lake from sub-basin 12 originates from groundwater seepage into the 48" stormline located along Edgewater Drive.

3.2a Sub-basin 1 Stream Baseflow

Stream baseflow at sub-basin 1 was measured with continuous flow measurement equipment set up just east of where the open channel stream flows under Westmoreland Avenue. A compound weir consisting of a sharp crested weir with 90° V notch was installed across the stream. Baseflow was measured using an Omni ES-310C float and pulley water level sensor to determine the water level behind the 90° V notch weir. The equation used to measure flows was:

$$\mathbf{Q = KH^{2.5}}$$

Where: Q = Flow rate (cfs)
K = Constant = 2.50
H = Head over weir (ft)

The flows occurring at the sub-basin 1 station consisted of stormwater runoff, Spring Lake overflows and baseflows. Annual baseflows were determined by reviewing continuous flow data from 9/28/95 to 9/28/96 and subtracting all flows associated with storm events and Spring Lake overflows. Differentiating constant low level baseflow conditions from the flow data was straight forward due the relatively rapid increase and decrease in flows associated with Spring Lake overflows and runoff.

Flow data indicated the annual baseflow from sub-basin 1 to Lake Adair ranged from 0.058 cfs to 0.175 cfs with an annual discharge volume of 42.9 ac-ft.

3.2b Sub-basin 6 Baseflow

Baseflow at sub-basin 6 was measured using the simple but accurate, timed bucket method. Even though automated flow measuring equipment was set up at this site, the primary measuring devise was a sharp crested weir, which is accurate for high flow conditions associated with stormwater runoff, but is not accurate with low flow conditions such as baseflows. Equipment for the timed bucket method consisted of a five gallon bucket (marked exactly at the point where it holds four gallons) and a stop watch. The bucket was placed under the outfall pipe during baseflow conditions and the stopwatch measured the amount of time to fill four gallons. This method produced an accurate flow rate in gallons per second which was then converted to cubic feet per second. This procedure would be duplicated three times during each flow measuring event and averaged. The outfall pipe at sub-basin 6 was ideal for this method due to the low flow rates and since the invert elevation of the pipe was high enough above water to intercept the flows with a bucket.

Baseflows were measured eight times at sub-basin 6 between 9/21/95 and 9/13/96. Flow rates ranged from 0.022 cfs to 0.093 cfs with an average flow rate of 0.056 cfs. This flow rate is equivalent to an annual discharge volume of 40.6 ac-ft from sub-basin 6 to Lake Adair.

3.2c Sub-basin 12 Baseflow

Baseflow at sub-basin 12 was estimated by measuring the wetted perimeter of the 48" stormline on Edgewater Dr. and using the Manning equation. The formula used was:

$$\mathbf{Q = (1.49AR^{2/3}S^{1/2})/\ n}$$

where: Q = Quantity of Flow in cfs

n = Manning coefficient of roughness dependent on material of conduit = 0.011

A = Cross sectional area of flow in square feet

R = Hydraulic radius in feet

S = Slope of the hydraulic gradient = 0.002

Since the 48" stormline which drains sub-basin 12 was submerged at the outfall, flow measurements were taken up gradient at the intersection of Edgewater Dr. and Sheridan Blvd. at which point the invert elevation of the line was above lake level. Due to the depth of the Edgewater Dr. stormline (approx. 20') and traffic conditions, access for flow measurements was difficult and potentially hazardous, resulting in only four flow measurements between 9/22/95 and 9/17/96. During this time period, baseflow rates ranged between 0.168 cfs to 0.355 cfs with an average flow rate of 0.231 cfs. This flow rate would result in an annual discharge volume of 167.3 ac-ft of baseflow from sub-basin 12 to Lake Adair.

The total annual volume of water entering Lake Adair from baseflows through stormwater conveyance systems was estimated at 250.8 ac-ft (Table 3). The majority (66.7%) of the baseflow originates from the 48" stormline which drains sub-basin 12 where the annual discharge was estimated at 167.3 ac-ft. Baseflow from sub-basin 1 and 6 were almost equal with annual discharge volumes of 42.9 ac-ft and 40.6 ac-ft., respectively.

Table 3. **Summary of Base-flow Data for Lake Adair.**

	Flow Range cfs	Annual Volume ac-ft
Sub-Basin 1	0.058 - 0.175	42.9
Sub-Basin 6	0.022 - 0.093	40.6
Sub-Basin 12	0.168 - 0.355	167.3
Total		250.8

3.3 Lake Adair Underdrains.

In order to prevent groundwater from seeping across sidewalks along North and South Lake Adair Blvd., underdrains were installed to intercept groundwater and pipe it to Lake Adair. The discharge from three underdrain systems were located and flows were measured one time to determine if these systems were a significant source of inflow to the lake. Two of the underdrain systems are located in the southwest corner of the lake and one is located along the north shoreline. Flows were measured on 7/18/96 by determining the time it took the underdrain system to fill a 2 liter bottle. The annual discharge volume from the three underdrain systems were estimated at 0.7 ac-ft, 3.6 ac-ft and 8.7 ac-ft. The total annual discharge from the three underdrain systems was estimated at 13.0 ac-ft.

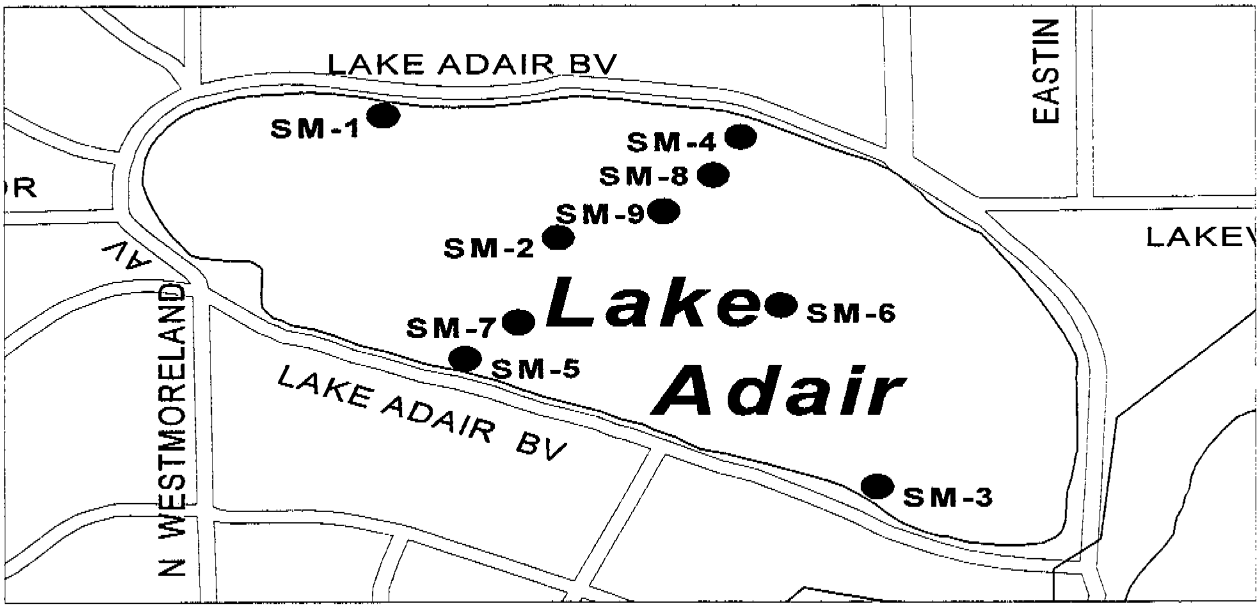
3.4 Groundwater Seepage

In order to determine the volume of groundwater seepage into Lake Adair, seepage meters were installed in the lake bottom. Seepage flux of groundwater can be measured by enclosing an area of lake bottom with a cylinder vented to a plastic bag (Lee, 1977). The seepage meters consisted of a 55 gallon drum with one end cut off. The drum's bung hole in the closed end was then fitted with a water tight quick release connector to which a 39 gallon heavy duty polyethylene bag was attached using hose clamps. The drums were then installed in the lake bottom by a scuba diver using a sledge hammer to drive the drum several inches into consolidated bottom sediments. The meter was allowed to equalize with the groundwater for approximately one week before data was collected. The water which collected in the bag over time represented the amount of groundwater seepage which would enter the lake through the lake's bottom. Since the cross sectional area of the seepage meter (0.255 m^2) and the amount of time in the field was known, seepage rates could be calculated.

Seepage meters were placed at 9 locations in Lake Adair in depths ranging from 1.1 m to 4.3 m (Figure 5). Four of the seepage meters were placed along the shoreline with two on the north shore and two on the south shoreline. Two of the meters were placed at mid depths of 2.7 m with one meter in the northern and one in the southern half of the lake. One meter was placed in a depth of 3.6 m depth. The last two meters were placed near the center of the lake at a depth of 4.3 m. The meters were placed in this manner because other research has shown a strong relationship between seepage rates and distance from shoreline (Lee, 1977). The intent of the sampling design was to collect data along a north - south transect across the lake and use regression analysis to develop equations which would predict seepage rates throughout the lake based on the distance from the shoreline. A review of the data indicated only a general trend of decreasing seepage rates as distance from shoreline increased. Due to a high degree of variability in the data and lack of a well defined relationship between seepage and distance from the shore, whole lake seepage volumes were based on an average of the nine stations.

Water was always present in the seepage meter bags at all nine station in Lake Adair, indicating groundwater was entering the lake. Empty seepage bags would indicate zero seepage or an outflow of lake water to the aquifer. Mean seepage rates at the nine stations ranged from 0.19 liters m^{-2} day^{-1} to 6.31 liters m^{-2} day^{-1} (Table 4) with an overall mean seepage rate of 2.72 liters m^{-2} day^{-1}.

Figure 5. Location of Seepage Meters in Lake Adair.



Seepage was lowest at station SM9 which was located at a depth of 3.6 m near the center of the lake. The highest seepage rates were measured at station SM3 which is in the southeast corner of the lake. The high groundwater inflows in the southeast corner of the lake was unexpected since it would seem that groundwater in this area would flow down gradient to nearby Lake Concord.

Table 4. Summary of Seepage Meter Data Collected at Lake Adair.

Station	Mean Seepage (liters m^{-2} day^{-1})	Seepage Range (liters m^{-2} day^{-1})	Meter Depth (m)	Samples
SM1	2.74	1.84 - 3.61	1.3	8
SM2	1.23	0.90 - 2.39	4.3	6
SM3	6.31	3.22 - 9.22	1.1	8
SM4	1.93	1.03 - 4.58	1.2	13
SM5	5.16	2.97 - 7.14	1.1	9
SM6	0.44	0.25 - 0.50	4.3	5
SM7	0.85	0.64 - 1.14	2.7	5
SM8	5.66	1.25 - 7.89	2.7	3
SM9	0.19	0.10 - 0.25	3.6	4

The total annual volume of groundwater seepage into Lake Adair was estimated using the equation:

$$\textbf{2.72 liters m}^{-2}\textbf{ day}^{-1}\textbf{ X 101,580 m}^{2}\textbf{ X 365 days = 100,848,624 liters = 81.8 ac-ft}$$

Where: 2.72 liters m^{-2} day^{-1} = average seepage rate of the eight seepage stations
101,580 m^2 = surface area of Lake Adair
365 days = converts from days to a year

3.5 Spring Lake Overflows

Lake Adair receives discharges from Spring Lake via a box culvert under Highway 441 which connects to a free flowing stream in sub-basin 1. The stream discharges to the southwest corner of Lake Adair. Spring Lake overflows to Lake Adair at an elevation of approximately 88.2 ft. M.S.L.

Spring Lake overflows were measured at sub-basin 1 with continuous flow measurement equipment set up just east of where the open channel stream flows under Westmoreland Avenue. A compound weir consisting of a sharp crested weir with 90° V notch was installed across the stream. Flow was measured using an Omni ES-310C float and pulley water level sensor to determine the water level behind the 90° V notch weir. The equation used to measure flows was:

$$\mathbf{Q = KH^{2.5}}$$

Where: Q = Flow rate (cfs)
K = Constant = 2.50
H = Head over weir (ft)

Total flows occurring at the sub-basin 1 station consisted of Spring Lake overflows, stormwater runoff and baseflows. Annual baseflows were determined by reviewing continuous flow data from 9/28/95 to 9/28/96 and subtracting all flows associated with storm events and stream baseflows. Spring Lake overflows only occurred after heavy rains and could be differentiated from the flow data from the rapid increase and decrease in flows associated with storm events and the steady low flow conditions associated with stream baseflows. Data indicated peak flow rates from Spring Lake overflows to Lake Adair were 8.5 cfs with an annual volume of 236.7 ac-ft.

3.6 Direct Precipitation

The volume of inflows to Lake Adair resulting from direct precipitation on the surface of the lake was not included in the hydrologic budget since it was assumed that evaporation was approximately equal to precipitation.

3.7 Summary of Inflows

The majority (33.3%) of the 753.9 ac-ft of water entering Lake Adair originated from surficial groundwater baseflows though stormwater systems in sub-basins 1, 6 and 12. Groundwater seepage into the 48" stormline in sub-basin 12 accounts for 167.3 ac-ft of the 250.8 ac-ft associated with stormwater systems baseflows. Spring Lake overflows which enter Lake Adair through sub-basin 1 contribute 31.4% of the inflows to Lake Adair with an annual volume of 236.7 ac-ft. Stormwater runoff was estimated to generate 22.8% of the total inflow with an annual volume of 171.6 ac-ft. Groundwater seepage through the bottom of Lake Adair was estimated to generate 10.8% of the inflow with an annual volume of 81.8 ac-ft. Groundwater seepage rates for Lake Adair appear normal for Central Florida lakes with Fellows (1980) reporting that groundwater seepage contributed 17.5% and 2.0%, respectively, to nearby Lake Conway and Lake Apopka. Underdrains located along sidewalks on Lake Adair Blvd. contributed 1.7% of the inflow with an annual volume of 13.0 ac-ft.

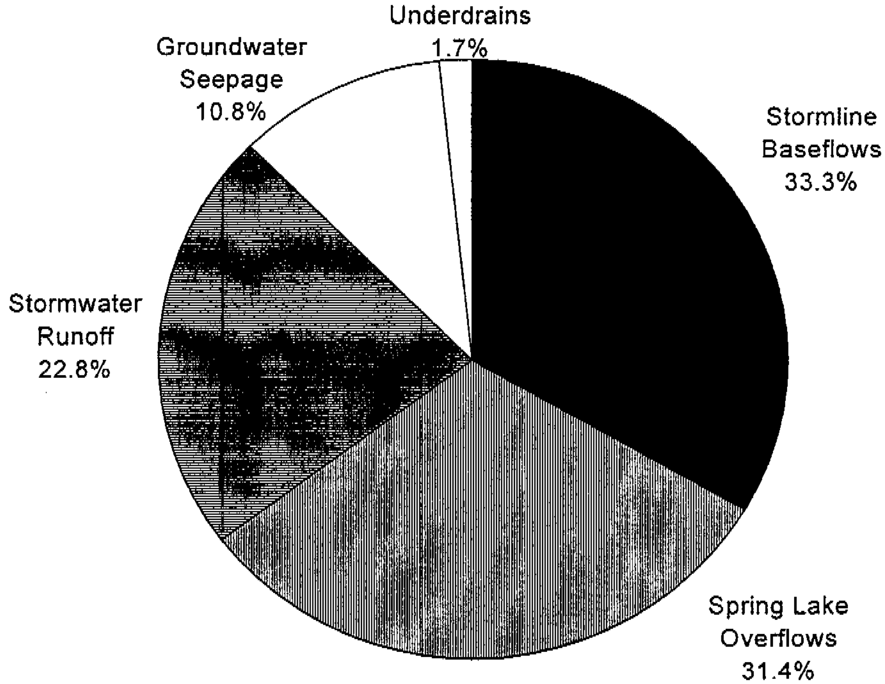


Figure 6. Percent Contribution of Inflows to Lake Adair.

3.8 Mean Hydraulic Resident Time.

Lake hydraulic resident time is the amount of time required to renew a lake's water volume and is determined by dividing the lake volume by total estimated inflows. Total annual inflow to Lake Adair was estimated to be 753.9 ac-ft during the study period and the volume of the lake is 415.0 ac-ft. Based on these estimates the mean hydraulic resident time for Lake Adair is equal to 0.55 years or 201 days. The hydraulic resident time has significant impacts on water quality. Algae biomass will increase with resident time since more time is provided to utilize available nutrients before being flushed from the system. Increasing resident time also increases the amount of nutrients and algae which will accumulate in the lake.

Section 4. Nutrient Loading to Lake Adair

4.1 Stormwater Runoff

Nutrient inputs from stormwater runoff was estimated by multiplying runoff volumes times phosphorus and nitrogen concentrations. Three automatic stormwater sampling stations were set up in the Lake Adair watershed to collect site specific data on nutrient concentrations. Automatic stormwater samplers were installed in sub-basins 1, 6, and 12. Nutrient data was collected at sub-basin 1 because it was not typical of other sub-basins since stormwater runoff was conveyed to the lake through a free flowing stream instead of pipes. Data was collected at sub-basin 6 to characterize stormwater runoff from residential areas in the Lake Adair watershed. A sampler was set up to collect data at sub-basin 12 because it was the only sub-basin which contained significant areas of commercial land use.

4.1a Description of Sub-basin Sampling Methods

Sub-basin 1

Stormwater runoff samples at sub-basin 1 were collected as flow proportionate composite samples using continuous flow measurement equipment set up just east of where the open channel stream flows under Westmoreland Ave. A 90° V notch weir was installed across the stream and water level upstream of the weir was measured using an Omni ES-310C float and pulley water level sensor installed in a PVC stilling well. The float and pulley was integrated with a Campbell CR10 data logger which was programmed to measure flow rates in the stream using the equation:

$$\mathbf{Q = KH^{2.5}}$$

Where: Q = Flow rate (cfs)
K = Constant (2.50)
H = Height over weir (ft)

The data logger was programmed to totalize flows during a storm event and at a predetermined flow volume send a pulse which triggered an Isco 3700 auto sampler to collect a sample of stormwater runoff. Event mean concentrations of stormwater runoff were obtained by a composite sample composed of a series of constant volume sub-samples collected at a time interval which varied with flow rates. For example, if the data logger was programmed to collect a sample for each 100 ft^3 of flow from a storm which produced 30,000 ft^3 of flow, the composited sample would consist of 30 sub-samples collected at a variable time interval dependent on flow rate.

To avoid collecting baseflow samples, the data logger was programmed to only trigger the sampler to collect samples at a predetermined elevation which was slightly higher than current baseflow stream elevations. Stormwater samples were not collected during periods when Spring Lake was overflowing to Lake Adair since the data logger could not be programmed to differentiate between these two flow conditions.

Sub-basin 6

Stormwater runoff samples at sub-basin 6 were collected as flow proportionate composite samples from the 24" stormline which runs along Reading Drive. Automatic sampling equipment and a sharp crested weir was set up in the catch basin at the intersection of Westmoreland Ave. and Reading Drive. Flow measuring equipment consisted of a sharp crested weir and Sigma 800SL auto sampler with an Integral Flowmeter. This equipment integrates a pressure transducer to measure water height with an automatic sampler. The pressure transducer was installed upstream of the weir and flows were measured using the sharp crested weir equation:

$$\mathbf{Q = KLH^{1.5}}$$

Where: Q = Flow rate (cfs)
K = Constant (2.50)

L = Length of weir = 39"
H = Head over weir

The sampler was programmed to collect flow proportionate composite samples of stormwater runoff. The sampler would begin collecting data and stormwater runoff with a rise in water level associated with a storm event.

Sub-basin 12

Stormwater runoff samples at sub-basin 12 were collected as flow proportionate composite samples from the 48" stormline on Edgewater Drive. Automatic sampling equipment was set up at the intersection of Edgewater Dr. and Sheridan Blvd. since the stormline down gradient of this point was surcharged with lake water and hydraulically unsuitable for measuring flow. Sampling equipment was identical to sub-basin 6 except a weir was not used. Flows were measured using the manning equation:

$$\mathbf{Q = (1.49AR^{2/3}S^{1/2})/ n}$$

where:
Q = Quantity of flow in cfs
n = Manning coefficient of roughness dependent on material of conduit = 0.011
A = Cross sectional area of flow in square feet
R = Hydraulic radius in feet
S = Slope of the hydraulic gradient = 0.002

The sampler was programmed to collect flow proportionate composite samples of stormwater runoff with an increase in water level which was associated with a storm event.

4.1b Chemical Characteristic of Stormwater Runoff

Samples collected from all three sub-basins were analyzed for total nitrogen, ammonia nitrogen, nitrate nitrogen, total phosphorus and ortho phosphate. Approximately half of the samples collected were also analyzed for cadmium, copper, lead and zinc which are heavy metals commonly found in stormwater runoff.

Sub-basin 1. (Residential)

Total phosphorus concentrations ranged from 0.151 mg/l to 3.36 mg/l with a mean value of 1.04 mg/l for the seven storm events sampled between 9/27/95 to 8/12/96. The mean concentration of phosphorus at sub-basin 1 was higher than expected for a residential land use, with more than twice the concentration as samples collected at sub-basins 6 and 12. Two of the samples which had much higher phosphorus concentrations occurred during large storm events with intense rainfall. Since stormwater in this sub-basin is conveyed through a open channel stream, it appears that some large storms may create water velocities which result in erosion and elevated phosphorus concentrations. Ortho phosphate, which is the soluble reactive component of total phosphorus available for direct utilization by plants ranged from 0.055 mg/l to 0.406 mg/l with a mean value of 0.166 mg/l.

Total nitrogen concentrations ranged from 0.82 mg/l to 8.05 mg/l with a mean value of 3.42 mg/l. Most of the nitrogen was in an organic form with nitrite and nitrate having mean concentrations of 0.012 mg/l and 0.43 mg/l, respectively. Ammonia, which is a form of nitrogen that can be directly utilized by plants along with inorganic forms, ranged from <0.03 mg/l to 0.88 mg/l with a mean value of 0.26 mg/l.

Results of four samples analyzed for heavy metals indicated low concentrations typical of stormwater runoff from residential land use. Cadmium concentrations ranged from 0.0003 mg/l to 0.0008 mg/l with a mean value of 0.0004 mg/l. Copper concentrations were near the detection limit with values ranging from <0.010 mg/l to 0.021 mg/l and a mean value of 0.015 mg/l. Lead concentrations ranged from 0.007 mg/l to 0.034 mg/l with a mean value of 0.018 mg/l. Zinc concentrations ranged from 0.043 mg/l to 0.095 mg/l with a mean concentration of 0.063 mg/l.

Sub-basin 6 (Residential)

Total phosphorus concentrations ranged from 0.093 mg/l to 0.933 mg/l with a mean value of 0.441 mg/l for the eight storm events sampled between 10/10/95 to 8/1/96. Ortho phosphates were similar to values in sub-basin 1 with concentrations ranging from 0.037 mg/l to 0.296 mg/l with a mean value of 0.104 mg/l. Nitrogen concentrations were very similar to sub-basin 1. Total nitrogen ranged from 0.72 mg/l to 7.10 mg/l with a mean value of 3.42 mg/l. Most of the nitrogen was organic with the nitrite and nitrate having mean concentrations of 0.011 mg/l and 0.53 mg/l, respectively. Ammonia concentrations ranged from <0.03 mg/l to 0.54 mg/l with a mean value of 0.26 mg/l.

Three samples were analyzed for heavy metals with data indicating concentrations typical of stormwater runoff. The range of concentrations for cadmium was 0.0001 mg/l to 0.0002 mg/l with a mean concentration of of 0.0002 mg/l. Copper ranged from 0.005 mg/l to 0.010 mg with a mean concentration of 0.007 mg/l. Concentrations of lead ranged from 0.006 mg/l to 0.007 mg/l with a mean value of 0.007 mg/l. Zinc concentrations ranged from 0.030 mg/l to 0.053 mg/l with a mean value of 0.042 mg/l.

Sub-basin 12 (Residential/Commercial)

Total phosphorus and ortho phosphate concentrations were lower in this sub-basin than the other two sample sites. Total phosphorus values ranged from 0.072 mg/l to 0.608 mg/l with a mean value of 0.321 mg/l for the nine storm events sampled from 9/27/95 to 7/24/96. Ortho phosphate ranged from <0.005 mg/l to 0.265 mg/l with a mean value of 0.166 mg/l.

Nitrogen values were also slightly lower at this site with concentrations ranging from 0.40 mg/l to 4.70 mg/l and a mean value of 2.08 mg/l (Table 5). Most of the nitrogen was organic with the nitrite and nitrate having mean concentrations of 0.010 mg/l and 0.26 mg/l, respectively.

Ammonia concentrations ranged from <0.03 mg/l to 0.54 mg/l with a mean value of 0.018 mg/l

Five sub-basin 12 runoff samples were analyzed for metals. Metal concentrations in this sub-basin were similar to the two residential sub-basins with the exception of zinc which was considerably higher in sub-basin 12. The range of concentrations for cadmium was 0.0001 mg/l to 0.0007 mg/l with a mean concentration of of 0.0003 mg/l. Copper ranged from 0.008 mg/l to 0.020 mg with a mean concentration of 0.012 mg/l. Concentrations of lead ranged from 0.005 mg/l to 0.029 mg/l with a mean value of 0.014 mg/l. Zinc concentrations ranged from 0.044 mg/l to 0.419 mg/l with a mean value of 0.173 mg/l.

Table 5. Summary of Chemical Data for Stormwater Runoff Samples Collected in the Lake Adair Watershed. All Concentrations are mg/l.

	Sub-Basin 1 mean (range)	Sub-Basin 6 mean (range)	Sub-Basin 12 mean (range)
AMMONIA	0.26 (<0.03 - 0.88)	0.20 (<0.03 - 0.54)	0.18 (<0.03 - 0.54)
NITRATE	0.43 (0.06 - 0.92)	0.53 (0.05 - 1.09)	0.26 (<0.02 - 0.63)
NITRITE	0.012 (0.005 - 0.021)	0.011 (<0.005 - 0.077)	0.010 (<0.005 - 0.027)
TOTAL NITROGEN	3.42 (0.82 - 8.05)	3.42 (0.72 - 7.10)	2.08 (0.40 - 4.70)
TOTAL PHOSPHORUS	1.04 (0.151 - 3.36)	0.441 (0.093 - 0.933)	0.321 (0.072 - 0.608)
ORTHO PHOSPHATE	0.166 (0.055 - 0.406)	0.104 (0.037 - 0.296)	0.082 (<0.005 - 0.265)
CADMIUM	0.0004 (0.0003 - 0.0008)	0.0002 (0.0001 - 0.0002)	0.0003 (0.0001 - 0.0007)
COPPER	0.015 (<0.010 - 0.021)	0.007 (0.005 - 0.010)	0.012 (0.008 - 0.020)
LEAD	0.018 (0.007 - 0.034)	0.007 (0.006 - 0.007)	0.014 (0.005 - 0.029)
ZINC	0.063 (0.043 - 0.095)	0.042 (0.030 - 0.053)	0.172 (0.044 - 0.419)

4.1c Nutrient Loading to Lake Adair From Stormwater Runoff

Mass loading of phosphorus and nitrogen was determined using stormwater runoff volumes which were estimated for each sub-basin and analytical data from runoff samples collected in the lake's watershed. Nutrient loading estimates for sub-basin 1 was based on site specific chemical data since it was the only basin which conveyed runoff through an open channel stream. Site specific chemistry data was also used at sub-basin 12 due to the mixed residential and commercial land use. Nutrient data collected at sub-basin 6 was used for loading estimates for sub-basins 2 - 5 and sub-basins 7 - 11 since the land use for all these sub-basins consisted of very similar residential landuse.

Mass loading of nutrients from each sub-basin was determined by multiplying the estimated annual volume of runoff in liters from the sub-basin times mean phosphorus and nitrogen concentrations in mg/l associated with the sub-basin. The results of this equation is a mass loading in milligrams since the liter unit cancels out. The loading rate is then converted to kg by dividing the result in mg by 1,000,000.

Using this method, Lake Adair receives an estimated annual phosphorus input of 92.6 kg from stormwater runoff produced in the entire watershed. Sub-basin 12 contributes the most phosphorus (40.5%) of any single sub-basin with an estimated annual loading of 37.5 kg. Sub-basin 1 contributes 24.9% of the phosphorus with an estimated annual loading of 23.1 kg. With the exception of sub-basin 6 which contributes 11.6% of the phosphorus loadings, no remaining single sub-basins contributed greater than 6% of the total phosphorus loadings associated with runoff (Table 6).

Total nitrogen loading from stormwater runoff was estimated to be 567.1 kg. Sub-basin 12 contributed the majority (42.8%) of the nitrogen loading with an estimated 242.9 kg. Sub-basin 6 was the second largest contributor of nitrogen with an estimated input of 82.6 kg, which was 14.6% of the watershed loading. Sub-basin 1 contributed 13.4% of the nitrogen loading with an estimated annual input of 75.9 kg. No remaining single sub-basins contributed greater than 7% of the nitrogen loading associated with runoff.

Table 6. Summary of Phosphorus and Nitrogen Loading to Lake Adair from Stormwater Runoff.

Basin	Phosphorus Loading kg/year	Nitrogen Loading kg/year	% Total Loading Phosphorus	% Total Loading Nitrogen
1	23.1	75.9	24.9	13.4
2	3.3	25.3	3.5	4.5
3	2.2	17.3	2.4	3.0
4	0.6	4.6	0.6	0.8
5	1.2	9.3	1.3	1.6
6	10.6	82.6	11.6	14.6
7	3.0	23.2	3.2	4.2
8	1.4	11.0	1.5	1.9
9	0.5	3.8	0.5	0.7
10	5.0	38.7	5.5	6.8
11	4.2	32.5	4.5	5.7
12	37.5	242.9	40.5	42.8
Total	92.6	567.1	100.0	100.0

4.2 Groundwater Seepage/Internal Loading

Seepage meters which were installed in Lake Adair to determine volumes of groundwater entering the lake, were also used to determine nutrient loading from groundwater seepage and internal loading associated with sediment release of phosphorus and nitrogen. Water chemistry data was not collected at a ninth seepage meter (station SM9) because seepage rates were not high enough to provide sufficient volume for analysis. The seepage meters consisted of a 55 gallon drum with one end cut off. The drum's bung hole in the closed end was then fitted with a water tight quick release connector to which a 39 gallon heavy duty polyethylene bag was attached using hose clamps. The drums were then installed in the lake bottom by a diver using a sledge hammer to drive the drums several inches into consolidated bottom sediments. The water which collected in the bag over time consisted of groundwater seepage which would enter the lake through the lake's bottom. The meter was allowed to equalize with the groundwater for approximately one week before data was collected. Samples collected from the seepage meter were filtered in the field with 0.7 micron glass fiber filters.

In addition to nutrients present in the groundwater, the water collected in the seepage bag would contain nutrients which were released from the bottom sediments to the water column inside the seepage meter. For this reason, samples collected from the seepage meters were assumed to measure nutrient levels resulting from groundwater contributions and internal nutrient loading from the lake sediments.

4.2a Chemical Characteristics of Groundwater Seepage Meter Water.

Samples collected from the seepage meters had a high variability in nutrient concentrations between sampling stations. With the exception of a general tendency for elevated phosphorus concentrations along the shoreline and elevated nitrogen along the north shoreline, data did not indicate any clear relationship between site location and water chemistry. In general, nutrient concentrations in the seepage meter samples were much higher than the lake water. Variation in water chemistry also existed between samples collected from the same station.

Mean total phosphorus concentrations ranged from 0.022 mg/l to 2.18 mg/l with an overall station mean of 0.93 mg/l. Stations SM1, SM4, and SM5 were all shoreline stations and had the three highest phosphorus concentrations among the eight meters. SM8 had much lower phosphorus concentrations than other sites and was unusual because it was a deep water station with high seepage rates. Most of the phosphorus at all seepage meter stations was predominantly in the form of ortho phosphate, except SM8 which had concentrations ranging from 0.009 mg/l to 1.99 mg/l.

Seepage water had high concentrations of nitrogen in Lake Adair. Mean total nitrogen concentrations ranged from 1.80 mg/l to 10.25 mg/l with an overall station mean of 7.02 mg/l. The highest concentrations of nitrogen was along the north shoreline where SM1 and SM4 had mean concentrations of 10.25 mg/l and 14.02 mg/l, respectively. The forms of nitrogen present varied greatly between sites and did not appear to have any relationship to meter locations. Nitrogen was predominantly in the form of ammonia at SM3, SM5 and SM6 which were two shoreline and one mid lake sites. Nitrogen was predominantly inorganic being composed of nitrate and nitrite at SM2, SM4 and SM7 which were shoreline, mid depth and deep water sites. Predominantly, organic nitrogen was present at SM1 and SM8 which was a shoreline and mid depth site (refer to Figure 5 for meter locations).

Elevated chloride concentrations were detected at SM3 which was the shallow water site in the SE corner of the lake with the highest seepage rate. The presence of high chloride concentrations may indicate sanitary sewage mixing in the groundwater from leaking sewer lines. Mean chloride concentrations were 52 mg/l at this site compared to concentrations which varied from 16 mg/l to 22 mg/l at the remaining sites.

The nutrient levels found in the seepage water did not appear to be related to nutrient levels in the sediments where the meter was placed. In general, the sediments along the shoreline are predominantly consolidated sand with organic content slowly increasing with depth. Loose unconsolidated organic material overlying consolidated organic sediments are present in depths > 4.0 m. Sediment samples were collected and analyzed on 7/12/96 next to seepage meter stations SM4, SM5 and SM6 to determine if there was any relationship between sediment nutrient concentration and seepage nutrient concentration. Stations SM4 and SM5 were located along the shoreline in predominantly sandy sediments at 1.2 m and 1.1 m depths respectively. Station SM6 was located in organic sediments near the center of the lake at a depth of 4.3 m. The phosphorus concentrations of the sediments at shoreline stations SM4 and SM-5 were 0.37 mg/l and <0.10 mg/l, respectively compared to 0.98 mg/l at the deep station SM6. Even though the phosphorus concentration of the sediments was higher at station SM6, the phosphorus concentration of seepage samples collected at this site were considerably lower than the two shoreline stations SM4 and SM5. Mean phosphorus concentrations of seepage water at SM6 was 0.87 mg/l compared to concentrations of 2.18 mg/l and 1.86 mg/l at stations SM4 and SM5, respectively.

Total nitrogen concentrations in the sediments at station SM6 were also considerably higher than the shoreline stations with concentrations of 1.72 mg/l compared to 0.10 mg/kg at station SM4 and <0.01 mg/l at station SM5. Even though sediment nitrogen was much higher at SM6, the seepage water collected at this site was approximately equal in nitrogen concentration to seepage water collected at the shoreline stations. Seepage samples collected at station SM6 had a mean nitrogen concentration of 8.97 mg/l compared to 14.02 mg/l and 8.82 mg/l at the shoreline stations SM4 and SM5, respectively (Table 7).

Increasing nutrient levels in the seepage water with increasing sediment nutrients would indicate high internal loading from the sediments at the water sediment interface, which does not appear to be the case at Lake Adair.

Table 7. Summary of Chemical Data for Eight Lake Adair Seepage Meters. All Concentrations are mg/l.

	AMMONIA mean (range)	CHLORIDE mean (range)	NITRATE mean (range)	NITRITE mean (range)	NITROGEN mean (range)	PHOSPHATE mean (range)	PHOSPHORUS mean (range)
SM1	4.53 (1.30 - 7.74)	16 (15 - 17)	3.10 (<0.02 - 8.17)	0.012 (0.005 - 0.020)	10.25 (5.68 - 16.00)	1.17 (0.68 - 1.94)	1.25 (0.69 - 2.18)
SM2	0.14 (<0.03 - 0.39)	17 (15 - 18)	0.79 (<0.02 - 1.73)	0.29 (<0.005 - 0.74)	1.8 (1.07 - 2.76)	0.24 (0.06 - 0.37)	0.26 (0.09 - 0.39)
SM3	1.22 (<0.03 - 3.81)	52 (43 - 59)	0.30 (<0.02 - 0.40)	0.007 (<0.005 - 0.018)	1.71 (0.88 - 4.14)	0.11 (0.02 - 0.40)	0.14 (0.02 - 0.52)
SM4	3.20 (0.64 - 14.10)	20 (12 - 23)	7.18 (<0.02 - 18.40)	2.64 (0.04 - 13.50)	14.02 (7.14 - 20.50)	1.99 (1.02 - 3.12)	2.18(0.83 - 3.26)
SM5	6.12 (3.48 - 11.4)	22 (19 - 23)	1.86 (<0.02 - 4.93)	0.45 (0.009 - 1.33)	8.82 (5.05 - 11.50)	1.84 (1.08 - 2.88)	1.86 (0.26 - 3.12)
SM6	7.98 (1.90 - 14.00)	18 (18 - 18)	0.02 (0.02 - <0.02)	0.005 (<0.005 - 0.006)	8.97 (2.84 - 15.40)	0.67 (0.11 - 1.03)	0.87 (0.12 - 1.13)
SM7	0.70 (0.03 - 2.02)	17 (16 - 17)	5.04 (2.45 - 6.73)	0.23 (<0.005 - 0.66)	6.57 (5.39 - 8.14)	0.64 (0.44 - 0.79)	0.87 (0.70 - 1.08)
SM8	1.71 (0.26 - 3.15)	18 (17 - 18)	0.08 (<0.02 - 0.13)	1.81 (0.51 - 3.11)	4.01 (3.84 - 4.18)	0.009 (0.006 - 0.011)	0.022 (0.020 - 0.024)

4.2b Nutrient Loading from Groundwater Seepage/Internal Loading

Annual loading of phosphorus and nitrogen from groundwater seepage/internal loading was estimated using nutrient concentrations and seepage rate data collected from the seepage meters. The total annual volume of water seeping into Lake Adair was estimated at 100,850,000 liters. The mean phosphorus concentration of the seepage water is 0.93 mg/l and the nitrogen concentration of the water is 7.02 mg/l. Based on this data the annual phosphorus and nitrogen loading associated with groundwater seepage/internal loading is:

100.9×10^6 l X 0.93 mg/l P = 93.8×10^6 mg = 93.8 kg Phosphorus year^{-1}

100.9×10^6 l X 7.02 mg/l N =70.8×10^7 mg = 708 kg Nitrogen year^{-1}

4.3 Spring Lake Overflows

Lake Adair receives discharges from Spring Lake via a box culvert under Highway 441 that connects to a free flowing stream in sub-basin 1. Spring Lake overflows to Lake Adair at an elevation of approximately 88.2 ft. M.S.L. Spring Lake overflows were measured at sub-basin 1 with continuous flow measurement equipment set up just east of where the open channel stream flows under Westmoreland Ave.

4.3a Chemical Characteristics of Spring Lake Discharge Water

Water quality information for Spring Lake is based on five water samples collected from Spring Lake between 9/7/95 to 8/27/96, which is the approximate time period flow data to Lake Adair was collected.

Spring Lake is eutrophic with total phosphorus concentrations ranging from 0.071 mg/l to 0.132 mg/l and a mean value of 0.097 mg/l. Ortho phosphate concentrations were low with four of the five samples below the detection limit of 0.005 mg/l and the remaining sample having a concentration of 0.006 mg/l. Total nitrogen concentrations were also typical of eutrophic conditions with a mean concentration of 1.25 mg/l and values ranging from 0.64

mg/l to 1.78 mg/l. The vast majority of nitrogen is organic with a mean nitrate concentration of 0.04 mg/l and nitrite concentrations below the detection limit of 0.005 mg/l. The mean ammonia concentration was 0.04 mg/l.

4.3b Estimation of Nutrient Loading from Spring Lake Overflow

Based on an estimated annual discharge volume of 236.7 ac-ft (291,850,000 liters) and mean total phosphorus and nitrogen concentrations of 0.071 mg/l and 1.25 mg/l respectively, nutrient loading to Lake Adair was estimated using the equations:

$$291.9\text{x}10^6 \text{ l X } 0.071 \text{ mg/l P} = 20.7\text{x}10^6 \text{ mg P} = 20.7 \text{ kg Phosphorus year}^{-1}$$

$$291.9\text{x}10^6 \text{ l X } 1.25 \text{ mg/l N} = 365\text{x}10^6 \text{ mg N} = 364.8 \text{ kg Nitrogen year}^{-1}$$

4.4 Baseflow from Stormwater Systems

Significant dry weather inflows to Lake Adair originate from sub-basins 1, 6 and 12 due to groundwater seepage into stormwater conveyance systems. The baseflow in sub-basin 1 is due to groundwater seepage into the stream located between Westmoreland Dr. and Edgewater Court. Baseflows to the lake from sub-basin 6 originates from groundwater seepage into the 24" stormline located along Reading Dr. which discharges to the lake. Baseflows to the lake from sub-basin 12 originates from groundwater seepage into the 48" stormline located along Edgewater Dr. which discharges to the lake. In addition to collecting flow data on the baseflow, grab samples were collected to determine nutrient concentrations.

4.4a Chemical Characteristics of Baseflow

Sub-basin 1

Ten grab samples were collected of baseflow from the stream which runs along Overbrook Dr. between 9/28/95 and 7/18/96. Samples were collected just east of where the stream flows under Westmoreland Drive. The baseflow occurs as a result of groundwater seepage into the stream.

Baseflow concentrations of total phosphorus were higher in sub-basin 1 than baseflows in sub-basin 6 or 12. Phosphorus concentrations ranged from 0.044 mg/l to 0.124 mg/l with a mean of 0.078 mg/l . The phosphorus was predominantly in the form of ortho phosphate which had a mean concentration of 0.042 mg/l

Total nitrogen concentrations were very similar to the other baseflow sites with a mean value of 1.27 mg/l and concentrations ranging from 1.07 mg/l to 1.56 mg/l. Approximately half of the nitrogen present was in an inorganic form with mean nitrate and nitrite concentrations of 0.69 mg/l and 0.013 mg/l, respectively. Ammonia concentrations ranged from <0.03 mg/l to 0.30 mg/l with a mean value of 0.10 mg/l.

Sub-basin 6

Ten grab samples were collected of baseflow from sub-basin 6 between 9/28/95 and 7/18/96. Samples were collected on the west shoreline of Lake Adair at the 12" outfall pipe which discharges water from the 24" pipe along Reading Drive. The baseflow at this site occurs as a result of groundwater seepage into the stormline.

Baseflow concentrations of total phosphorus were very low with a mean concentration of 0.013 mg/l and values ranging from <0.005 mg/l to 0.019 mg/l. The phosphorus was predominantly in the form of ortho phosphate with a mean concentration of 0.007 mg/l.

Total nitrogen concentrations were very similar to the other baseflow sites with a mean value of 1.37 mg/l and concentrations ranging from 1.12 mg/l to 1.70 mg/l. The majority of nitrogen present was inorganic, in the form of nitrate which had a mean concentration of 1.00 mg/l. Nitrate concentrations were low with a mean value of 0.006 mg/l. Ammonia concentrations ranged from <0.03 mg/l to 0.15 mg/l with a mean value of 0.08 mg/l.

Sub-basin 12 - Six grab samples of baseflow were collected in sub-basin 12 between 9/28/95 to 6/28/96. Samples were collected from the 48" stormline at the intersection of Edgewater Dr. and Sheridan Boulevard. Baseflow concentrations of total phosphorus were low with a mean concentration of 0.027 mg/l and values ranging from 0.018 mg/l to 0.038 mg/l (Table 8). The phosphorus was predominantly in the form of ortho phosphate which had a mean concentration of 0.016 mg/l.

Total nitrogen concentrations were very similar to the other baseflow sites with a mean value of 1.35 mg/l and concentrations ranging from 1.24 mg/l to 1.56 mg/l. The majority of nitrogen present was inorganic and in the form of nitrate which had a mean concentration of 1.15 mg/l. Nitrite and ammonia concentrations were low with concentrations below the detection limits of 0.005 mg/l and 0.03 mg/l, respectively, for all samples.

Table 8. Summary of Chemical Data for Lake Adair Baseflows. All Concentrations are mg/l.

	Sub-Basin 1 mean (range)	Sub-Basin 6 mean (range)	Sub-Basin 12 mean (range)
Ammonia	0.10 (<0.03 - 0.30)	0.08 (<0.03 - 0.15)	<0.03 (<0.03 - <0.03)
Nitrate	0.69 (0.28 - 1.03)	1.00 (0.78 - 1.28)	1.15 (0.95 - 1.31)
Nitrite	0.013 (<0.005 - 0.026)	0.006 (<0.005 - 0.008)	<0.005 (<0.005 - <0.005)
Total Nitrogen	1.27 (1.07 - 1.56)	1.23 (1.12 - 1.70)	1.35 (1.24 - 1.56)
Total Phosphorus	0.078 (0.044 - 0.124)	0.013 (0.005 - 0.026)	0.027 (0.018 - 0.038)
Ortho Phosphate	0.042 (0.009 - 0.071)	0.007 (<0.005 - 0.019)	0.016 (<0.005 - 0.025)

4.4b Estimation of Nutrient Loading from Baseflows

Phosphorus and nitrogen loading to Lake Adair from stormwater system baseflows was estimated using flow data and nutrient concentration data at each of the three sub-basin sites.

Based on the annual volume of water entering the lake from baseflow in liters and total phosphorus and nitrogen concentrations, mass loading for each sub-basin was determined using the following equations:

Sub-basin 1 **53×10^6 l X 0.078 mg/l P = 4.1×10^6 mg P = 4.1 kg Phosphorus year^{-1}**
53×10^6 l X 1.27 mg/l N = 67.2×10^6 mg N = 67.2 kg Nitrogen year^{-1}

Sub-basin 6 **50.1×10^6 l X 0.013 mg/l P = 65×10^4 mg P = 0.7 kg Phosphorus year^{-1}**
50×10^6 l X 1.23 mg/l N = 61.5×10^6 mg N = 61.6 kg Nitrogen year^{-1}

Sub-basin 12 **206×10^6 l X 0.027 mg/l P = 5.5×10^6 mg P = 5.6 kg Phosphorus year^{-1}**
206×10^6 l X 1.35 mg/l N = 27.8×10^7 mg N = 278.5 kg Nitrogen year^{-1}

Total annual phosphorus loading from the three sub-basins was estimated at only 10.4 kg due to the relatively low phosphorus concentrations in the baseflow. Nitrogen loading from baseflow was significant with a total annual loading of 346.8 kg.

4.5 Lake Adair Underdrains

In order to prevent groundwater from seeping across sidewalks along North and South Lake Adair Blvd., underdrains were installed to intercept the groundwater and pipe it to Lake Adair. The discharge from three under drain systems were located and flows were measured one time to determine if these systems were a significant source of inflow to the lake. Two of the under drain systems are located along the southwest corner of the lake and one is along North Lake Adair Blvd. The discharge volumes from the underdrain systems located along the southwest portion of the lake was estimated at 3.6 ac-ft year^{-1}, 0.7 ac-ft year^{-1}, and the underdrain system along North Lake Adair Blvd. generated a volume of 8.69 ac-ft $year^{-1}$. The total annual discharge from the three underdrain systems was estimated at 13.0 ac-ft. Only one sample and flow measurement was collected at the underdrain sites since this was considered a very small component of the hydrologic or nutrient budget for Lake Adair.

4.5a Chemical Characteristics of Underdrain Water

The water collected from the underdrain systems had higher phosphorus and nitrogen than baseflow samples even though both types of flows came from the same source; the surficial aquifer. This indicates the presence of a source of nutrients, such as leaking sewage laterals along the sidewalk area of Lake Adair The underdrain sample collected along North Lake Adair Blvd. had a total phosphorus concentration of 0.383 mg/l and a ortho phosphate concentration of 0.294 mg/l. Nitrogen levels were very high with a concentration of 4.12 mg/l, which was predominantly in the form of nitrate which had a concentration of 3.15 mg/l. Underdrain samples collected on the south side of the lake had phosphorus concentrations of 0.307 mg/l and 0.383 mg/l and corresponding ortho phosphate concentrations of 0.244 mg/l and 0.272 mg/l. Nitrogen concentrations on the south side of the lake were considerably lower with concentrations of 1.98 mg/l and 0.58 mg/l.

4.5b Estimation of Nutrient Loading from Underdrain Systems

Phosphorus and nitrogen loading to Lake Adair from underdrain systems was estimated using very limited (one sample) flow and nutrient concentration data at each of the sites. Based on the annual volume of water entering the lake from baseflow in liters and total phosphorus and nitrogen concentrations, mass loading for each underdrain was determined using the following equation:

North Underdrain

$11x10^6$ l X 0.383 mg/l P = $4.1x10^6$ mg P = 4.1 kg Phosphorus $year^{-1}$
$11x10^6$ l X 4.12 mg/l N = $44.1x10^7$ mg N = 44.1 kg Nitrogen $year^{-1}$

South Underdrain I

$4.5x10^6$ l X 0.307 mg/l P = $1.4x10^6$ mg P = 1.4 kg Phosphorus $year^{-1}$
$4.5x10^6$ l X 1.98 mg/l N = $8.8x10^6$ mg N = 8.8 kg Nitrogen $year^{-1}$

South Underdrain II

$9x10^5$ l X 0.387 mg/l P = $3.5x10^5$ mg P = 0.3 kg Phosphorus $year^{-1}$
$9x10^5$ l X 0.58 mg/l N = $5.2x10^5$ mg N = 0.5 kg Nitrogen $year^{-1}$

Based on these estimations, the combined underdrain systems are contributing approximately 9.9 kg phosphorus and 53.4 kg nitrogen to Lake Adair on an annual basis.

4.6 Nutrient Loading To Lake Adair From Roosting Cormorants

Nutrient loading from cormorants was included in the nutrient budget for Lake Adair. A large roosting colony of double-crested cormorants *Phalacrocorax auritus* is present on the lake. The cormorants roost on the north shoreline of Lake Adair in cypress tree branches which overhang the water. Field surveillance indicates the birds are migratory arriving at the lake in October and leaving in April. Bird counts conducted during 1996 indicates several hundred cormorants roost on Lake Adair with a maximum count of 844 birds present at one time. The majority of the birds were observed to be present from late afternoon until morning when they would leave the lake area, presumably to feed in different water bodies than Lake Adair.

Since very little data existed on the nutrient loading to water bodies from cormorants or other piscivorous birds, data was collected on Lake Adair to quantify phosphorus and nitrogen loading from the roosting population of cormorants. The method used to estimate nutrient loading consisted of placing three to five clean pre-weighed aluminum pie pans under the cormorant roost. The pans, which had an area of 0.046 m^2, were left in the field from 20 to 40 hours and any twigs or material other than cormorant droppings were removed from the pan. The pans were then re-weighed on an analytical balance with the increase in weight being a direct measure of the amount of cormorant droppings. Since the area of the pan and time in the field was known, the loading rate of cormorant droppings per unit area could be determined. The cormorant droppings were then analyzed for percent total solids, total phosphorus and total nitrogen. This method was repeated five times from December to April to estimate a mean loading rate. The area under the roosting colony of cormorants was measured in the field so that a total loading of phosphorus and nitrogen could be determined.

Analysis of cormorant droppings reveal very high concentrations of phosphorus and nitrogen. Phosphorus concentrations in 7 samples ranged from 3.3 % to 12.3 % with a mean value of 7.7 % on a dry weight basis. Nitrogen concentrations in 7 samples ranged from 9.2 % to 20.5 % with a mean value of 13.4 % on a dry weight basis.

The method used to estimate nutrient loading per unit area of the pans to Lake Adair from the cormorants was:

$$\mathbf{L_p = W_s (S/100) (N/100)}$$

Where: L_p = Nutrient Loading per Unit Area of 0.046 m^2 Pan
W_s = Mean Wet Weight (g) of Bird Droppings Collected in Pans
S = Mean % Solids of Samples
N = Mean % Nutrient of Samples (Dry Weight)
100 = Converts % Concentration to Weight in Grams

The nutrient loading calculated in the above equation was converted to nutrient loading in grams per m^2 per day using the following equation:

$$\mathbf{L_r = (L_p \times 21.74)/T}$$

Where: L_r = Nutrient Loading Rate in Grams per m^2 per Day

L_p = Nutrient Loading per Unit Area of 0.046 m^2 Pan
21.74 = Multiplication Factor to Convert 0.046 m^2 Pan Area to 1 m^2
T = Time in Days Pan Was Left Under Roost
24 = Factor to Convert Hours to Days

From these equations total phosphorus and total nitrogen loading rates from the cormorants were estimated for the five time periods this data was collected. Total phosphorus loading rates ranged from 1.2 g m^{-2} day^{-1} to 3.5 g m^{-2} day^{-1} with a mean value of 2.3 g m^{-2} day^{-1}. Total nitrogen loading rates ranged from 1.4 g m^{-2} day^{-1} to 7.8 g m^{-2} day^{1} with a mean value of 4.3 g m^{-2} day^{-1}. The total annual nutrient loading rate was calculated for each data collection period using the equation:

Annual Nutrient Loading From Cormorants in kg = Loading Rate (g m^{-2} day^{-1}) x 1687 m^2 x 160 x 10^{-3}

Where: 1687 m^2 = Total Measured Roosting Area Directly Over Lake
160 days = Estimated Number of Days per Year Birds Roost on Lake
10^{-3} = Converts Grams to Kilograms

From this equation the mean loading rate of phosphorus from cormorants was estimated at 613.9 kg $year^{-1}$. The mean loading rate of nitrogen was estimated at 1147.5 kg $year^{-1}$. These loading rates are extremely high for a lake with the volume of Lake Adair and could be expected to cause severe water quality problems such as algae blooms. The nutrient loading from the Lake Adair cormorant population should be considered an external loading since it appears that the vast majority of birds feed at distant water bodies and only return to the lake to roost. If the cormorants consumed fish from Lake Adair they would be considered a mechanism for nutrient recycling within the lake.

These loading rates are most likely conservative estimates due to the sampling method. The amount of bird droppings collected in the pans was less than what was actually produced due to splatter and adhesion to tree canopy.

4.7 Potential for Nutrient Loading from Resuspension of Bottom Sediments

In many shallow Florida lakes which have loose unconsolidated organic sediments, resuspension of the nutrient rich organic material by wave action is an important mechanism for increasing nutrient levels in the water column. In general, the sediments along the shoreline of Lake Adair are predominantly consolidated sand with organic content slowly increasing with depth. Loose unconsolidated organic material overlying consolidated sand and organic sediments is present at depths > 4.0 m. Since boating activity rarely occurs in Lake Adair, any waves present would be generated by the wind.

In order to predict the potential for resuspension of bottom sediments, equations for maximum wave height, wave length and vertical water displacement were referenced from Wetzel (1983).

The maximum height of a wind wave for a lake can be calculated using the equation:

Height of wind wave = 0.105 x square root of maximum fetch in centimeters

The maximum fetch of Lake Adair is 560 meters or 56,000 centimeters, so using the above equation the maximum wave height in Lake Adair is 24.8 centimeters or 0.248 meters. Since traveling waves are confined to surface layers and cause little displacement of the deeper water masses (Wetzel 1983), it is unlikely that waves would have any potential to disturb sediments in Lake Adair except along the shoreline. The potential for waves to disturb bottom sediments can also be evaluated using the general rule that the decrease in vertical motion with increasing depth can be approximately described as a halving of the vertical displacement of the wave for every depth increase of 1/9 of the wavelength. The maximum wavelength is approximately 20 times the wave height so for Lake Adair a maximum wave length would be 4.96 meters. By dividing the wave length of 4.96 m by 9, we determine the vertical displacement of a wave would be halved for each 0.55 meter depth increase. At a depth of 3.9 meters which is the mean depth of Lake Adair the vertical displacement of water would be approximately the wave height halved 7 times or 2.0 millimeters for the maximum wave. It is unlikely that a vertical water movement of 2.0 millimeters would cause any significant resuspension of bottom material and even this slight water movement would only occur under certain rare conditions when the wind speed and direction were able to generate maximum wave heights. It appears that the resuspension of the nutrient rich organic sediments which exists in the deeper portions of Lake Adair is very unlikely.

4.8 Summary of Nutrient Loading to Lake Adair

The amount of phosphorus entering Lake Adair on an annual basis is estimated to be 841.3 kg. The vast majority (73.0 %) of phosphorus originates from roosting cormorants which contribute 613.9 kg yr^{-1} (Table 9). The second largest source of phosphorus loading to the lake was groundwater seepage/internal loading which was estimated at 93.8 kg $year^{-1}$. Stormwater runoff from the 226 acre watershed contributed 92.6 kg $year^{-1}$ of phosphorus per year. Phosphorus loading from upstream lake overflows and stormline baseflows contributed only 20.7 kg $year^{-1}$ and 10.4 kg $year^{-1}$, respectively. Underdrains contributed 9.9%

Table 9. Summary of Phosphorus and Nitrogen Loading to Lake Adair.

	Phosphorus Loading kg/yr	% of Total	Nitrogen Loading kg/yr	% of Total
Cormorants (Birds)	613.9	73.0	1147.5	36.0
Groundwater Seepage	93.8	11.1	708	22.3
Stormwater Runoff	92.6	11.0	567.1	17.6
Spring Lake Overflows	20.7	2.5	364.8	11.5
Stormline Baseflows	10.4	1.2	346.8	10.9
Underdrains	9.9	1.2	53.4	1.7
Total	841.3	100.0	3181.6	100.0

Nitrogen loading to Lake Adair was estimated to be 3181.6 kg $year^{-1}$ with the cormorants being the single largest source, contributing 1147.5 kg $year^{-1}$ or 36.0% of the loading. The second largest source of nitrogen loading was groundwater seepage/internal loading which contributed 708.0 kg $year^{-1}$ followed by stormwater runoff which contributed 567.1 kg $year^{-1}$. Nitrogen loading from upstream lake overflows and stormline baseflows was estimated at 364.8 kg $year^{-1}$ and 346.8 kg year respectively. The underdrains contributed 53.4 kg $year^{-1}$ or 1.7% of the nitrogen in Lake Adair.

Section 5.0 Prediction of Water Quality Changes from Nutrient Loading Reductions

The prediction of water quality benefits resulting from removal of nutrient sources identified in this study required the use of trophic state models. Empirical models were also used to indicate the accuracy of estimates made by the Lake Adair study by comparing actual nutrient concentrations to model predictions generated using the estimated hydrologic and nutrient loading input data generated by this study. Empirical models were used for prediction of phosphorus, nitrogen, chlorophyll-a and Secchi depth (water transparency). Attempts to predict chlorophyll-a and Secchi depths in Lake Adair for nutrient abatement options where modeling predicted that total phosphorus concentrations would remain above 0.100 mg/l were not attempted. Research in Florida lakes indicates that when phosphorus concentrations exceed 0.100 mg/l, the relationship between phosphorus concentrations and chlorophyll-a is unpredictable. This is presumably due to factors such as sunlight becoming the limiting factor instead of nutrient concentrations when algae densities increase to the point that self shading is an important factor. Models which predict Secchi depth were also considered inaccurate at phosphorus concentrations above 0.100 mg/l since they are based on the relationship with chlorophyll-a.

Prediction of total phosphorus in Lake Adair was done using the general Vollenwieder model (Vollenwieder 1975) with a modified phosphorus sedimentation coefficient proposed by Canfield and Bachman (1981). The formula for the model used was:

$$\mathbf{TP} = L / z \ (\mathrm{s} + p)$$

where:

TP = Predicted in lake phosphorus concentrations, ug/l
L = Annual phosphorus loading per unit Lake area, mg x m^{-2} x year^{-1}
z = Mean depth, m
s = Phosphorus sedimentation coefficient, yr^{-1} = $0.114(L/z)^{0.589}$
p = Annual flushing rate, yr^{-1}

Phosphorus modeling using the Vollenweider equation and data collected at Lake Adair predicted a phosphorus concentration of 0.166 mg/l which agreed well with actual data of 0.177 mg/l based on data collected during 1995 and 1996. Data from the 1995 - 1996 time period was used because it corresponded approximately with the study period. Since the predicted and actual phosphorus concentrations were relatively close, it was assumed that the vast majority of nutrients entering the lake was accounted for in the phosphorus budget and the hydrologic budget was reasonably accurate.

Prediction of total nitrogen in Lake Adair was done using a model of the form used by Dillion and Rigler (1974) and modified by Baker et al (1985) specifically for use with Florida lakes. The formula for the model used was:

$$\mathbf{TN = 0.899\{L_N(1 - R_N)/q_S\}^{0.976}}$$

where:

$\mathbf{TN}$ = predicted nitrogen concentrations, mg/l
L_N = annual nitrogen loading per unit lake area, g/m $^{-2}$ yr $^{-1}$
q_S = areal water loading, m/yr
R_N = nitrogen sedimentation coefficient, yr $^{-1}$ = v/v + q_S,
where, v = 11.6 + 0.2 q_S

Using this equation, the predicted in lake ~~phosphorus~~ nitrogen concentration was 1.23 mg/l which was lower than the actual concentrations which averaged 1.46 mg/l based on 1995 and 1996 data. The small discrepancy between the predicted vs. actual nitrogen concentrations could be due to a number of factors such as unaccounted sources (nitrogen fixation by blue-green algae), underestimation of nitrogen loading or model error.

Prediction of the effects of removing the nutrient loading of the various sources identified in this study on Lake Adair water quality was done by subtracting the nutrient loading and any associated inflow, if appropriate, from the loading and hydrologic components of the phosphorus and nitrogen models. Reductions or increases in nutrient concentrations associated with the sources were based on changes from conditions predicted from the nitrogen and phosphorus models. For example, the effect of removing stormline baseflows on the phosphorus concentration in the lake was evaluated by comparing model results with the phosphorus loading and volume of water associated with this source present and removed.

Based on nutrient modeling, the largest reduction in nutrient concentrations would be achieved by removing the nutrients associated with the roosting cormorants which was expected since the birds are the largest single nutrient source to the lake. Modeling predicted that the phosphorus concentrations in the lake would drop from the predicted value of 0.166 mg/l to 0.080 mg/l and nitrogen concentrations would drop from 1.23 mg/l to 0.79 mg/l by removing nutrients associated with the birds. Since this scenario resulted in a predicted phosphorus concentration of <0.100 mg/l, an evaluation of the resulting chlorophyll-a and Secchi depths was done. Chlorophyll-a models are based on the relationship between nutrient levels and the amount of algae and depends on the whether phosphorus or nitrogen is the limiting nutrient in a lake. Lakes with TN/TP ratios between 10 and 30 exhibit relatively well balanced nutrition and it is not possible to assign a single limiting nutrient (Brezonik 1984). The predicted phosphorus to nitrogen ratio in lake Adair resulting from removing the loading associated with the birds would be 10. Since chlorophyll-a concentrations would be influenced by phosphorus and nitrogen concentrations, chlorophyll-a vs. nitrogen and phosphorus regression equations developed by Brezonik (1984) were used and averaged to predict resulting chlorophyll-a concentrations. The equations were developed using least absolute value regression analysis on data from 169 Florida lakes with balanced conditions. The regression equations used were:

ln chlorophyll-a = 1.29 ln Total Phosphorus (μg/l) - 2.44
ln chlorophyll-a = 1.37 ln Total Nitrogen (mg/l) + 2.7

Using these equations and predicted nutrient data, the expected results of removing the nutrient loading associated with the roosting cormorants would be a reduction of chlorophyll-a from the current concentrations of 72 $\mu g/m^3$ (based on 1995 and 1996 data) to 18 $\mu g/m^3$.

Since Secchi depth is closely correlated to chlorophyll-a concentrations, a chlorophyll-a vs. Secchi depth regression equation developed by Brezonik (1984) from Florida lake data, was used to predict improvements in water transparency. The equation used to predict the Secchi depth at a chlorophyll-a concentration of 18 μg/l was:

$$\ln \text{Secchi Depth} = 1.46 - 0.484 \ln \text{chlorophyll-a} \ (\mu g/l)$$

Results of this equation predict that the Secchi depth in Lake Adair would increase from the current average value of 0.7 m (based on 1995 and 1996 data) to 1.2 m.

Modeling results indicate that the effects of removing phosphorus and nitrogen inputs associated with the remaining sources of nutrient loading to the lake would have a minimal effect if the loading associated with the birds is allowed to continue (Table 10). Removing nutrient loading associated with groundwater seepage/internal loading, which is the second highest source of nutrients, would result in phosphorus and nitrogen concentrations of 0.156 mg/l and 0.96 mg/l respectively. This scenario may produce a small but noticeable improvement in water quality because of the reduction in nitrogen concentrations, but is impractical since it is very unlikely that the nitrogen loading associated with groundwater inflows could be significantly reduced. The results associated with removing nutrients associated with stormwater runoff would result in almost identical conditions as removing seepage/internal loading, phosphorus and nitrogen concentrations of 0.157 mg/l and 1.01 mg/l respectively. This scenario would only result in slight improvement and assumes that all of the stormwater could be treated at the various outfalls to the lake and that stormwater abatement would be 100 % efficient in removing nutrients. The predicted effects of removing the inflows from Spring Lake was a lowering of nitrogen to 1.09 mg/l and a increase in phosphorus concentrations to 1.75 mg/l.

The effects of increasing flows from Spring Lake were also evaluated with models indicating reductions in phosphorus concentrations and increases in nitrogen concentrations with increasing flows. Removing flows associated with underdrains around Lake Adair would have no effect on phosphorus concentrations and would reduce nitrogen from 1.23 mg/ l to 1.21 mg/l.

Table 10. Prediction of Phosphorus and Nitrogen Concentrations Resulting from Various Management Strategies.

Modeling Scenario	Total Phosphorus (mg/l)	Total Nitrogen (mg/l)
Predicted Conditions (No Abatement)	0.166	1.23
Remove Bird Nutrients	0.080	0.79
Remove Seepage Nutrients	0.156	0.96
Remove Stormwater Nutrients	0.157	1.01
Double Spring Lake Inflows	0.159	1.37
Remove Underdrains	0.166	1.21
Remove Spring Lake Inflows	0.175	1.09
Remove Dry Weather Flows	0.176	1.10

Section 6.0 Summary

The purpose of this research was to perform a diagnostic study of Lake Adair to determine factors which contribute to water quality problems associated with excessive planktonic algae growth. This study involved collecting data so that a hydrologic and nutrient budget could be developed for Lake Adair. Hydrologic inputs to Lake Adair which were evaluated included: stormwater runoff, stormline base flows, an open channel ditch, overflow discharges from Spring Lake, groundwater seepage through the lake bottom and underdrains. Data was also collected to provide nutrient loading estimates associated with all of the hydrologic inputs evaluated. Nutrient loading from a large colony of migratory water fowl which roosts on the lake was also evaluated. Mathematical modeling of the lake was performed using data collected to develop strategies for improving water quality.

The majority (33.3%) of the 753.9 ac-ft of water entering Lake Adair originated from surficial groundwater baseflows though stormwater systems in sub-basins 1, 6 and 12. Groundwater seepage into the 48" stormline in sub-basin 12 accounts for 167.3 ac-ft of the 250.8 ac-ft associated with stormwater systems baseflows. Spring Lake overflows which enter Lake Adair through sub-basin 1 contribute 31.4% of the inflows to Lake Adair with an annual volume of 236.7 ac-ft. Stormwater runoff was estimated to generate 22.8% of the total inflow with an annual volume of 171.6 ac.ft. Groundwater seepage through the bottom of Lake Adair was estimated to generate 10.8% of the inflow with an annual volume of 81.8 ac-ft. Underdrains located along sidewalks on Lake Adair Blvd. contributed 1.7% of the inflow with an annual volume of 13.0 ac-ft.

Total annual inflow to Lake Adair was estimated to be 753.9 ac-ft during the study period and the volume of the lake is 415.0 ac-ft. Based on these estimates the mean hydraulic resident time for Lake Adair is equal to 0.55 years or 201 days.

The amount of phosphorus entering Lake Adair on an annual basis is estimated to be 841.3 kg. The vast majority (73.0 %) of phosphorus originates from roosting cormorants which contribute 613.9 kg yr^{-1} (Table 9). The second largest source of phosphorus loading to the lake was groundwater seepage/internal loading which was estimated at 93.8 kg $year^{-1}$. Stormwater runoff from the 226 acre watershed contributed 92.6 kg $year^{-1}$ of phosphorus per year. Phosphorus loading from upstream lake overflows and stormline baseflows contributed only 20.7 kg $year^{-1}$ and 10.4 kg $year^{-1}$, respectively.

Nitrogen loading to Lake Adair was estimated to be 3181.6 kg $year^{-1}$ with the cormorants being the single largest source, contributing 1147.5 kg $year^{-1}$ or 36.1% of the loading. The second largest source of nitrogen loading was groundwater seepage/internal loading which contributed 708.0 kg $year^{-1}$ followed by stormwater runoff which contributed 561.1 kg $year^{-1}$. Nitrogen loading from upstream lake overflows and stormline baseflows was estimated at 364.8 kg $year^{-1}$ and 346.8 kg $year^{-1}$ respectively.

Based on nutrient modeling, the largest reduction in nutrient concentrations would be achieved by removing the nutrients associated with the roosting cormorants which was expected since the birds are the largest single nutrient source to the lake. Modeling predicted that the phosphorus concentrations in the lake would drop from the predicted value of 0.166 mg/l to 0.080 mg/l and nitrogen concentrations would drop from 1.23 mg/l to 0.79 mg/l by removing nutrients associated with the birds. Modeling results indicate that the effects of removing phosphorus and nitrogen associated with the remaining sources of nutrient loading to the lake would have a minimal effect if the loading associated with the birds continued. Removing nutrient loading associated with groundwater seepage/internal loading, which is the second highest source of nutrients, would result in phosphorus and nitrogen concentrations of 0.156 mg/l and 0.96 mg/l respectively. This scenario may produce a small but noticeable improvement in water quality because of the reduction in nitrogen concentrations, but is impractical since it is very unlikely that the nitrogen loading associated with groundwater inflows could be significantly reduced. Removing nutrients associated with stormwater runoff would result in phosphorus and nitrogen concentrations of 0.157 mg/l and 1.01 mg/l respectively which is almost identical to removing seepage/internal loading. This scenario would only result in slight improvements and assumes that all of the stormwater could be treated at the various outfalls to the lake and that stormwater abatement would be 100% efficient in removing nutrients. The predicted effects of removing the inflows from Spring Lake was a slight lowering of nitrogen to 1.09 mg/l and an increase in phosphorus concentrations to 1.75 mg/l.

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APPENDIX I

Lake Adair Stormwater Runoff Chemical Data for September, 1995 through August, 1996.

Lake Adair Stormwater Runoff Chemical Data for September, 1995 through August, 1996.

Sub-basin 1

Parameter	9/27/95	10/3/95	11/8/95	3/19/96	4/16/96	4/30/96	8/12/96
Ammonia mg/L	0.03	**0.03**	0.32	0.05	0.88	0.41	0.12
Nitrate mg/L	0.180	0.46	0.61	0.06	0.92	0.40	0.41
Nitrite mg/L	0.005	0.014	0.009	0.021	0.015	0.009	0.014
TKN mg/L	0.63	0.64	4.24	3.64	3.04	7.64	0.97
Total N mg/L	0.82	1.11	4.86	3.72	3.98	8.05	1.39
Total Phosphorus mg/L	0.209	0.151	1.88	0.747	0.658	3.360	0.269
Ortho Phosphate mg/L	0.069	0.061	0.406	**0.005**	0.302	0.262	0.055
Cadmium mg/L	0.0003	0.0003	0.0008	0.0003			
Copper mg/L	0.011	**0.010**	0.021	0.016			
Lead mg/L	0.020	0.007	0.034	0.011			
Zinc mg/L	0.043	0.051	0.095	0.064			

Sub-basin 6

Parameter	1/3/96	1/12/96	3/7/96	3/19/96	4/16/96	4/30/96	8/1/96
Ammonia mg/L	0.30	0.16	0.22	**0.03**	0.27	0.54	0.05
Nitrate mg/L	0.43	0.42	0.56	0.33	0.94	0.45	1.09
Nitrite mg/L	**0.005**	0.017	0.017	0.007	0.017	0.008	0.014
TKN mg/L	0.90	0.87	3.84	3.44	2.60	6.64	4.02
Total N mg/L	1.33	1.31	4.42	3.78	3.56	7.10	5.12
Total Phosphorus mg/L	0.119	0.189	0.720	0.635	0.933	0.683	0.093
Ortho Phosphate mg/L	0.037	0.059	0.130	0.118	0.090	0.296	0.066
Cadmium mg/L	0.0002	0.0001					
Copper mg/L	0.005	0.006					
Lead mg/L	0.007	0.007					
Zinc mg/L	0.044	0.053					

Sub-basin 12

Parameter	9/27/95	10/3/95	12/19/95	12/19/95	1/3/96	1/12/96	3/7/96	3/19/96	4/30/96
Ammonia mg/L	**0.03**	**0.03**	0.09	0.09	**0.03**	0.10	0.64	0.06	0.21
Nitrate mg/L	0.12	0.20	0.33	0.33	**0.02**	0.24	0.30	0.25	0.27
Nitrite mg/L	**0.005**	0.008	0.008	0.008	**0.005**	0.019	0.005	0.006	0.008
TKN mg/L	0.28	0.64	1.84	1.84	0.97	0.92	3.84	1.48	2.26
Total N mg/L	0.40	0.85	2.18	2.18	0.97	1.18	4.14	1.74	2.54
Total Phosphorus mg/L	0.072	0.147	0.446	0.446	0.148	0.215	0.608	0.244	0.440
Ortho Phosphate mg/L	0.016	0.052	0.118	0.118	0.029	0.055	0.265	**0.005**	0.172
Cadmium mg/L	0.0002	0.0003	0.0007	0.0007	0.0001	0.0003			
Copper mg/L	**0.010**	**0.010**	0.020	0.020	0.008	0.012			
Lead mg/L	0.014	0.010	0.029	0.029	0.005	0.013			
Zinc mg/L	0.044	0.177	0.162	0.162	0.058	0.419			

APPENDIX II

Hydrologic Modeling Results for Lake Adair Sub-basins.

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 1

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.65
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.65
0.31-0.40	0.35	2.0	0.057	8	0.03	0.086	0.77
0.41-0.50	0.45	2.0	0.043	6	0.05	0.111	0.97
0.51-1.00	0.75	4.0	0.106	15	0.08	0.107	3.87
1.01-1.50	1.25	4.0	0.057	8	0.15	0.120	3.87
1.51-2.00	1.75	4.0	0.021	3	0.21	0.120	2.03
2.01-2.50	2.25	8.0	0.007	1	0.31	0.138	1.00
>2.50	3.35	8.0	0.014	2	0.65	0.194	4.19
							18.0

AREA = 38.7 WEIGHTED "C" VALUE = 0.114

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 2

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.18
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.18
0.31-0.40	0.35	2.0	0.057	8	0.04	0.114	0.29
0.41-0.50	0.45	2.0	0.043	6	0.05	0.111	0.27
0.51-1.00	0.75	4.0	0.106	15	0.10	0.133	1.36
1.01-1.50	1.25	4.0	0.057	8	0.18	0.144	1.31
1.51-2.00	1.75	4.0	0.021	3	0.26	0.149	0.71
2.01-2.50	2.25	8.0	0.007	1	0.37	0.164	0.34
>2.50	3.35	8.0	0.014	2	0.76	0.227	1.38
							6.0

AREA = 10.9 WEIGHTED "C" VALUE = 0.135

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 3

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.10
0.21-0.30	0.25	2.0	0.071	10	0.03	0.120	0.15
0.31-0.40	0.35	2.0	0.057	8	0.05	0.143	0.20
0.41-0.50	0.45	2.0	0.043	6	0.07	0.156	0.21
0.51-1.00	0.75	4.0	0.106	15	0.13	0.173	0.98
1.01-1.50	1.25	4.0	0.057	8	0.23	0.184	0.92
1.51-2.00	1.75	4.0	0.021	3	0.33	0.189	0.50
2.01-2.50	2.25	8.0	0.007	1	0.45	0.200	0.23
>2.50	3.35	8.0	0.014	2	0.85	0.254	0.85
							4.1

AREA = 6.0 WEIGHTED "C" VALUE = 0.168

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 4

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.02
0.21-0.30	0.25	2.0	0.071	10	0.03	0.120	0.03
0.31-0.40	0.35	2.0	0.057	8	0.06	0.171	0.05
0.41-0.50	0.45	2.0	0.043	6	0.08	0.178	0.05
0.51-1.00	0.75	4.0	0.106	15	0.15	0.200	0.24
1.01-1.50	1.25	4.0	0.057	8	0.27	0.216	0.23
1.51-2.00	1.75	4.0	0.021	3	0.45	0.257	0.15
2.01-2.50	2.25	8.0	0.007	1	0.68	0.302	0.07
>2.50	3.35	8.0	0.014	2	1.30	0.388	0.28
							1.1

AREA = 1.3 WEIGHTED "C" VALUE = 0.214

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 5

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.04
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.04
0.31-0.40	0.35	2.0	0.057	8	0.04	0.114	0.06
0.41-0.50	0.45	2.0	0.043	6	0.05	0.111	0.06
0.51-1.00	0.75	4.0	0.106	15	0.12	0.160	0.35
1.01-1.50	1.25	4.0	0.057	8	0.32	0.256	0.49
1.51-2.00	1.75	4.0	0.021	3	0.61	0.349	0.35
2.01-2.50	2.25	8.0	0.007	1	0.94	0.418	0.18
>2.50	3.35	8.0	0.014	2	1.78	0.531	0.68
							2.2

AREA = 2.3 WEIGHTED "C" VALUE = 0.239

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 6

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.44
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.44
0.31-0.40	0.35	2.0	0.057	8	0.04	0.114	0.70
0.41-0.50	0.45	2.0	0.043	6	0.05	0.111	0.66
0.51-1.00	0.75	4.0	0.106	15	0.10	0.133	3.29
1.01-1.50	1.25	4.0	0.057	8	0.22	0.176	3.86
1.51-2.00	1.75	4.0	0.021	3	0.42	0.240	2.76
2.01-2.50	2.25	8.0	0.007	1	0.68	0.302	1.49
>2.50	3.35	8.0	0.014	2	1.37	0.409	6.01
							19.6

AREA = 26.3 WEIGHTED "C" VALUE = 0.183

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 7

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.14
0.21-0.30	0.25	2.0	0.071	10	0.03	0.120	0.21
0.31-0.40	0.35	2.0	0.057	8	0.04	0.114	0.22
0.41-0.50	0.45	2.0	0.043	6	0.06	0.133	0.25
0.51-1.00	0.75	4.0	0.106	15	0.11	0.147	1.14
1.01-1.50	1.25	4.0	0.057	8	0.20	0.160	1.11
1.51-2.00	1.75	4.0	0.021	3	0.32	0.183	0.66
2.01-2.50	2.25	8.0	0.007	1	0.50	0.222	0.35
>2.50	3.35	8.0	0.014	2	1.04	0.310	1.44
							5.5

AREA = 8.3 WEIGHTED "C" VALUE = 0.163

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 8

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.11
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.11
0.31-0.40	0.35	2.0	0.057	8	0.03	0.086	0.13
0.41-0.50	0.45	2.0	0.043	6	0.04	0.089	0.13
0.51-1.00	0.75	4.0	0.106	15	0.08	0.107	0.65
1.01-1.50	1.25	4.0	0.057	8	0.14	0.112	0.61
1.51-2.00	1.75	4.0	0.021	3	0.20	0.114	0.33
2.01-2.50	2.25	8.0	0.007	1	0.26	0.116	0.14
>2.50	3.35	8.0	0.014	2	0.41	0.122	0.44
							2.6

AREA = 6.5 WEIGHTED "C" VALUE = 0.100

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 9

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.02
0.21-0.30	0.25	2.0	0.071	10	0.04	0.160	0.04
0.31-0.40	0.35	2.0	0.057	8	0.06	0.171	0.05
0.41-0.50	0.45	2.0	0.043	6	0.08	0.178	0.05
0.51-1.00	0.75	4.0	0.106	15	0.15	0.200	0.23
1.01-1.50	1.25	4.0	0.057	8	0.27	0.216	0.22
1.51-2.00	1.75	4.0	0.021	3	0.39	0.223	0.12
2.01-2.50	2.25	8.0	0.007	1	0.51	0.227	0.05
>2.50	3.35	8.0	0.014	2	0.87	0.260	0.17
							0.9

AREA = 1.2 WEIGHTED "C" VALUE = 0.192

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 10

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.24
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.24
0.31-0.40	0.35	2.0	0.057	8	0.04	0.114	0.38
0.41-0.50	0.45	2.0	0.043	6	0.06	0.133	0.43
0.51-1.00	0.75	4.0	0.106	15	0.11	0.147	1.97
1.01-1.50	1.25	4.0	0.057	8	0.19	0.152	1.81
1.51-2.00	1.75	4.0	0.021	3	0.31	0.177	1.11
2.01-2.50	2.25	8.0	0.007	1	0.49	0.218	0.58
>2.50	3.35	8.0	0.014	2	1.02	0.304	2.43
							9.2

AREA = 14.3 WEIGHTED "C" VALUE = 0.157

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 11

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.01	0.067	0.29
0.21-0.30	0.25	2.0	0.071	10	0.02	0.080	0.29
0.31-0.40	0.35	2.0	0.057	8	0.03	0.086	0.35
0.41-0.50	0.45	2.0	0.043	6	0.05	0.111	0.43
0.51-1.00	0.75	4.0	0.106	15	0.08	0.107	1.73
1.01-1.50	1.25	4.0	0.057	8	0.15	0.120	1.73
1.51-2.00	1.75	4.0	0.021	3	0.21	0.120	0.91
2.01-2.50	2.25	8.0	0.007	1	0.28	0.124	0.40
>2.50	3.35	8.0	0.014	2	0.56	0.167	1.61
							7.7

AREA = 17.3 WEIGHTED "C" VALUE = 0.110

SUMMARY OF RAIN EVENT CHARACTERISTICS USED FOR ESTIMATION OF RUNOFF VOLUMES IN LAKE ADAIR FOR SUB-BASIN 12

RAINFALL EVENT RANGE (inches)	INTERVAL POINT USED (inches)	ASSUMED DURATION (hours)	FRACTION OF ANNUAL RAIN EVENTS	NUMBER OF ANNUAL RAIN EVENTS	EVENT RUNOFF (inches)	EVENT RUNOFF "C" VALUE	ANNUAL RUNOFF VOLUME (ac-ft)
0.00-0.05	0.05	1.0	0.348	49	0.00	0.000	0.00
0.06-0.10	0.08	1.0	0.135	19	0.00	0.000	0.00
0.11-0.20	0.15	1.0	0.142	20	0.02	0.133	2.29
0.21-0.30	0.25	2.0	0.071	10	0.05	0.200	2.86
0.31-0.40	0.35	2.0	0.057	8	0.09	0.257	4.12
0.41-0.50	0.45	2.0	0.043	6	0.12	0.267	4.12
0.51-1.00	0.75	4.0	0.106	15	0.23	0.307	19.75
1.01-1.50	1.25	4.0	0.057	8	0.46	0.368	21.07
1.51-2.00	1.75	4.0	0.021	3	0.74	0.423	12.71
2.01-2.50	2.25	8.0	0.007	1	1.07	0.476	6.13
>2.50	3.35	8.0	0.014	2	1.89	0.564	21.64
							94.7

AREA = 68.7 WEIGHTED "C" VALUE = 0.338

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.05 INCH 1 HOUR STORM

```
How many basins?           -->  12
Simulation Duration (hrs)-->  4
Time Increment (mins)      -->  1
Print Interval             -->  12
Save Results? (Y/N)        -->  N

Specify FILENAME containing INPUT DATA                    --> A:ADAIR.PAR
```

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.05 INCH 1 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 8

Storm Duration (hrs) --> 1
Total Rainfall (inches) --> .05

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.05 INCH 1 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9
		10	11	12						
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.200	0.004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.400	0.021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.600	0.040	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.800	0.049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.000	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.200	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.400	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.600	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.800	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.000	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.200	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.400	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.600	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.800	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.000	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.200	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.400	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.600	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.800	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
4.000	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.05 INCH 1 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	0	0	0	0	0	0	0	0	0	0	0	0
RO VOL (ac-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RO VOL (inches)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PEAK FLOW (cfs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PEAK TIME (hrs)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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   SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR 0.08 INCH 1 HOUR STORM

How many basins?            -->  12
Simulation Duration (hrs)-->  4
Time Increment (mins)     -->  1
Print Interval            -->  12
Save Results? (Y/N)       -->  N

Specify FILENAME containing INPUT DATA              --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR 0.08 INCH 1 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 8

Storm Duration (hrs)   --> 1
Total Rainfall (inches)   --> .08

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR 0.08 INCH 1 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1 / 10	BASIN 2 / 11	BASIN 3 / 12	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.200	0.006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.400	0.033	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.600	0.064	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.800	0.079	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.000	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.200	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.400	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.600	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.800	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.000	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.200	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.400	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.600	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
2.800	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.000	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.200	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.400	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.600	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
3.800	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
4.000	0.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR 0.08 INCH 1 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9
	10	11	12						
RO VOL (cfs-hrs)	0	0	0	0	0	0	0	0	0
	0	0	0						
RO VOL (ac-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0						
RO VOL (inches)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00						
PEAK FLOW (cfs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0						
PEAK TIME (hrs)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000						

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   SANTA BARBARA URBAN HYDROGRAPH     SB88119    VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.15 INCH 2 HOUR STORM

How many basins?           -->  12
Simulation Duration (hrs)-->  6
Time Increment (mins)      -->  1
Print Interval             -->  24
Save Results? (Y/N)        -->  N

Specify FILENAME containing INPUT DATA                    --> A:ADAIR.PAR
```

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.15 INCH 2 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 9

Storm Duration (hrs) --> 2
Total Rainfall (inches) --> .15

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.15 INCH 2 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.400	0.038	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.800	0.105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.200	0.129	0.2	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.1	0.4
1.600	0.142	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.5
2.000	0.150	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.5
2.400	0.150	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
2.800	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
3.200	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
3.600	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
4.000	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4.400	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4.800	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
5.200	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
5.600	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
6.000	0.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.15 INCH 2 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	0	0	0	0	0	0	0	0	0	0	0	1
RO VOL (ac-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
RO VOL (inches)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
PEAK FLOW (cfs)	0.2	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.1	0.5
PEAK TIME (hrs)	1.400	1.200	1.017	1.017	1.017	1.217	1.017	1.017	1.017	1.017	1.017	1.800

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.25 INCH 2 HOUR STORM

```
How many basins?            -->  12
Simulation Duration (hrs)-->  10
Time Increment (mins)       -->  1
Print Interval              -->  30
Save Results? (Y/N)         -->  N
```

Specify FILENAME containing INPUT DATA   --> A:ADAIR.PAR

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.25 INCH 2 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 9

Storm Duration (hrs) --> 2
Total Rainfall (inches) --> .25

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.25 INCH 2 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1 / 10	BASIN 2 / 11	BASIN 3 / 12	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
0.500	0.088	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
1.000	0.200	0.6	0.3	0.2	0.0	0.1	0.5	0.2	0.1	0.0
		0.4	0.3	1.2						
1.500	0.232	0.4	0.1	0.1	0.0	0.0	0.3	0.1	0.1	0.0
		0.2	0.2	1.3						
2.000	0.250	0.3	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0
		0.1	0.1	1.2						
2.500	0.250	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
		0.0	0.0	0.9						
3.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.7						
3.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.5						
4.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.4						
4.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.3						
5.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.2						
5.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.2						
6.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
6.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
7.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
7.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
8.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
8.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
9.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
9.500	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
10.000	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.25 INCH 2 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	1	0	0	0	0	1	0	0	0	0	0	4
RO VOL (ac-ft)	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3
RO VOL (inches)	0.02	0.02	0.03	0.03	0.02	0.02	0.03	0.02	0.04	0.02	0.02	0.05
PEAK FLOW (cfs)	0.6	0.3	0.3	0.1	0.1	0.5	0.3	0.2	0.1	0.4	0.4	1.3
PEAK TIME (hrs)	1.000	0.817	0.800	0.800	0.800	0.817	0.800	0.800	0.800	0.817	0.817	1.417

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   SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.35 INCH 2 HOUR STORM

How many basins?          -->  12
Simulation Duration (hrs)-->  12
Time Increment (mins)     -->  1
Print Interval            -->  30
Save Results? (Y/N)       -->  N

Specify FILENAME containing INPUT DATA                   --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.35 INCH 2 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 9

Storm Duration (hrs) --> 2
Total Rainfall (inches) --> .35

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.35 INCH 2 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.123	0.2	0.1	0.1	0.0	0.0	0.2	0.1	0.1	0.0	0.1	0.1	0.3
1.000	0.280	1.0	0.4	0.3	0.1	0.1	0.9	0.3	0.2	0.1	0.6	0.5	2.1
1.500	0.325	0.7	0.2	0.1	0.0	0.0	0.5	0.1	0.1	0.0	0.3	0.3	2.2
2.000	0.350	0.4	0.1	0.1	0.0	0.0	0.3	0.1	0.0	0.0	0.1	0.1	1.9
2.500	0.350	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.4
3.000	0.350	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
3.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
4.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
4.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
5.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
5.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
6.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
6.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
7.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
7.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
8.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
8.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.500	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.000	0.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.35 INCH 2 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9
	10	11	12						
RO VOL (cfs-hrs)	1	0	0	0	0	1	0	0	0
	1	1	6						
RO VOL (ac-ft)	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	0.0	0.0	0.5						
RO VOL (inches)	0.03	0.04	0.05	0.06	0.04	0.04	0.04	0.03	0.06
	0.04	0.03	0.09						
PEAK FLOW (cfs)	1.0	0.5	0.4	0.1	0.1	0.9	0.5	0.3	0.1
	0.7	0.7	2.2						
PEAK TIME (hrs)	0.817	0.817	0.800	0.800	0.800	0.817	0.800	0.800	0.800
	0.817	0.817	1.217						

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   SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.45 INCH 2 HOUR STORM

How many basins?          -->  12
Simulation Duration (hrs)-->  12
Time Increment (mins)     -->  1
Print Interval            -->  30
Save Results? (Y/N)       -->  N

Specify FILENAME containing INPUT DATA                    --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.45 INCH 2 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 9

Storm Duration (hrs) --> 2
Total Rainfall (inches) --> .45

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.45 INCH 2 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.158	0.5	0.2	0.2	0.1	0.1	0.4	0.3	0.2	0.1	0.4	0.4	0.7
1.000	0.360	1.4	0.5	0.4	0.1	0.1	1.2	0.4	0.3	0.1	0.7	0.7	3.0
1.500	0.418	0.9	0.3	0.1	0.0	0.0	0.7	0.2	0.1	0.0	0.3	0.3	3.0
2.000	0.450	0.5	0.1	0.1	0.0	0.0	0.4	0.1	0.0	0.0	0.2	0.2	2.6
2.500	0.450	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	2.0
3.000	0.450	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
3.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
4.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
4.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
5.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
5.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
6.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
6.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
7.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
7.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
8.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
8.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.500	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.000	0.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.45 INCH 2 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	2	1	0	0	0	1	0	0	0	1	1	9
RO VOL (ac-ft)	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.7
RO VOL (inches)	0.05	0.05	0.07	0.08	0.05	0.05	0.06	0.04	0.08	0.06	0.05	0.12
PEAK FLOW (cfs)	1.4	0.7	0.6	0.1	0.2	1.3	0.7	0.4	0.1	0.9	0.9	3.1
PEAK TIME (hrs)	0.817	0.817	0.800	0.800	0.800	0.817	0.800	0.800	0.800	0.800	0.800	1.200

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    SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

 LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.75 INCH 4 HOUR STORM

 How many basins?             -->  12
 Simulation Duration (hrs)-->  16
 Time Increment (mins)        -->  1
 Print Interval               -->  30
 Save Results? (Y/N)          -->  N

 Specify FILENAME containing INPUT DATA                 --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.75 INCH 4 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 10

Storm Duration (hrs) --> 4
Total Rainfall (inches) --> .75

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.75 INCH 4 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1.500	0.240	0.8	0.4	0.3	0.1	0.1	0.8	0.4	0.2	0.1	0.5	0.5	1.7
2.000	0.435	1.5	0.6	0.5	0.1	0.1	1.3	0.5	0.3	0.1	0.8	0.8	3.7
2.500	0.592	1.6	0.6	0.4	0.1	0.1	1.3	0.5	0.3	0.1	0.8	0.7	4.7
3.000	0.697	1.3	0.4	0.3	0.1	0.1	1.0	0.3	0.2	0.1	0.5	0.5	4.8
3.500	0.735	0.7	0.2	0.1	0.0	0.1	0.5	0.1	0.1	0.0	0.2	0.2	4.1
4.000	0.750	0.4	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.1	3.3
4.500	0.750	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	2.4
5.000	0.750	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
5.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
6.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
6.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
7.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
7.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
8.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
8.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
9.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
9.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
10.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
10.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
11.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
11.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.75 INCH 4 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1 / 10	BASIN 2 / 11	BASIN 3 / 12	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9
12.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
13.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
13.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
14.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
14.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
15.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
15.500	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
16.000	0.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 0.75 INCH 4 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	3	1	1	0	0	3	1	1	0	2	1	16
RO VOL (ac-ft)	0.3	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.1	1.3
RO VOL (inches)	0.08	0.10	0.13	0.15	0.12	0.10	0.11	0.08	0.15	0.11	0.08	0.23
PEAK FLOW (cfs)	1.6	0.6	0.5	0.1	0.1	1.3	0.5	0.3	0.1	0.8	0.8	4.8
PEAK TIME (hrs)	2.500	2.000	2.000	2.000	2.000	2.017	2.000	2.000	2.000	2.000	2.000	3.000

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   SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.25 INCH 4 HOUR STORM

How many basins?            -->  12
Simulation Duration (hrs)-->  18
Time Increment (mins)       -->  1
Print Interval              -->  30
Save Results? (Y/N)         -->  N

Specify FILENAME containing INPUT DATA                  --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.25 INCH 4 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 10

Storm Duration (hrs) --> 4
Total Rainfall (inches) --> 1.25

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.25 INCH 4 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.175	0.5	0.3	0.2	0.1	0.1	0.5	0.3	0.2	0.1	0.4	0.4	1.0
1.500	0.400	1.6	0.7	0.5	0.1	0.2	1.4	0.6	0.3	0.1	0.9	0.9	3.5
2.000	0.725	2.6	1.0	0.8	0.2	0.3	2.3	0.9	0.5	0.2	1.4	1.4	6.6
2.500	0.987	2.6	0.9	0.6	0.2	0.5	2.6	0.8	0.4	0.2	1.3	1.2	8.7
3.000	1.162	2.1	0.7	0.4	0.1	0.4	2.6	0.5	0.3	0.1	0.9	0.9	9.4
3.500	1.225	1.2	0.3	0.2	0.0	0.2	1.6	0.2	0.1	0.0	0.4	0.4	8.2
4.000	1.250	0.6	0.1	0.1	0.0	0.1	0.8	0.1	0.0	0.0	0.2	0.2	6.6
4.500	1.250	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	4.9
5.000	1.250	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	3.7
5.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8
6.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
6.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
7.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
7.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
8.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
8.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
9.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
9.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
10.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
10.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
11.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
11.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
12.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.25 INCH 4 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
12.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17.500	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18.000	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.25 INCH 4 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	6	2	1	0	1	6	2	1	0	3	3	32
RO VOL (ac-ft)	0.5	0.2	0.1	0.0	0.1	0.5	0.1	0.1	0.0	0.2	0.2	2.6
RO VOL (inches)	0.15	0.18	0.23	0.27	0.32	0.22	0.20	0.14	0.27	0.19	0.15	0.46
PEAK FLOW (cfs)	2.6	1.0	0.8	0.2	0.5	2.6	0.9	0.5	0.2	1.4	1.4	9.4
PEAK TIME (hrs)	2.500	2.000	2.000	2.000	2.500	2.517	2.000	2.000	2.000	2.000	2.000	3.000

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  SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.75 INCH 4 HOUR STORM

How many basins?          -->  12
Simulation Duration (hrs)-->  18
Time Increment (mins)     -->  1
Print Interval            -->  30
Save Results? (Y/N)       -->  N

Specify FILENAME containing INPUT DATA                -->> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.75 INCH 4 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 10

Storm Duration (hrs)   --> 4
Total Rainfall (inches)   --> 1.75

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.75 INCH 4 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.070	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.245	1.0	0.4	0.4	0.1	0.1	0.9	0.5	0.2	0.1	0.6	0.6	1.8
1.500	0.560	2.3	0.9	0.7	0.2	0.2	2.0	0.9	0.5	0.2	1.3	1.3	5.2
2.000	1.015	3.7	1.4	1.1	0.3	0.7	3.7	1.3	0.7	0.3	2.0	1.9	10.1
2.500	1.382	3.7	1.3	0.9	0.3	0.9	5.4	1.2	0.6	0.2	2.0	1.7	14.1
3.000	1.627	2.9	0.9	0.6	0.2	0.7	5.3	1.1	0.4	0.1	1.8	1.2	15.5
3.500	1.715	1.7	0.5	0.2	0.1	0.3	3.2	0.5	0.2	0.1	0.9	0.5	13.5
4.000	1.750	0.9	0.2	0.1	0.0	0.1	1.6	0.2	0.1	0.0	0.4	0.2	10.8
4.500	1.750	0.3	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.1	0.0	8.1
5.000	1.750	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.1
5.500	1.750	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	4.5
6.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
6.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
7.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
7.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
8.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
8.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
9.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
9.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
10.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
10.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
11.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
11.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
12.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.75 INCH 4 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
12.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
13.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
13.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17.500	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18.000	1.750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 1.75 INCH 4 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	8	3	2	1	1	11	3	1	0	4	4	51
RO VOL (ac-ft)	0.7	0.2	0.2	0.0	0.1	0.9	0.2	0.1	0.0	0.4	0.3	4.2
RO VOL (inches)	0.21	0.26	0.33	0.45	0.61	0.42	0.32	0.20	0.39	0.31	0.21	0.74
PEAK FLOW (cfs)	3.7	1.4	1.1	0.3	0.9	5.4	1.3	0.7	0.3	2.0	1.9	15.5
PEAK TIME (hrs)	2.017	2.000	2.000	2.500	2.500	2.517	2.000	2.000	2.000	2.000	2.000	3.000

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   SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 2.25 INCH 8 HOUR STORM

How many basins?           -->  12
Simulation Duration (hrs)-->  18
Time Increment (mins)     -->  1
Print Interval            -->  30
Save Results? (Y/N)       -->  N

Specify FILENAME containing INPUT DATA                  --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 2.25 INCH 8 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 11

Storm Duration (hrs) --> 8
Total Rainfall (inches) --> 2.25

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 2.25 INCH 8 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.045	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.169	0.5	0.2	0.2	0.1	0.1	0.5	0.3	0.1	0.1	0.3	0.3	0.9
2.000	0.292	1.0	0.4	0.3	0.1	0.1	0.8	0.3	0.2	0.1	0.5	0.5	2.2
2.500	0.461	1.4	0.5	0.4	0.1	0.1	1.2	0.5	0.3	0.1	0.7	0.7	3.7
3.000	0.630	1.6	0.6	0.4	0.1	0.2	1.3	0.5	0.3	0.1	0.8	0.8	4.9
3.500	1.102	3.5	1.4	1.1	0.3	0.8	4.0	1.3	0.7	0.3	1.9	1.9	10.4
4.000	1.575	4.3	1.6	1.1	0.4	1.2	7.4	1.9	0.8	0.3	2.8	2.1	16.6
4.500	1.755	2.8	0.9	0.5	0.2	0.5	5.3	1.0	0.3	0.1	1.8	1.0	16.3
5.000	1.935	2.4	0.8	0.5	0.2	0.5	4.8	1.0	0.3	0.1	1.7	0.8	16.2
5.500	2.003	1.5	0.4	0.2	0.1	0.2	2.8	0.4	0.1	0.0	0.9	0.4	13.7
6.000	2.070	1.2	0.4	0.2	0.1	0.2	2.2	0.4	0.1	0.0	0.7	0.3	11.8
6.500	2.126	1.0	0.3	0.2	0.1	0.2	1.8	0.4	0.1	0.0	0.6	0.3	10.1
7.000	2.183	1.0	0.3	0.2	0.1	0.2	1.7	0.4	0.1	0.0	0.6	0.3	8.9
7.500	2.216	0.7	0.2	0.1	0.0	0.1	1.2	0.2	0.1	0.0	0.4	0.2	7.5
8.000	2.250	0.7	0.2	0.1	0.0	0.1	1.1	0.2	0.1	0.0	0.4	0.2	6.4
8.500	2.250	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.0	4.8
9.000	2.250	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	3.6
9.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7
10.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
10.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
11.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
11.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
12.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 2.25 INCH 8 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1 / 10	BASIN 2 / 11	BASIN 3 / 12	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9
12.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.5						
13.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.4						
13.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.3						
14.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.2						
14.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
15.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
15.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
16.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
16.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
17.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
17.500	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
18.000	2.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						

SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 2.25 INCH 8 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	12	4	3	1	2	18	4	2	1	7	5	74
RO VOL (ac-ft)	1.0	0.3	0.2	0.1	0.2	1.5	0.3	0.1	0.1	0.6	0.4	6.1
RO VOL (inches)	0.31	0.37	0.45	0.68	0.94	0.68	0.50	0.26	0.51	0.49	0.28	1.07
PEAK FLOW (cfs)	4.3	1.6	1.1	0.4	1.2	7.4	1.9	0.8	0.3	2.8	2.1	16.7
PEAK TIME (hrs)	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.017

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  SANTA BARBARA URBAN HYDROGRAPH    SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 3.35 INCH 8 HOUR STORM

How many basins?          -->  12
Simulation Duration (hrs)-->  20
Time Increment (mins)     -->  1
Print Interval            -->  30
Save Results? (Y/N)       -->  N

Specify FILENAME containing INPUT DATA                  --> A:ADAIR.PAR
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SANTA BARBARA URBAN HYDROGRAPH   SB88119   VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 3.35 INCH 8 HOUR STORM

BASIN ID	NODE #	AREA (acres)	% LAKE	% DCIA	CN N-DCIA	TC (min)	INI AB DCIA (ins)	INI AB N-DCIA (dec)
1	99	38.7	0.0	12.9	54.0	31.2	0.10	0.20
2	99	10.9	0.0	15.7	55.0	19.2	0.10	0.20
3	99	6.0	0.0	19.7	54.0	11.4	0.10	0.20
4	99	1.3	0.0	23.1	66.0	10.0	0.10	0.20
5	99	2.3	0.0	15.4	80.0	10.0	0.10	0.20
6	99	26.3	0.0	15.6	72.0	27.0	0.10	0.20
7	99	8.3	0.0	17.0	63.0	10.0	0.10	0.20
8	99	6.5	0.0	12.2	41.0	11.4	0.10	0.20
9	99	1.2	0.0	23.6	49.0	10.0	0.10	0.20
10	99	14.3	0.0	16.2	63.0	17.4	0.10	0.20
11	99	17.3	0.0	12.9	50.0	16.8	0.10	0.20
12	99	68.7	0.0	35.5	74.0	103.2	0.10	0.20

***** RAINFALL INPUT SECTION *****

Mass Curve or Actual Rainfall? (M/A) --> M

1 SCS TYPE II - 24 HOUR DISTRIBUTION
2 SCS TYPE II (Fla. Modified) - 24 HOUR
3 SCS TYPE III - 24 HOUR DISTRIBUTION
4 OC 10 YEAR 6 HOUR STORM (5.25 INCHES)
5 OC 25 YEAR 6 HOUR STORM (5.75 INCHES)
6 OC 10 YEAR 24 HOUR STORM (7.50 INCHES)
7 OC 25 YEAR 24 HOUR STORM (8.60 INCHES)
8 FDOT 1 HOUR DURATION MASS CURVE
9 FDOT 2 HOUR DURATION MASS CURVE
10 FDOT 4 HOUR DURATION MASS CURVE
11 FDOT 8 HOUR DURATION MASS CURVE
12 FDOT 24 HOUR DURATION MASS CURVE
13 FDOT 3 DAY (72 HOUR) DURATION MASS CURVE
14 FDOT 7 DAY (168 HOUR) DURATION MASS CURVE
15 FDOT 10 DAY (240 HOUR) DURATION MASS CURVE
16 SFWMD 72 HOUR DISTRIBUTION

Specify CURVE TYPE = 11

Storm Duration (hrs)   --> 8
Total Rainfall (inches)   --> 3.35

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 3.35 INCH 8 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1	BASIN 2	BASIN 3	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9	BASIN 10	BASIN 11	BASIN 12
0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.034	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.067	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.251	1.0	0.5	0.4	0.1	0.1	0.9	0.5	0.3	0.1	0.6	0.6	1.9
2.000	0.435	1.5	0.6	0.4	0.1	0.1	1.3	0.5	0.3	0.1	0.8	0.8	3.7
2.500	0.687	2.1	0.8	0.6	0.2	0.3	1.8	0.7	0.4	0.1	1.1	1.1	5.9
3.000	0.938	2.4	0.9	0.6	0.2	0.4	2.2	0.7	0.4	0.1	1.2	1.1	7.8
3.500	1.641	5.3	2.1	1.6	0.6	1.7	9.5	2.7	1.1	0.4	3.9	2.8	18.7
4.000	2.345	8.5	3.4	2.2	0.9	2.2	16.1	4.5	1.1	0.4	6.8	3.6	30.0
4.500	2.613	6.8	2.2	1.2	0.4	1.0	11.0	2.2	0.5	0.2	4.1	2.3	29.3
5.000	2.881	6.6	2.1	1.2	0.4	1.0	9.6	2.2	0.4	0.2	3.8	2.3	28.9
5.500	2.982	4.2	1.1	0.5	0.2	0.4	5.5	0.9	0.2	0.1	1.9	1.2	24.3
6.000	3.082	3.3	0.9	0.5	0.2	0.4	4.2	0.9	0.2	0.1	1.6	1.0	20.9
6.500	3.166	2.7	0.8	0.4	0.1	0.3	3.4	0.8	0.2	0.1	1.3	0.9	17.9
7.000	3.250	2.5	0.8	0.4	0.1	0.3	3.1	0.8	0.2	0.1	1.3	0.9	15.7
7.500	3.300	1.9	0.5	0.3	0.1	0.2	2.3	0.5	0.1	0.0	0.9	0.6	13.1
8.000	3.350	1.7	0.5	0.3	0.1	0.2	2.0	0.5	0.1	0.0	0.8	0.6	11.2
8.500	3.350	0.6	0.1	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.1	0.1	8.4
9.000	3.350	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.3
9.500	3.350	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	4.7
10.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5
10.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6
11.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
11.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
12.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 3.35 INCH 8 HOUR STORM

TIME (hrs)	RAIN (ins)	BASIN 1 / 10	BASIN 2 / 11	BASIN 3 / 12	BASIN 4	BASIN 5	BASIN 6	BASIN 7	BASIN 8	BASIN 9
12.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.8						
13.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.6						
13.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.5						
14.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.3						
14.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.3						
15.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.2						
15.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
16.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
16.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
17.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.1						
17.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
18.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
18.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
19.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
19.500	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						
20.000	3.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0						

SANTA BARBARA URBAN HYDROGRAPH SB88119 VER 1.3

LAKE ADAIR SUB-BASIN HYDROGRAPHS FOR A 3.35 INCH 8 HOUR STORM

*** RUNOFF SUMMARY ***

BASIN ID# -->	1	2	3	4	5	6	7	8	9	10	11	12
RO VOL (cfs-hrs)	25	8	5	2	4	36	9	3	1	15	10	131
RO VOL (ac-ft)	2.1	0.7	0.4	0.1	0.3	3.0	0.7	0.2	0.1	1.2	0.8	10.8
RO VOL (inches)	0.65	0.76	0.85	1.30	1.78	1.37	1.04	0.41	0.87	1.02	0.56	1.89
PEAK FLOW (cfs)	8.6	3.4	2.2	0.9	2.2	16.1	4.5	1.1	0.4	6.8	3.6	30.2
PEAK TIME (hrs)	4.017	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.017

APPENDIX III

Lake Adair Baseflow Chemical Data for September, 1995, through July, 1996.

Lake Adair Baseflow Chemical Data for September, 1995 through July, 1996.

Sub-basin 1

Parameter	9/28/95	10/17/95	12/18/95	1/18/96	3/1/96	4/8/96	4/29/96	6/6/96	6/28/96	7/18/96
Ammonia mg/L	0.05	0.10	***0.03***	0.06	***0.03***	0.15	0.10	***0.03***	0.3	0.12
Nitrate mg/L	0.53	0.72	1.03	1.00	1.02	0.77	0.78	0.28	0.28	0.46
Nitrite mg/L	0.013	0.017	0.013	0.018	0.007	0.018	0.005	0.005	0.010	0.026
TKN mg/L	0.66	0.82	0.25	0.33	0.21	0.41	0.29	1.02	1.08	0.58
Total N mg/L	1.20	1.56	1.29	1.35	1.24	1.20	1.08	1.3	1.37	1.07
Total Phosphorus mg/L	0.075	0.124	0.068	0.085	0.090	0.097	0.087	0.044	0.059	0.055
Ortho Phosphate mg/L	0.038	0.037	0.049	0.051	0.059	0.059	0.071	0.019	0.009	0.023
Fecal Coliforms colonies/100 mL	500	1,700	134							

Sub-basin 6

Parameter	9/28/95	10/17/95	12/18/95	1/18/96	3/1/96	4/8/96	4/29/96	6/6/96	6/28/96	7/18/96
Ammonia mg/L	0.07	0.12	0.04	0.15	***0.03***	0.08	0.07	0.12	0.08	0.07
Nitrate mg/L	0.86	0.80	0.78	0.87	1.14	1.09	1.08	1.28	1.02	1.06
Nitrite mg/L	0.005	0.006	0.005	0.006	0.006	0.006	0.005	0.005	0.005	0.008
TKN mg/L	0.37	0.39	0.34	0.35	0.48	0.32	0.31	0.42	0.39	0.29
Total N mg/L	1.23	1.20	1.12	1.23	1.63	1.42	1.40	1.70	1.42	1.36
Total Phosphorus mg/L	0.015	0.011	0.007	0.011	0.026	0.012	***0.005***	0.018	0.007	0.013
Ortho Phosphate mg/L	0.005	0.008	***0.005***	***0.005***	0.006	***0.005***	***0.005***	0.019	0.009	0.007
Fecal Coliforms colonies/100 mL	800	700	5							100

Sub-basin 12

Parameter	9/28/95	12/18/95	1/18/96	4/26/95	6/6/96	6/28/96
Ammonia mg/L	***0.03***	***0.03***	***0.03***	***0.03***	***0.03***	***0.03***
Nitrate mg/L	1.31	1.10	1.15	1.19	1.17	0.95
Nitrite mg/L	***0.005***	***0.005***	***0.005***	***0.005***	***0.005***	***0.005***
TKN mg/L	0.25	0.28	0.12	0.10	0.18	0.29
Total N mg/L	1.56	1.38	1.27	1.29	1.35	1.24
Total Phosphorus mg/L	0.038	0.021	0.033	0.030	0.018	0.022
Ortho Phosphate mg/L	0.022	0.013	0.013	0.025	0.019	***0.005***
Fecal Coliforms colonies/100 mL		260				

APPENDIX IV

Lake Adair Seepage Meter Chemical Data for August, 1995 through October, 1996.

Lake Adair Seepage Meter Chemical Data for August, 1995 through October, 1996.

Seepage Meter 1

Parameter	8/30/95	10/10/95	10/25/95	11/22/95	1/29/96	2/23/96	3/27/96
Ammonia mg/L	1.30	5.70	7.74	6.10	5.35	2.64	2.86
Chloride mg/L					17.00	15.00	17.00
Nitrate mg/L	***0.02***	8.17	3.66	3.08	1.17	3.38	2.20
Nitrite mg/L		0.008	0.020	0.010	0.010	0.020	0.005
TKN mg/L		6.00	8.64	7.40	5.60	2.92	3.48
Total N mg/L	16.00	14.20	12.30	10.50	6.78	6.32	5.68
Ortho Phosphate mg/L	1.940	1.770	1.360	1.050	0.708	0.695	0.681
Total Phosphorus mg/L	2.180	1.840	1.360	1.180	0.762	0.714	0.689
Fecal Coliforms colonies/100 mL	1,000		***2***				

Seepage Meter 2

Parameter	8/30/95	12/8/95	1/11/96	1/29/96	2/23/96	3/27/96
Ammonia mg/L		0.39	***0.03***	0.23	***0.03***	***0.03***
Chloride mg/L		15.00		18.00	17.00	17.00
Nitrate mg/L		***0.02***	0.16	1.10	0.93	1.73
Nitrite mg/L		0.024	0.652	0.742	***0.005***	***0.005***
TKN mg/L		1.04	0.70	0.92	0.50	0.68
Total N mg/L		1.07	1.51	2.76	1.43	2.41
Ortho Phosphate mg/L		0.062	0.180	0.336	0.259	0.371
Total Phosphorus mg/L		0.093	0.189	0.371	0.259	0.391
Fecal Coliforms colonies/100 mL						

Seepage Meter 3

Parameter	10/25/95	11/22/95	12/8/95	1/11/96	1/29/96	2/23/96	3/27/96
Ammonia mg/L	3.81	2.02	1.14	0.86	0.66	0.03	0.05
Chloride mg/L			43.00		51.00	55.00	59.00
Nitrate mg/L	***0.02***	0.13	0.10	0.17	0.14	0.72	0.80
Nitrite mg/L	0.018	***0.005***	***0.005***	***0.005***	***0.005***	***0.005***	***0.005***
TKN mg/L	4.12	2.18	1.23	1.06	0.90	0.16	0.23
Total N mg/L	4.14	2.31	1.33	1.23	1.04	0.88	1.03
Ortho Phosphate mg/L	0.396	0.178	0.076	0.051	0.027	0.020	0.018
Total Phosphorus mg/L	0.524	0.199	0.087	0.056	0.045	0.030	0.023
Fecal Coliforms colonies/100 mL	<100						

Lake Adair Seepage Meter Chemical Data for August, 1995 through October, 1996 (continued).

Seepage Meter 4

Parameter	5/10/96	5/31/96	6/12/96	6/28/96	7/12/96	8/13/96	8/21/96	9/4/96
Ammonia mg/L	1.42	0.64	0.64	0.89	1.620	4.16	3.86	1.63
Chloride mg/L	23.00	20.00				21.00	21.0	20.00
Nitrate mg/L	***0.02***	6.53	1.10	18.40	16.80	11.20	9.47	11.40
Nitrite mg/L	7.340	1.120	13.500	0.337	0.268	0.043	0.206	0.052
TKN mg/L	2.24	1.53	1.20	1.78	2.26	4.85	4.32	2.34
Total N mg/L	9.58	9.18	15.80	20.50	19.70	16.10	14.00	13.80
Ortho Phosphate mg/L	1.93	2.39	3.040	3.12	3.12	1.16	1.94	1.95
Total Phosphorus mg/L	2.040	2.360	3.040	3.180	3.260	2.550	1.880	1.920
Fecal Coliforms colonies/100 mL								

Seepage Meter 4 (continued)

Parameter	9/11/96	9/25/96	9/30/96	10/9/96
Ammonia mg/L	1.90	14.10	4.52	2.99
Chloride mg/L	17.00	21.00	21.00	12.00
Nitrate mg/L	4.62	***0.02***	0.23	6.37
Nitrite mg/L	0.040	0.528	4.890	3.330
TKN mg/L	2.48	17.80	5.30	4.12
Total N mg/L	7.14	18.20	10.40	13.80
Ortho Phosphate mg/L	1.02	1.840	1.270	1.090
Total Phosphorus mg/L	0.832	1.830	1.660	1.600
Fecal Coliforms colonies/100 mL				

Seepage Meter 5

Parameter	5/10/96	5/31/96	6/12/96	6/28/96	7/12/96	8/21/96	9/4/96	9/11/96
Ammonia mg/L	11.40	4.60	9.65	4.46	4.010	7.00	4.38	3.48
Chloride mg/L	22.00	23.00				23.00	22.00	19.00
Nitrate mg/L	***0.02***	4.93	***0.02***	4.42	4.230	***0.02***	0.56	0.66
Nitrite mg/L	0.14	1.22	0.68	0.085	0.009	0.04	1.33	0.113
TKN mg/L	11.40	5.00	8.90	5.32	4.600	7.50	5.12	4.28
Total N mg/L	11.50	11.20	9.58	9.82	8.840	7.54	7.01	5.05
Ortho Phosphate mg/L	2.53	2.88	2.180	1.92	1.740	1.19	1.22	1.080
Total Phosphorus mg/L	3.120	2.940	2.220	2.080	1.750	1.240	1.250	0.259
Fecal Coliforms colonies/100 mL								

Lake Adair Seepage Meter Chemical Data for August, 1995 through October, 1996 (continued).

Seepage Meter 6

Parameter	6/12/96	6/28/96	7/12/96	8/13/96	9/4/96
Ammonia mg/L	6.34	7.36	10.300	14.00	1.90
Chloride mg/L				18.00	18.00
Nitrate mg/L	***0.02***	***0.02***	***0.02***	***0.02***	***0.02***
Nitrite mg/L	***0.005***	***0.005***	***0.005***	***0.005***	0.006
TKN mg/L	7.92	7.40	11.300	15.40	2.84
Total N mg/L	7.92	7.40	11.300	15.40	2.85
Ortho Phosphate mg/L	0.981	1.02	1.030	0.215	0.11
Total Phosphorus mg/L	0.960	1.000	1.130	1.130	0.119
Fecal Coliforms colonies/100 mL					

Seepage Meter 7

Parameter	9/11/96	9/25/96	9/30/96	10/9/96
Ammonia mg/L	2.02	0.22	0.51	***0.03***
Chloride mg/L	16.00	17	17.00	17.00
Nitrate mg/L	2.45	5.36	6.73	5.62
Nitrite mg/L	0.656	0.201	0.070	***0.005***
TKN mg/L	2.28	0.95	1.34	0.62
Total N mg/L	5.39	6.51	8.14	6.24
Ortho Phosphate mg/L	0.442	0.662	0.788	0.658
Total Phosphorus mg/L	1.080	0.746	0.971	0.700
Fecal Coliforms colonies/100 mL				

Seepage Meter 8

Parameter	9/30/96	10/9/96
Ammonia mg/L	3.15	0.26
Chloride mg/L	18.00	17.00
Nitrate mg/L	***0.02***	0.13
Nitrite mg/L	0.505	3.11
TKN mg/L	3.68	0.60
Total N mg/L	4.18	3.84
Ortho Phosphate mg/L	0.011	0.006
Total Phosphorus mg/L	0.024	0.020
Fecal Coliforms colonies/100 mL		

APPENDIX V

Lake Adair Seepage Meter Flow Volume Data by Date.

Lake Adair Seepage Meter Flow Volume Data by Date.

DATE	SEEPAGE METER #	AMOUNT (L) PER DAY	TOTAL AMT. (L)	# OF DAYS
8/30/95	SM 1	0.92	18.4	20
8/30/95	SM 2	0.07	1.3	20
8/30/95	SM 3	1.51	30.1	20
10/10/95	SM 1	0.79	32.4	41
10/25/95	SM 1	0.91	13.6	15
10/25/95	SM3	0.82	46.0	56
11/22/95	SM1	0.85	23.9	28
11/22/95	SM3	2.35	65.7	28
12/8/95	SM2	0.61	9.8	16
12/8/95	SM3	1.80	28.8	16
1/11/96	SM 1	0.50	17.0	34
1/11/96	SM 2	0.23	7.7	34
1/11/96	SM 3	1.53	52.1	34
1/29/96	SM 1	0.60	10.8	18
1/29/96	SM 2	0.33	5.9	18
1/29/96	SM 3	1.98	35.6	18
2/23/96	SM1	0.47	11.7	25
2/23/96	SM2	0.36	9.0	25
2/23/96	SM3	1.36	33.9	25
3/27/96	SM1	0.55	18.0	33
3/27/96	SM2	0.29	9.6	33
3/27/96	SM3	1.54	50.8	33
5/10/96	SM4	0.55	8.2	15
5/10/96	SM5	1.26	18.9	15
5/31/96	SM4	0.30	6.2	21
5/31/96	SM5	0.76	15.9	21
6/13/96	SM4	0.26	3.4	13
6/13/96	SM5	1.28	16.7	13
6/13/96	SM6	0.10	1.3	13
6/28/96	SM4	0.35	5.2	15
6/28/96	SM5	1.15	17.2	15
6/28/96	SM6	0.13	1.9	15
7/12/96	SM4	0.39	5.4	14
7/12/96	SM5	1.35	18.9	14
7/12/96	SM6	0.12	1.7	14
8/13/96	SM4	0.31	10.0	32
8/13/96	SM6	0.09	3.0	32
8/21/96	SM4	0.46	3.7	8
8/21/96	SM5	1.30	10.4	8
9/4/96	SM4	0.35	4.9	14
9/4/96	SM5	1.43	20.0	14
9/4/96	SM7	0.11	1.6	14
9/11/96	SM4	0.84	5.9	7
9/11/96	SM5	1.49	10.4	7
9/11/96	SM7	0.24	1.7	7

DATE	SEEPAGE METER #	AMOUNT (L) PER DAY	TOTAL AMT. (L)	# OF DAYS
9/25/96	SM4	0.40	3.2	8
9/25/96	SM7	0.16	1.3	8
9/25/96	SM8	2.01	16.1	8
9/25/96	SM9	0.03	0.2	8
9/30/96	SM4	0.60	3.0	5
9/30/96	SM7	0.30	1.5	5
9/30/96	SM8	0.32	1.6	5
9/30/96	SM9	0.06	0.3	5
10/9/96	SM4	0.42	3.8	9
10/9/96	SM7	0.20	1.8	9
10/9/96	SM8	2.00	18.0	9
10/9/96	SM9	0.05	0.5	9
AVERAGE		**0.73**	**13.6**	**18**