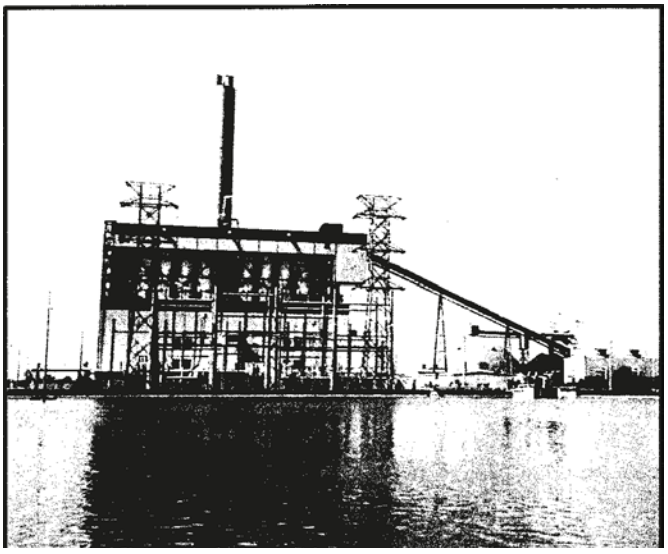
AES
Puerto Rico

Run-on and Run-off Control System Plan Five-Year Update



Coal Combustion Residuals Temporary Stockpile Area

AES Puerto Rico, L.P.

December 2021

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APPENDIX

1.0 Introduction

Facility Information

AES Puerto Rico (AES-PR} is a bituminous coal-fueled power plant that generates and sells electricity to the Puerto Rico Electric Power Authority (PREPA} with a total power generation capacity of 454 Megawatts (MW). AES-PR also produces a manufactured aggregate known as Agremax™.

AES-PR is located on an 85 acre tract of land owned by AES Puerto Rico, LP. It is bordered to the north by a pharmaceutical facility (TAPI Puerto Rico, lnc.-TAPI) and vacant land owned by the Puerto Rico Land Administration (PRLA); to the south by wetlands and Bahia Las Mareas; to the east by the former Chevron Phillips Chemical Puerto Rico Core, LLC (CPC) facilities; and to the west by AES llumina and PRLA vacant land. The facility owned and operated by AES-PR is composed of a coal-fired power plant and an ancillary marine dock that is not contiguous to the main power plant. It also occupies associated rights-of-way for elevated conveyors, transmission lines, make-up water supply lines, process steam piping and service/access roads.

The AES-PR facilities are completely fenced and gated and include a power plant building, office/ storage and maintenance buildings, open paved parking areas, cooling tower, open coal and manufactured aggregate stockpile areas, limestone storage dome, manufactured aggregate / coal pile stockpiles runoff pond, a storm water runoff pond, a make-up water pond, a cooling tower water pond, water treatment facilities, material and equipment storage areas and storm water collection and conveyance systems. The coal pile runoff pond collects non-industrial storm water runoff from the coal stockpile, the limestone storage dome area, the manufactured aggregate (Agremax™) stockpile and certain areas adjacent to these locations. The storm water runoff pond collects non-industrial storm water runoff.

Federal Regulations

Title 40 Section 257.81(a)(1) and (2) of the Code of Federal Regulations (CFR) stipulates that in accordance with the requirements under the Clean Water Act, the owner or operator of a Coal Combustion Residuals (CCR) unit must design, construct, operate, and maintain the following control systems:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm

In addition, 40 CFR 257.81(b) requires that run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 40 CFR 257.3-3 i.e., point sources that discharge into waters of the United States must do so through a National Pollutant Discharge Elimination System (NPDES) permitted outfall.

The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans required by 40 CFR 257.81(c) every five years. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed a periodic run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by 40 CFR 257.105(g) (3).

The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record as required by 40 CFR 257.105(g)(3). The owner or operator must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

2.0 Purpose / Methodology

This report was prepared by Winston R. Esteves P.E. (WRE) to fulfill the requirements of 40 CFR 257.81(c) (4) to prepare periodic run-on and run-off control system plan every five years.

To develop this periodic run-on and run-off control system plan, WRE performed the following tasks:

- Reviewed the initial run-on and run-off control system plan, see Appendix A.
- Reviewed the CCR Annual Inspection Reports.
- Reviewed the Storm Water Pollution Prevention Plans.
- Reviewed the Environmental Assessment for the Agremax™ Staging Area Liner Project.
- Reviewed the available daily precipitation logs.
- Reviewed and amended the water ponds operation and maintenance procedure.
- Reviewed the current National Oceanic and Atmospheric Administration (NOAA) precipitation values for the AES-PR location.
- Reviewed the 2021 bathymetric survey for the coal pile runoff pond.
- Reviewed aerial photos and surveys of the Agremax™ temporary stockpile area.
- Interviewed site management and operations personnel.
- Prepared this revised run-on and run-off control system plan.

3.0 Hydrologic Criteria

According to the currently available NOAA Point Precipitation Frequency Estimates, the 25-year, 24-hour and 100-year, 24-hour precipitation totals are consistent with the precipitation data used to obtain the site-specific calculations presented in the initial Run-on and Run-off Control System Plan of 2016. The soil types, cover conditions (represented by runoff curve numbers), the

topography and the watersheds that contribute flows to the concrete ditches, culverts and the coal pile runoff pond also remain similar to 2016, therefore the hydrologic / hydraulic analysis performed in 2012 (Appendix A) is still considered valid.

4.0 Run-on and Run-off Control Systems

- Run-on Controls: the AES CCR temporary stockpile is encircled by concrete ditches and culverts designed and constructed to handle peak flows from the 100-year, 24-hour rainfall which are significantly larger than that from the 25-year, 24-hour rainfall. These controls are adequately inspected, maintained and managed through the implementation of erosion and sediment control best management practices (BMPs) or storm water control measures (SWCMs) that are part of the AES-PR Storm Water Pollution Prevention Plan (SWPPP) to minimize sediment accumulations that may reduce the hydraulic capacity of the run-on controls. Therefore, the initial and current run-on controls effectively prevent flow onto the active portion of this CCR unit during the peak discharge from a 24-hour, 25-year storm.

- Run-off Controls: the AES CCR temporary stockpile is encircled by concrete ditches and culverts that discharge into the 15.2 million gallons coal pile runoff pond, all designed and constructed to handle peak flows from the 100-year, 24-hour rainfall which are significantly larger than that from the 25-year, 24-hour rainfall. These controls are adequately inspected, maintained and managed through the implementation of erosion and sediment control best management practices (BMPs) or storm water control measures (SWCMs) that are part of the AES-PR Storm Water Pollution Prevention Plan (SWPPP) to minimize sediment

accumulations that may reduce the hydraulic capacity of the run-off controls. The 2021 bathymetric survey of the coal pile runoff pond indicates that about 2 million gallons of sediment now occupy the pond. The 100-year, 24-hour rainfall would generate a runoff volume of about 12.2 million gallons while the 25-year, 24-hour rainfall would generate a runoff volume of about 8.5 million gallons. Therefore, the initial and current run-off controls of the active part of this CCR unit effectively collect and control at least the water volume resulting from a 25-year, 24-hour storm.

- Run-off Discharge: run-off from the active portion of the AES CCR temporary stockpile is collected in the coal pile runoff pond that was designed, constructed and is operated a zero-discharge unit. There have been no discharges to surface waters from this run-off control system since the initial run-on and run-off system plan was developed in 2016, not even during Hurricane Maria when a total rainfall of 27.95 inches was recorded at AES-PR. Therefore, the run-off from the active portion of this CCR unit is handled in accordance with the surface water requirements of 40 CFR 257.3-3.

5.0 Proposed Conditions

In compliance with CCR Rule requirements, AES-PR has initiated the construction activities associated with the Agremax™ Staging Area Liner Project that will include the placement of a liner and leachate collection system under the Agremax™ temporary stockpile area. The leachate to be collected will be pumped to the coal pile runoff pond. At this time, the volume of leachate that will be generated has not been determined, therefore this project could have a future impact on this revised Run-On and Run-off Control System Plan. Presently, no additional significant operational modifications or expansions of the Agremax™ Staging Area footprint are anticipated.

6.0 Conclusions and Recommendations

Based on the review of the information described in Section 2 of this Report and the current site conditions, the AES CCR (Agremax™) temporary stockpile area meets the requirements of 40 CFR 257.81 (a) and (b) of the EPA CCR Rule.

WRE recommends that, as the sedimentation levels in the coal runoff pond increase, the frequency of the bathymetric surveys be reassessed in order to better anticipate when the critical sediment level will occur and plan ahead for its removal. The potential impact that construction projects e.g. Black Start and the Agremax™ Staging Area Liner Project (and the resulting leachate management operations) may have on the site's hydrologic and hydraulic conditions used to develop this Plan should be evaluated in order to determine if this Plan must be amended as per 40 CFR 257.81 (c) (2) before the next 5-year revision period in 2026.

7.0 Limitations

The statements, conclusions, recommendations and opinions included in this Report are based upon, and limited by the agreed scope of work, information disclosed by AES-PR and reasonably ascertainable information obtained from ground-level and aerial visual observations, review of CCR Annual Inspection Reports and site rainfall data, interviews with AES personnel, and our understanding of applicable environmental regulations and are only intended to give approximations of the hydraulic- hydrologic conditions found at the time, limited to the particular issues actually targeted by WRE in the agreed-upon scope of work. No representations or warranties are made concerning the site conditions subsequent to the date of the last information used in the preparation of this Report. If additional information that might impact our conclusions becomes available, we reserve the right to review the information, reassess the potential concerns, and modify opinions, if warranted.

8.0 Certification

Pursuant to 40 CFR 257.81 (c) (5) by this certification, I attest that:

(i) I am a Professional Engineer currently licensed in the Commonwealth of Puerto Rico;

(ii) I am familiar with the provisions of 40 CFR Part 257 Subpart D;

(iii) I or my agent have visited and examined the AES Puerto Rico CCR Temporary Stockpile Area;

(iv) it is my professional opinion that, to the best of my knowledge, information, and belief, this Run-On and Run-Off Control System Plan has been prepared in accordance with current good and accepted engineering practice(s) and standard(s) , including consideration of applicable industry standards and the requirements of the CCR Rule;

(v) this Run-On and Run-Off Control System Plan meets the requirements of 40 CFR 257.819(c);and

(vi) this Plan is adequate for the AES- PR CCR Temporary Stockpile Area.

"Certification "in this document is exclusively a statement of professional opinion not to be interpreted or construed as a guarantee, warranty or legal opinion.

Name: Winston R. Esteves **Signature:**

Position: Environmental Consultant Lic.#:8827

Date: December 31, 2021 **PE Stamp:**

9.0 References

AES Puerto Rico. Run-on and Run-off Control System Plan. Coal Combustion Residue Temporary Stockpile Area. October 2016.

AES Puerto Rico. 2018-2021 CCR Annual Inspection Reports.

AES Puerto Rico. Storm Water Pollution Prevention Plan for Industrial Activities. August 2021.

AES Puerto Rico. SOP-WT-18. Water Retention Ponds Management Procedure. Revision 2. December 23, 2021.

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Caribe Environmental Services. Hydrologic and Hydraulic Study. Existing Conditions Evaluation. AES-PR Study, 2012

U.S. Department of Commerce, National Oceanographic and Atmospheric Administration (NOAA). Point Precipitation Frequency Estimates. AES Guayama, Puerto Rico. NOAA Atlas 14, Volume 3, Version 4.

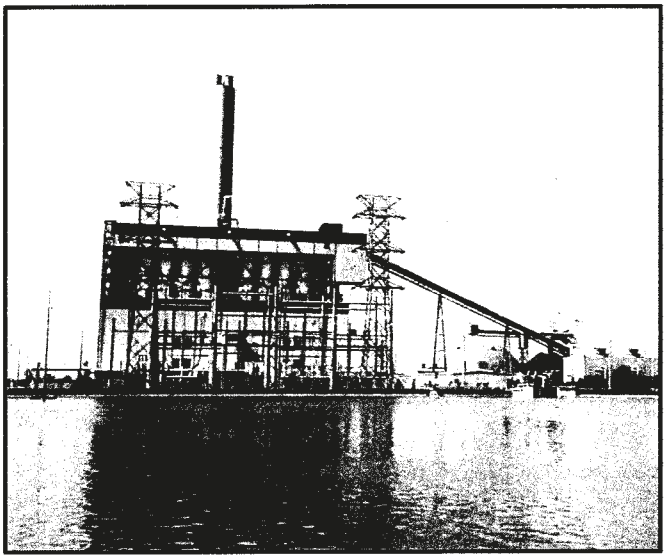
U.S. Environmental Protection Agency. 40 CFR Part 257.81 Run-on and run-off controls for CCR landfills.

U.S. Geological Survey, Topographic Map of the Central Aguirre 1970, photo revised 1982.

APPENDIX A
Initial Run-On and Run-Off Control System Plan. October 2016

AES Puerto Rico

Run-on and run-off control system plan



Coal Combustion Residue Temporary Stockpile Area

AES Puerto Rico, L.P.

October 2016

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1.0 Introduction

Title 40 Section 257.81 of the Code of Federal Regulation (CFR) stipulates that in accordance with the surface water requirements under the Clean Water Act, the owner or operator of a CCR unit[1] must design, construct, operate, and maintain the following control systems:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm

The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit that document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of the 40 CFR 257.81. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3).

2.0 Facility Information

AES Puerto Rico (AES-PR) is a bituminous coal-fueled power plant that generates and sells electricity to the Puerto Rico Electric Power Authority (PREPA) with a total power generation capacity of 454 Megawatts (MW); this represents approximately 15% of the electricity consumed on the island. AES-PR also produces a manufactured aggregate known as Agremax.

[1] AES Puerto Rico's temporary storage of its inventory of manufactured aggregate is not a CCR unit subject to the CCR Rule, 40 C.F.R. Part 257. Nonetheless, as a protective measure, AES Puerto Rico has prepared this plan and taken other steps to satisfy CCR Rule requirements applicable to CCR landfills. By undertaking these measures, AES Puerto Rico does not admit its facility is covered by the CCR Rule and expressly preserves all rights and defenses.

AES-PR is located on an 85 acre tract of land owned by AES Puerto Rico, LP. It is bordered to the north by a pharmaceutical facility (TAPI Puerto Rico, Inc.-TAPI) and vacant land owned by the Puerto Rico Land Administration (PRLA); to the south by wetlands and Bahia Las Mareas; to the east by the former Chevron Phillips Chemical Puerto Rico Core, LLC (CPC) facilities; and to the west by AES Ilumina and PRLA vacant land. The facility owned and operated by AES-PR is composed of a coal-fired power plant and an ancillary marine dock that is not contiguous to the main power plant. It also occupies associated rights-of-way for elevated conveyors, transmission lines, make-up water supply lines, process steam piping and service/access roads. The facility operates under Standard Industrial Classification (SIC) Code Nos. 4911- Electric Services- and 4491-Marine Cargo Handling.

The physical address of this facility is:

AES Puerto Rico, LP

Km 142.0, State Road PR 3

Jobos Ward

Guayama, Puerto Rico

Figure 1 is the AES-PR Location Map that shows the body of water that could be affected by its discharge; the storm water discharges of the main facility drain south towards a wetland area; the dock facility drains directly to Bahia Las Mareas. The AES-PR facilities are completely fenced and gated and include a power plant building, office / storage and maintenance buildings, open paved parking areas, cooling tower, open coal and manufactured aggregate stockpile areas, limestone storage dome, manufactured aggregate / coal pile runoff pond, a storm water runoff pond, a make-up water pond, a cooling tower water pond, water treatment facilities, material and equipment storage areas and storm water collection and conveyance systems. The coal pile runoff pond collects non-industrial storm water runoff from the coal stockpile, the limestone storage dome area, the manufactured aggregate stockpile and certain areas adjacent to these locations. The storm water runoff pond collects non-industrial storm water runoff.

3.0 Management of Run-on and run-off controls

AES-PR has constructed and maintains an internal system to capture and reuse storm water runoff and eliminate industrial water discharges from its facility including a 14.5 million gallon no-discharge pond that collects runoff from the coal / manufactured aggregate stockpiles for reuse and a 1.9 million gallon storm water pond. Other runoff structural controls include grading and aggregate stabilization of perimeter roads and open areas, a catch basin and inlet at the north east corner of the property to divert off-site run-on, a berm along the AES east boundary with CPC, a grated inlet to intercept runoff before it leaves the facility at its southeast access gate, a berm along the north, south and west outside perimeter of industrial areas to prevent storm water discharges to the outside, a low wall along the perimeter of the cooling tower and a dedicated concrete channel within a larger concrete channel along a section of the AES west boundary to separate its storm water discharges from those of TAPI .

4.0 Design and Construction of the run-on and run-off control systems at the CCR Temporary Storage Area

AES-PR power plant was designed and constructed consistent with recognized and generally accepted good engineering standards. An initial Hydrologic and Hydraulic analysis was conducted by Caribbean Architects and Engineers on October 1999, as part of the engineering analysis performed for the design and construction of the AES Puerto Rico energy plant.

A complete evaluation of the run-on and run-off facility control systems was performed in order to determine the effectiveness of the storm water control systems. The permanent run-on and run-off controls maintained at the coal combustion residue temporary storage area are the following:

- South Concrete Drainage Ditch,
- Center Concrete Drainage Ditch,
- Coal/ Pile Manufactured Aggregate Runoff Pond,

- Southeast Concrete Ditch Low Wall; and
- South Concrete Curb.

On April 2012 a site hydrologic/hydraulic study was performed by Caribe Environmental Services (Colon, 2012) to determine the hydrologic/hydraulic conditions at the AES facility and Off-site areas for the 24-hour storm event with return periods of 2, 10, 25 and 100 years. The hydraulic evaluation included a detailed hydraulic analysis of the hydraulic systems within the AES site and Off-site areas. The site hydrologic/hydraulic study (H/H Study) and applicable structural plant improvements completed are summarized in the next sections.

4.1.1. H/H Study Methodology

The H/H Study was based on an "as-built" topographic survey and the 2006 Precipitation-Frequency Atlas of the United States (Volume 3, Version 4.0: Puerto Rico and the U.S. Virgin Islands, updated March 21, 2008), for the 24-hour storm events with return periods of 2 years, 10 years, 25 years and 100 years.

The evaluation for the H/H study was performed using the Hydrologic Modeling System (HEC-HMS) computer model (Version 3.5, August 2010) and the Hydrologic Engineering Center's River Analysis System (HEC-RAS) computer model (USACE, 2008) developed by the United States Army Corps of Engineers (USACE). The principal calculation parameters considered for these models includes the drainage area, the Curve Number (CN), and the time of concentration (TC).

Data used to compute weighted CNs were obtained from the Soil Survey of Humacao Area, Puerto Rico, U.S. Department of Agriculture Soil Conservation Survey; Survey Area Data: Version 3, August 19, 2008, aerial imagery obtained from Google Earth Pro (November 1, 2006), the USGS topographic map for Central Aguirre (USGS, 1982); and field observations.

TCs were computed using the Kirpich and the average overland velocities method (Gupta, 2001). Data for computation of the times of concentrations were obtained from the USGS

topographic maps, aerial imagery obtained from Google Earth Pro (November 1, 2006) and the topographic survey map provided by ARC Surveyors.

The drainage areas were delineated using the United States Geological Survey (USGS) topographic map, topographic data provided by ARC Surveyors (retained by AES-PR for the preparation of the AES-PR facility topographic map), and field observations. The On-site AES-PR facility under existing conditions was divided into 31 sub-basins (**Figure 2)**. The coal combustion residue temporary storage area was delineated as sub-basin 23. Runoff generated from this area drains through the plant south and center concrete drainage ditch which eventually discharge into the Coal Pile/Manufactured Aggregate Runoff Pond. **Figure 3** presents the approximate location and identification for each of the ditches and culverts located within the AES facility.

The existing topographic data, geometry of structures and hydrologic data were coded into the HEC-RAS Model to estimate the 2, 10, 25, and 100-year flood elevations. Manning roughness coefficients (N) were selected based on field observations, professional experience and published data. Concrete ditches and culverts N values were assigned a value of 0.013. The overbank N values ranged from 0.016 to 0.030. Entrance and exits loss coefficients near the culverts were assumed to be approximately 0.5 and 1.0 respectively as recommended by FHWA, 1985.

4.1.2. H/H Study Results Summary

The following results were obtained from the H/H study:

- The southern part of the AES-PR facility including sub-basin 20, 21, 22, 22A 22B and 23 generally drains towards the west into the Coal Pile/Manufactured Aggregate Runoff Pond.
- The drainage areas, Tc and CN computed results for sub-basins 20, 21, 22, 22A 22B and 23 hydrologic analyses are presented in **Table 1**.
- Peak flows for the 25 years-24 hours event that will be generated within sub-basins 20, 21, 22, 22A 22B and 23 are presented in **Table 2**.

- The South Concrete Drainage Ditch (CD-1 and CD-2) drains part of the coal pile area, part of the limestone dome area, part of the ash pile area, and part of the south access road into the coal pile/manufactured aggregate runoff pond.
- The Center Concrete Drainage Ditch (CD-6, CD-7 and CD-8) drains part of the coal pile area, part of the limestone dome area, part of the ash pile area, and part of the center access road into the coal pile/manufactured aggregate runoff pond.
- Characteristics of South and Center concrete ditches and the coal pile/manufactured aggregate runoff pond are presented in **Table 3** and **Table 4** respectively.
- No overflows are expected from the Coal/ Pile Manufactured Aggregate Runoff Pond for any of the storm events evaluated.
- The results of the hydraulic evaluation for South and Center concrete ditches are summarized in **Table 5**.
- The results of the hydraulic evaluation for the Coal/ Pile Manufactured Aggregate Runoff Pond are summarized in **Table 6.**

The following improvements to the run-on and run-off control systems were completed based on the H/H Study recommendations:

- A concrete curb was constructed along the south road area (**Attachment 4**).
- A low wall was constructed to increase eastern ditch outer bank height (**Attachment 4**).

5.0 Operation and Maintenance of the run-on and run-off control systems

The CCR temporary stockpile area receives manufactured aggregate material that is generated from the coal combustion products from AES-PR.[2] Manufactured aggregate is produced using a pug mill that operates during daily hours and then is transported by a conveyor to the stockpile area. The run-off generated from the pug mill area drains to concrete dich eight (CD-8) and into the coal pile/manufactured aggregate runoff pond.

A wet suppression system is placed in service during nighttime for watering the stockpile surfaces. All the run-off generated from the CCR temporary stockpile area is directed through CD-1 and CD-2 into the coal pile/manufactured aggregate runoff pond. Part of the run-off from the CCR stockpile area is capture at the west side of sub-basin 23 and pumped to concrete dich two (CD-2).

The coal pile/manufactured runoff pond was design to manage the run-off generated from a 100 years/24 hours storm event, see **Figure 4**. Also, two 750 GPM centrifugal pumps are installed at the east side of pond for water reuse.

AES-PR has a preventive maintenance program that is performed by AES-PR qualified personnel. This program includes:

- Schedule for periodic inspections.
- Kept maintenance records.
- Work-order generation to track and fix equipment problems.
- Inspection and cleaning of the concrete diches.
- Maintenance of facility equipment and systems.
- Visual inspection of the CCR temporary stockpile area.

[2] AES-PR currently maintains two separate temporary Agremax™ stockpiles. These two stockpiles are located in the stockpile area behind the plant. One stockpile includes Agremax™ inventory produced and stored before October 17, 2015. The second stockpile has Agremax™ inventory produced on or after October 17, 2015. This plan covers run on/run off from entire stockpile area.

7.0 Amendment of the Plan

The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(3). The owner or operator must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

8.0 Certification

Certification by the Professional Engineer:

I hereby certify that I am familiar with the provisions of 40 CFR Part 257, that the run-on and run-off control system plan meet the requirements of the 40 CFR section 257.81, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

Name: Pedro E. Labayen, PE

Signature: _____

Position: Environmental Engineer

Lic. #: 24451

Date: 10/14/2016

PE Stamp:

9.0 References

Atlas of Ground-Water Resources in Puerto Rico and the US Virgin Islands. 1996. U.S. Geological Survey. Water Resources Investigations Report 94-4198.

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U.S. Army Corps of Engineers (USACE), "HEC-HMS" Technical Reference Manual. Version 4.0. March 2008, Hydrologic Engineering Center, Davis, California

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U.S. Geological Survey, Topographic map of the Central Aguirre 1970, photo revised 1982.

Tables

Table 1: Drainage areas, Tc and CN computed results

Hydrologic/Hydraulic Study
AES Facility - Existing Conditions Evaluation
Guaynabo Puerto Rico
CES Project No. 11-0021

AES On-Site and Off-Site
Sub Basin Characteristics - Existing Conditions

Sub Basin	Area (acres)	Area (mi²)	Curve Number CN (AMC-II)	Time of Concentration Tc (min)
Sub Basin 1	1.4	0.0021904	91.0	4.04
Sub Basin 2	0.7	0.0011618	91.0	2.94
Sub Basin 3	2.6	0.0040348	94.4	6.11
Sub Basin 4	0.5	0.0008548	98.0	2.41
Sub Basin 5	3.1	0.0048927	98.0	1.89
Sub Basin 6	0.8	0.0011907	98.0	2.26
Sub Basin 7	0.7	0.0011023	94.5	2.53
Sub Basin 8	0.2	0.0003297	98.0	1.37
Sub Basin 9	1.4	0.0021765	94.5	2.67
Sub Basin 10	0.9	0.0013822	84.4	6.41
Sub Basin 11	3.7	0.0057085	88.2	18.06
Sub Basin 12	5.8	0.0090255	98.0	1.00
Sub Basin 13	1.8	0.0027575	83.6	8.18
Sub Basin 14	0.0215	0.0000336	98.0	0.33
Sub Basin 15	1.8	0.0027572	92.2	1.00
Sub Basin 16	6.9	0.0107332	94.4	4.45
Sub Basin 16A	0.8	0.0012720	91.0	2.50
Sub Basin 16B	0.3	0.0004432	98.0	2.50
Sub Basin 17	5.6	0.0087800	86.0	6.84
Sub Basin 17A	5.3	0.0082626	87.9	3.91
Sub Basin 18	1.6	0.0024521	84.0	3.62
Sub Basin 19	2.8	0.0043645	84.0	2.19
Sub Basin 20	8.2	0.0127892	98.0	1.00
Sub Basin 21	6.9	0.0107468	89.0	7.20
Sub Basin 22	5.5	0.0086448	89.0	4.47
Sub Basin 22A	1.3	0.0020714	91.0	2.00
Sub Basin 22B	0.4	0.0006857	91.0	1.00
Sub Basin 23	10.7	0.0167572	89.0	5.74
Sub Basin 24	0.2	0.0003583	98.0	1.14
Sub Basin 25	0.68	0.0010560	83.0	4.69
Sub Basin 26	0.3	0.0005328	95.3	8.99
Offsite 1*	30.5	0.0477098	68.5	30.6
Offsite 2*	93.1	0.1455000	71.5	40.2
Offsite 3A*	27.0	0.0422604	93	12.6
Offsite 3B*	150.6	0.2353100	73.5	43.2

*= refer to Appendix A for details

Table 2: Peak flows for the 25 years-24 hours

Hydrologic/Hydraulic Study
AES Facility - Existing Conditions Evaluation
Guayama Puerto Rico
CES Project No. 11-0034

Peak Flows
2, 10, 25, and 100 years-24 hr Storm Events

Peak Discharges				
Sub Basin	**2 yr-24hr (cfs)**	**10yr-24 hrs (cfs)**	**25 yr-24 hrs (cfs)**	**100yr-24hrs (cfs)**
Sub Basin 1	5.3	9.1	10.9	13.3
Sub Basin 2	2.9	5.1	6.1	7.4
Sub Basin 3	9.5	15.8	18.7	22.7
Sub Basin 4	2.5	4.0	4.7	5.6
Sub Basin 5	14.4	23.0	27.0	32.6
Sub Basin 6	3.5	5.6	6.5	7.9
Sub Basin 7	3.0	5.0	5.9	7.4
Sub Basin 8	1.0	1.6	1.8	2.2
Sub Basin 9	6.0	9.9	11.7	14.2
Sub Basin 10	2.5	4.9	5.9	7.4
Sub Basin 11	7.9	14.5	17.5	21.6
Sub Basin 12	26.7	42.7	50.1	60.5
Sub Basin 13	4.5	8.9	10.9	13.6
Sub Basin 14	0.1	0.2	0.22	0.24
Sub Basin 15	7.5	12.7	15.0	18.3
Sub Basin 16	27.4	45.4	53.6	64.9
Sub Basin 16A	3.3	5.7	6.8	8.2
Sub Basin 16B	1.3	2.1	2.4	2.9
Sub Basin 17	16.3	31.0	37.7	46.7
Sub Basin 17A	18.4	33.6	40.4	49.7
Sub Basin 18	4.9	9.6	11.8	14.7
Sub Basin 19	9.3	18.2	22.2	27.6
Sub Basin 20	37.8	60.6	71.0	85.7
Sub Basin 21	21.4	38.6	46.4	57.0
Sub Basin 22	19.5	35.0	41.9	51.5
Sub Basin 22A	5.4	9.4	11.1	13.6
Sub Basin 22B	1.8	3.1	3.7	4.5
Sub Basin 23	35.4	63.7	76.5	93.9
Sub Basin 24	1.1	1.7	2.0	2.4
Sub Basin 25	2.0	3.9	4.8	6.0
Sub Basin 26	1.1	1.9	2.2	2.7
Offsite 1	34.0	75.2	96.6	127.4
Offsite 2	100	216.8	275.5	359.5
Offsite 3A	74.6	126.4	149.8	182.2
Offsite 3B	164.4	349.0	441.2	572.3
Peak Inflows into Ponds				
Pond	**2 yr-24hr (cfs)**	**10yr-24 hrs (cfs)**	**25 yr-24 hrs (cfs)**	**100yr-24hrs (cfs)**
MW Supply Pond	35.6	78.0	99.9	131.4
Cooling Towers Make-Up Pond	26.7	42.7	50.1	60.5
Storm Water Pond and	73.1	122.1	144.8	175.9
Coal Pile/Manufactured Aggregate Runoff Pond	109.2	189.7	226.3	276.6

Table 3: Existing AES On-Site & Off-Site Concrete Drainage Ditch, Open Main Channel and Swale Characteristics

Existing AES On-Site & Off-Site
Concrete Drainage Ditch, Open Main Channel and Swale Characteristics

Conveyance Structure	Top Bank With (m)	Length (m)	I.E. Elev. Down (m)	I.E. Elev. Up (m)	Approximate Bank Height (m)
Concrete Ditch (CD)					
CD-1	1.5	323	2.92	3.80	0.5
CD-2	1.5	390	3.84	4.81	0.5
CD-3	1.5	79	4.93	5.28	0.25
CD-4	1.2	35	5.49	5.89	0.4
CD-5	1.2	74	5.93	6.02	0.3
CD-6	2.3	260	3.00	3.80	0.6
CD-7	2.3	94	3.92	4.58	0.5
CD-8	0.6	33	4.83	5.00	0.4
CD-9	1.7	263	5.26	6.76	0.4
CD-10	1.7	182	6.79	8.39	0.4
Swale					
Swale -1	12.0	190	1.56	2.92	2.00
Swale -2	9.0	67	2.95	3.85	0.4
Drainage Ditch South of TAPI	4.0	137	2.77	3.1	0.7
Open Concrete Main Channel					
North of Undeveloped area at the AES Facility	6.33	561	1.79	3.38	2.05
West of Undeveloped area at the AES Facility	14.2	150	1.39	1.78	2.15
West of Coal Pile Pond	6.2	115	1.12	1.30	2.3

m = meters
Elev. Elevation
I.E. = invert elevation

Table 4: Existing AES On-Site Ponds Characteristics

Hydrologic/Hydraulic Study
AES Facility - Existing Conditions Evaluation
Guayama Puerto Rico
CES Project No. 11-0034

Existing AES On-Site Ponds Characteristics

Pond Identification	Approximate Pond Maximum Storage Capacity (ac-ft/gallons)*	Pond Bottom Elevation (m amsl)	Pond Top Elevation (m amsl)	Storage Required by AES Industrial Processes (ac-ft/gallons)	Approximate Pond Available Storage Capacity (ac-ft/gallons)*
MW Supply Pond	8.18/2,666,031	3.41	7.30	5.11/1,665,000	2.04/666,031
Cooling Towers Make Up Pond	61.32/19,981,374	3.65	7.30	47.97/15,630,000	6.08/1,981,374
Storm Water Pond	5.44/1,774,024	2.32	4.00	NA	5.44/1,774,024
Coal Pile/Manufactured Aggregate Runoff Pond	46.74/15,229,535	1.89	4.00	NA	46.74/15,229,535

* = Based on pond topography provided by ARC Surveyors on Jan 5, 2012 and assuming no sedimentation in pond.
NA = Not Applicable
m amsl = meters above mean sea level

Table 5: Existing Conditions AES On-Site Concrete Ditches, Culverts and Swales Hydraulic Capacity Results 25 yr/24 hr Event

Hydrologic/Hydraulic Study
AES Facility - Existing Conditions Evaluation
Guayama Puerto Rico
CES Project No. 11-0024

Existing Conditions AES On-Site Concrete Ditches, Culverts and Swales
Hydraulic Capacity Results
25 yr/24 Hr Event

Concrete Ditch/ Swale No.	Peak Flow (cms/cfs)	Concrete Ditch Bank Elevation (m)+		W.S. Elev. (m)++
		Left Bank	Right Bank	
South Concrete Drainage Ditch (CD-1 - CD-2)				
CD-1	3.46/122.2	3.40	3.47	3.63 ++
CD-2	2.17/76.6	4.34	4.35	4.49 ++
East Concrete Drainage Ditch (CD-3 - CD-5)				
CD-3	1.00/35.2	5.13	5.10	5.40 ++
CD-4	0.47/16.5	6.00	5.93	6.00 ++
CD-5	0.31/10.9	6.34	6.17	6.35 ++
Center Concrete Drainage Ditch (CD-6 - CD-8)				
CD-6	1.59/56.3	3.44	3.42	3.58 ++
CD-7	0.42/14.8	4.40	4.40	4.72 ++
CD-8	0.10/3.5	5.06	5.06	5.35 ++
West Concrete Drainage Ditch (CD-9 - CD-10)				
CD-9	0.20/7.0	5.71	5.65	5.75 ++
CD-10	0.14/4.9	7.22	7.22	7.09
Swales (SWALE-1 -SWALE-2)				
SWALE-1	4.99/176.1	3.50	3.77	3.50++
SWALE-2	3.75/132.3	3.90	3.75	4.21++
Culvert No.	**Peak Flow (cms/cfs)**	**Flowing Through Culvert (cms/cfs)**	**W.S. Elev. At Culvert Entrance (m)**	**Overflow Elevation (m)+++**
Culvert (C-1 - C-9)				
C-1	2.17/76.6	0.05/1.8	4.49*	4.34
C-2	0.47/16.5	0.48/17.0	6.00	6.00
C-3	0.31/10.9	0.06/2.1	6.35*	6.17
C-4	0.42/14.8	0.42/14.8	4.72	5.50
C-5	0.10/3.5	0.08/2.82	5.35*	5.32
C-6	0.20/6.9	0.20/7.1	5.75	6.53
C-7	0.14/4.9	0.14/4.9	7.09	7.70
C-8	4.99/176.1	4.79/169.2	3.50*	3.48
C-9	3.75/132.3	0.74/26.1	4.21	4.23

\+ = Elevation At Most Downstream Section
cms = Cubic Meters/Second
cfs = cubic feet/second
Elev. = Elevation (Meters above Mean Sea Level)
W.S. = Water Surface
m = Meters
++ = Water Surface Elevation above Bank Elevation
+++ = Water Surface Elevation Needed for Overflow to Occur Upstream of Culvert
* = Overflow will occur.

Table 6: Retention and Process Ponds - Hydraulic Capacity Results 2, 10, 25, and 100 yr/24 Hr Event

Hydrologic/Hydraulic Study
AES Facility - Existing Conditions Evaluation
Guayama Puerto Rico
CES Project No. 11-0034

Existing Conditions AES On-Site
Retention and Process Ponds - Hydraulic Capacity Results
2, 10, 25, and 100 yr/24 Hr Event

Approximate Pond Maximum Storage Capacity (Ac-Ft/Gallons)*	Pond Bottom Elevation (m amsl)	Pond Top Elevation (m amsl)	Storage Required By AES Industrial Processes (Ac-Ft/Gallons)	Approximate Pond Available Storage Capacity (Ac-Ft/Gallons)*	100 Yr/24hr Runoff Volume Draining Into The Pond (Ac-Ft/Gallons)	25 Yr/24hr Runoff Volume Draining Into The Pond (Ac-Ft/Gallons)	10 Yr/24hr Runoff Volume Draining Into The Pond (Ac-Ft/Gallons)	2 Yr/24hr Runoff Volume Draining Into The Pond (Ac-Ft/Gallons)
MW Supply Pond								
8.18/2,666,031	3.41	7.30	5.11/1,665,000	3.07/1,000,000	30.26/9,860,265**	19.98/6,510,511**	14.17/4,617,315**	5.29/1,723,754**
Cooling Towers Make Up Pond								
61.32/19,981,374	3.65	7.30	47.97/15,630,000	13.35/4,350,000	6.91/2,251,634	4.94/1,609,706	3.78/1,231,718	1.84/599,567
Storm Water Pond								
5.44/1,774,024	2.32	4.00	NA	5.44/1,774,024	25.38/8,270,109**	17.87/5,822,965**	13.46/4,385,960**	6.14/2,000,727**
Coal Pile/Manufactured Aggregate Runoff Pond								
46.74/15,229,535	1.89	4.00	NA	46.74/15,229,535	37.25/12,137,965	26.02/8,478,654	19.44/6,334,551	8.58/2,795,805

* = Based On Pond Topography Provided By Arc Surveyors On Jan 5, 2012 And Assuming No Sedimentation in Pond.
** = Generated Runoff Volume Greater Than Available Pond Storage
NA = Not Applicable
Ac-Ft = Acres - Feet

Figures

Figure 1: AES-PR Site Location Map

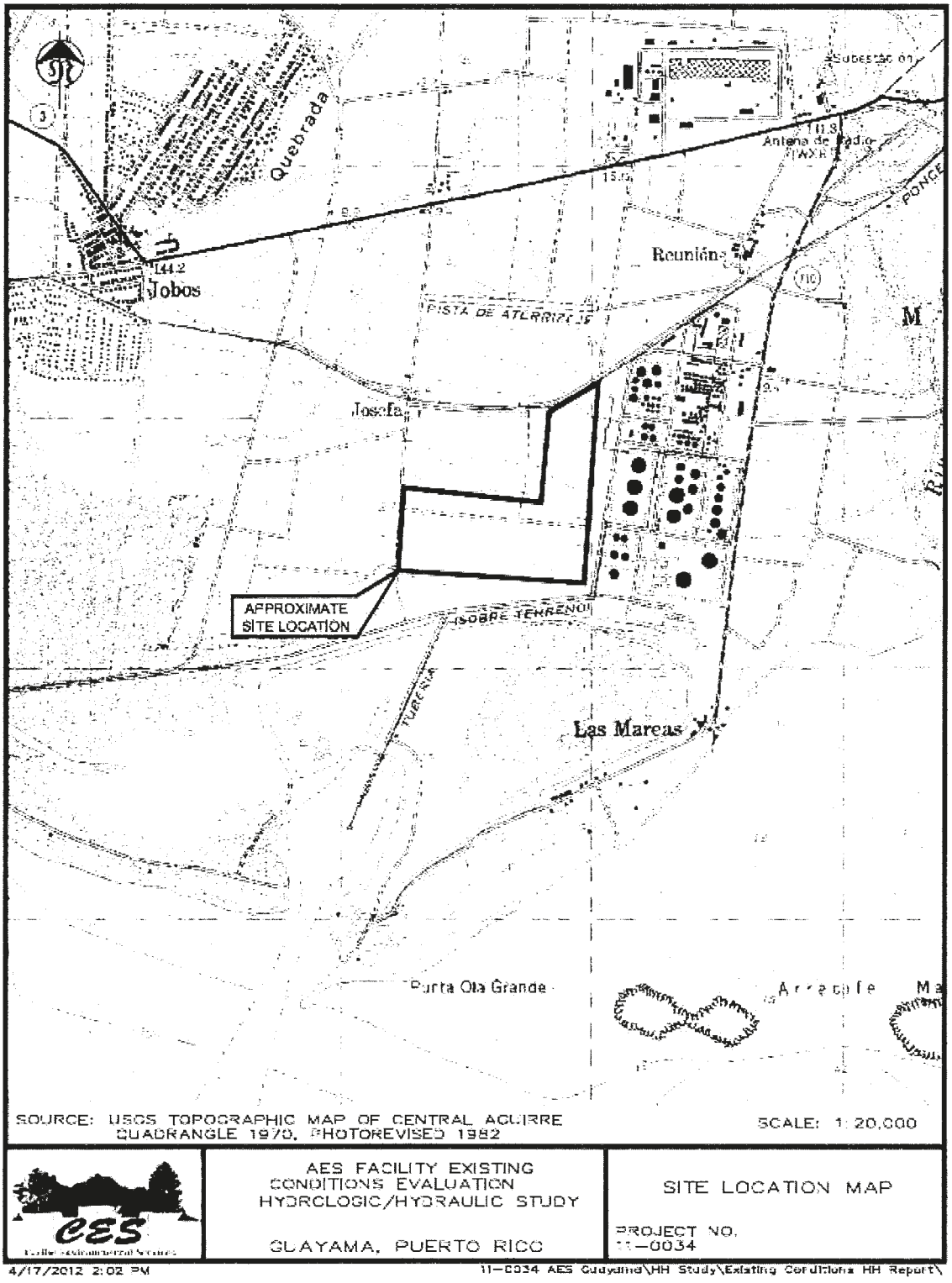


Figure 2: Approximate delimitation of onsite watersheds drainage areas

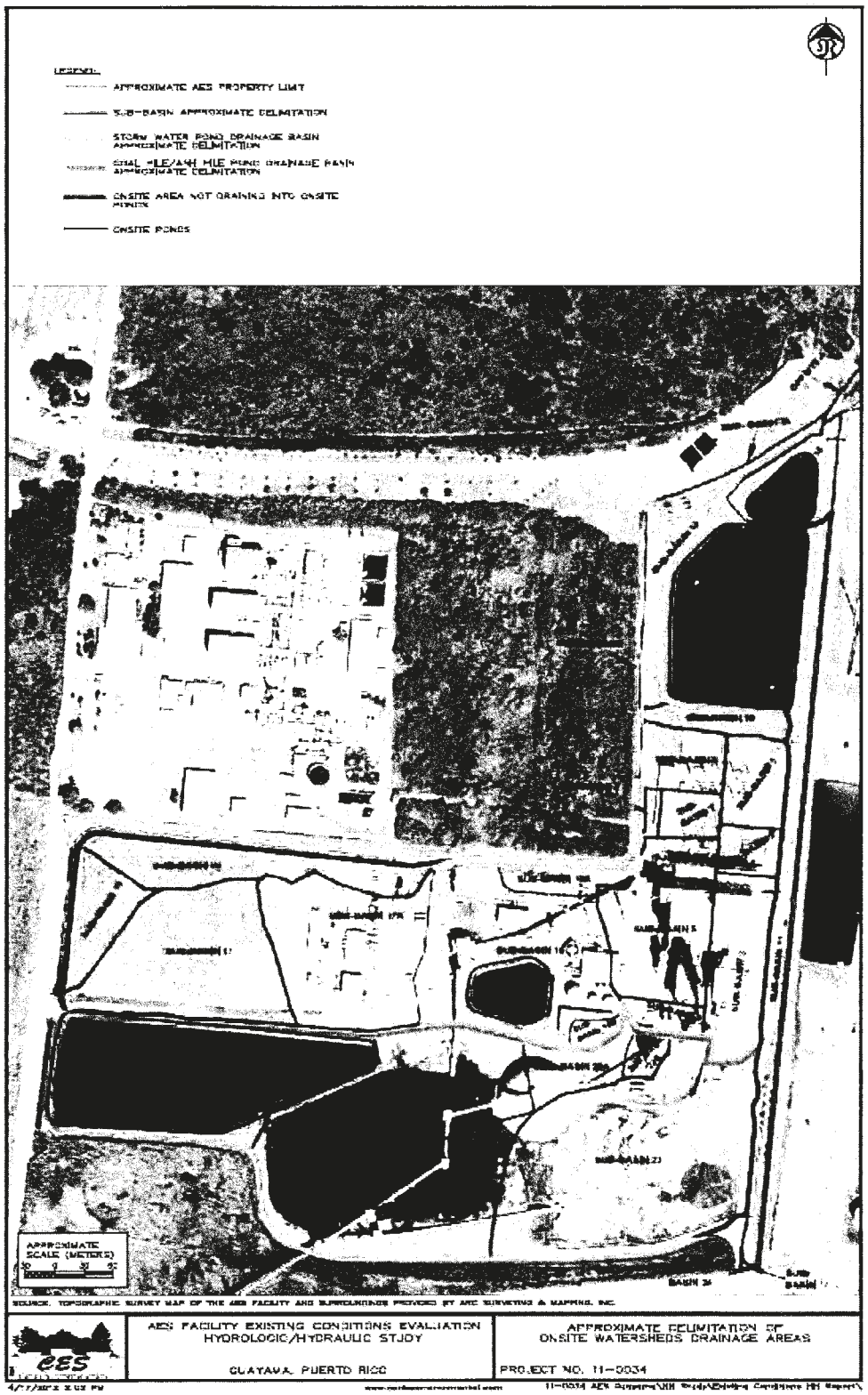


Figure 3: Onsite and offsite storm water sewer system, hydraulic structures and ponds configuration

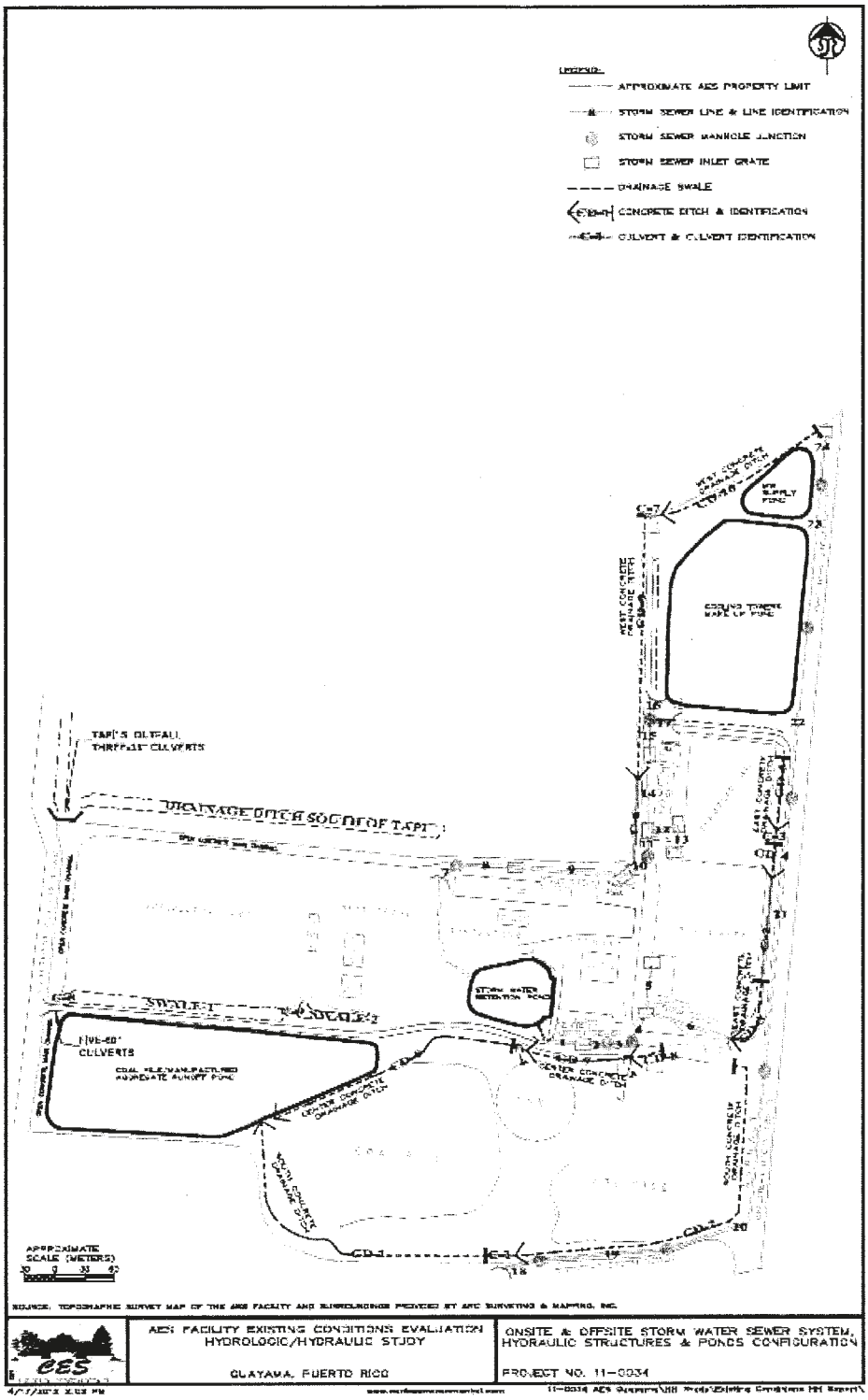
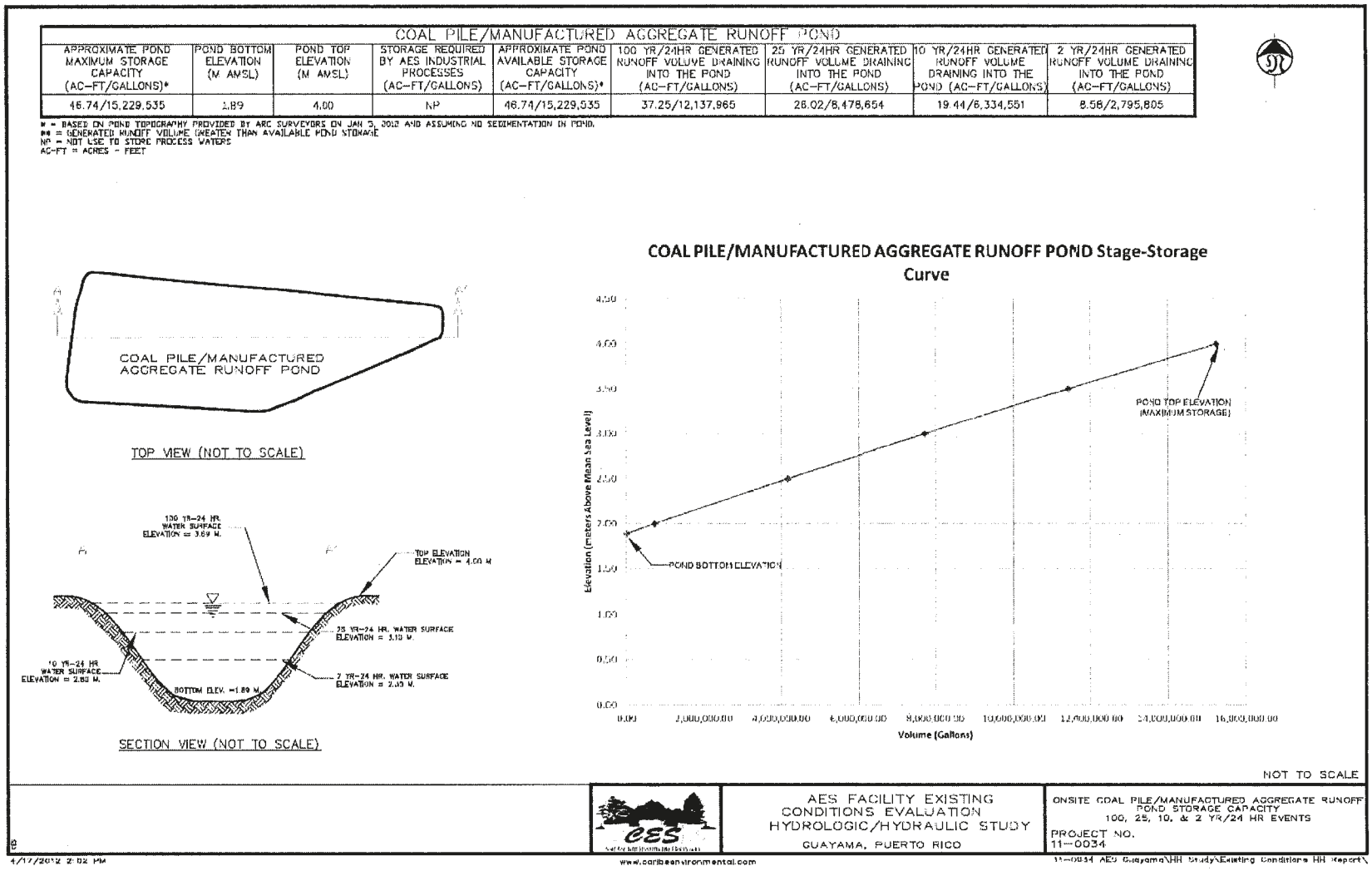


Figure 4: Onsite Coal Pile/Manufactured Aggregate Runoff Pond Storage Capacity 100, 25, 10, and 2 Yr-24 hr Storm Events



COAL PILE/MANUFACTURED AGGREGATE RUNOFF POND

APPROXIMATE POND MAXIMUM STORAGE CAPACITY (AC-FT/GALLONS)*	POND BOTTOM ELEVATION (M AMSL)	POND TOP ELEVATION (M AMSL)	STORAGE REQUIRED BY AES INDUSTRIAL PROCESSES (AC-FT/GALLONS)	APPROXIMATE POND AVAILABLE STORAGE CAPACITY (AC-FT/GALLONS)*	100 YR/24HR GENERATED RUNOFF VOLUME DRAINING INTO THE POND (AC-FT/GALLONS)	25 YR/24HR GENERATED RUNOFF VOLUME DRAINING INTO THE POND (AC-FT/GALLONS)	10 YR/24HR GENERATED RUNOFF VOLUME DRAINING INTO THE POND (AC-FT/GALLONS)	2 YR/24HR GENERATED RUNOFF VOLUME DRAINING INTO THE POND (AC-FT/GALLONS)
46.74/15,229,535	1.89	4.00	NP	46.74/15,229,535	37.25/12,137,965	26.02/8,478,654	19.44/6,334,551	8.58/2,795,805

M = BASED ON POND TOPOGRAPHY PROVIDED BY ARC SURVEYORS ON JAN 3, 2012 AND ASSUMING NO SEDIMENTATION IN POND.
= GENERATED RUNOFF VOLUME GREATER THAN AVAILABLE POND STORAGE
NP = NOT USE TO STORE PROCESS WATERS
AC-FT = ACRES - FEET

Attachments

Attachment 1: Sub-basins 20 to 23 input and output data from the HEC-HMS Hydrologic Modeling System computer model.

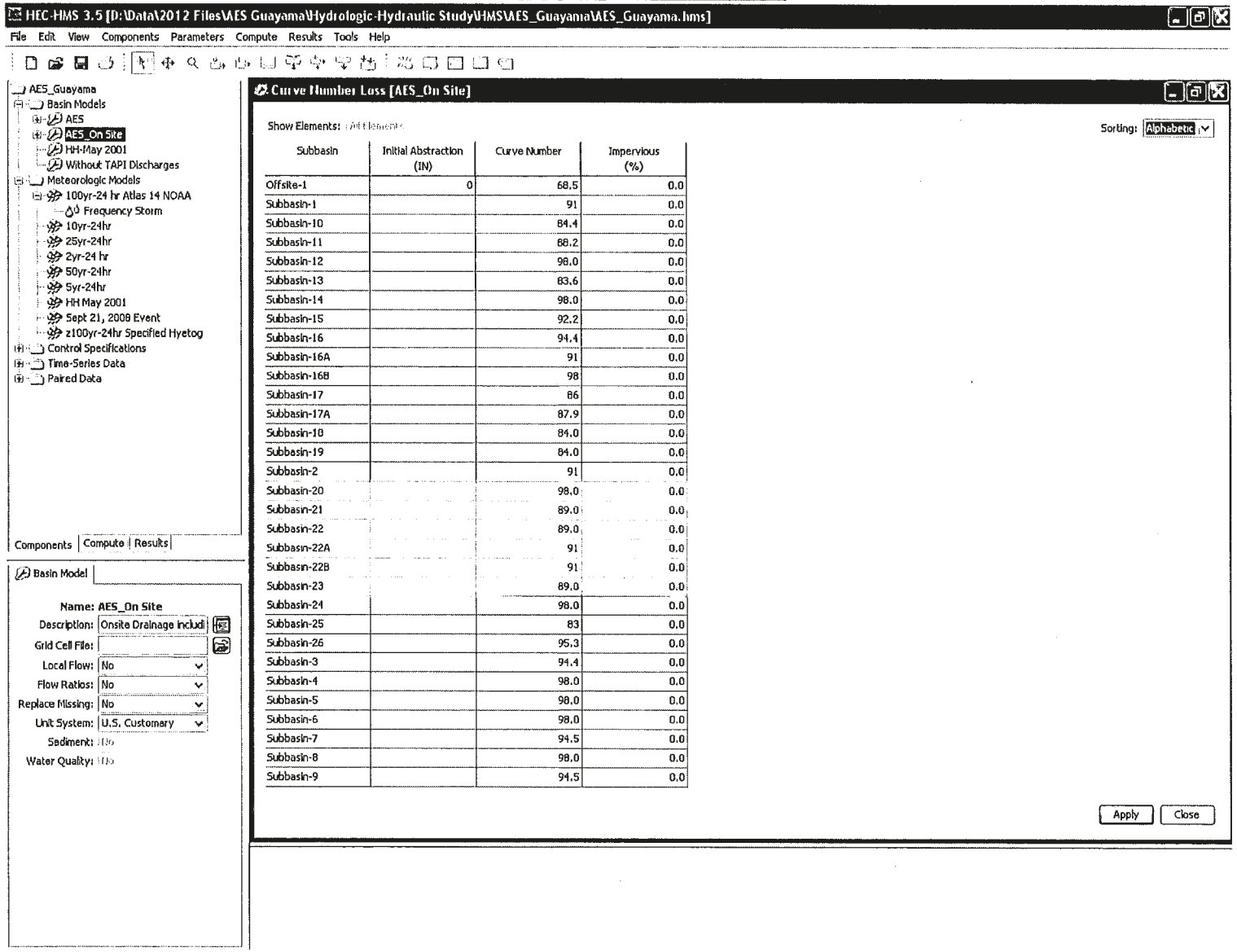
HEC-HMS

Project : AES_Guayama

Basin Model : AES_On Site

Apr 04 11:02:30 GMT-04:00 2012

INPUT DATA



Subbasin	Initial Abstraction (IN)	Curve Number	Impervious (%)
Offsite-1	0	68.5	0.0
Subbasin-1		91	0.0
Subbasin-10		84.4	0.0
Subbasin-11		88.2	0.0
Subbasin-12		98.0	0.0
Subbasin-13		83.6	0.0
Subbasin-14		98.0	0.0
Subbasin-15		92.2	0.0
Subbasin-16		94.4	0.0
Subbasin-16A		91	0.0
Subbasin-16B		98	0.0
Subbasin-17		86	0.0
Subbasin-17A		87.9	0.0
Subbasin-18		84.0	0.0
Subbasin-19		84.0	0.0
Subbasin-2		91	0.0
Subbasin-20		98.0	0.0
Subbasin-21		89.0	0.0
Subbasin-22		89.0	0.0
Subbasin-22A		91	0.0
Subbasin-22B		91	0.0
Subbasin-23		89.0	0.0
Subbasin-24		98.0	0.0
Subbasin-25		83	0.0
Subbasin-26		95.3	0.0
Subbasin-3		94.4	0.0
Subbasin-4		98.0	0.0
Subbasin-5		98.0	0.0
Subbasin-6		98.0	0.0
Subbasin-7		94.5	0.0
Subbasin-8		98.0	0.0
Subbasin-9		94.5	0.0

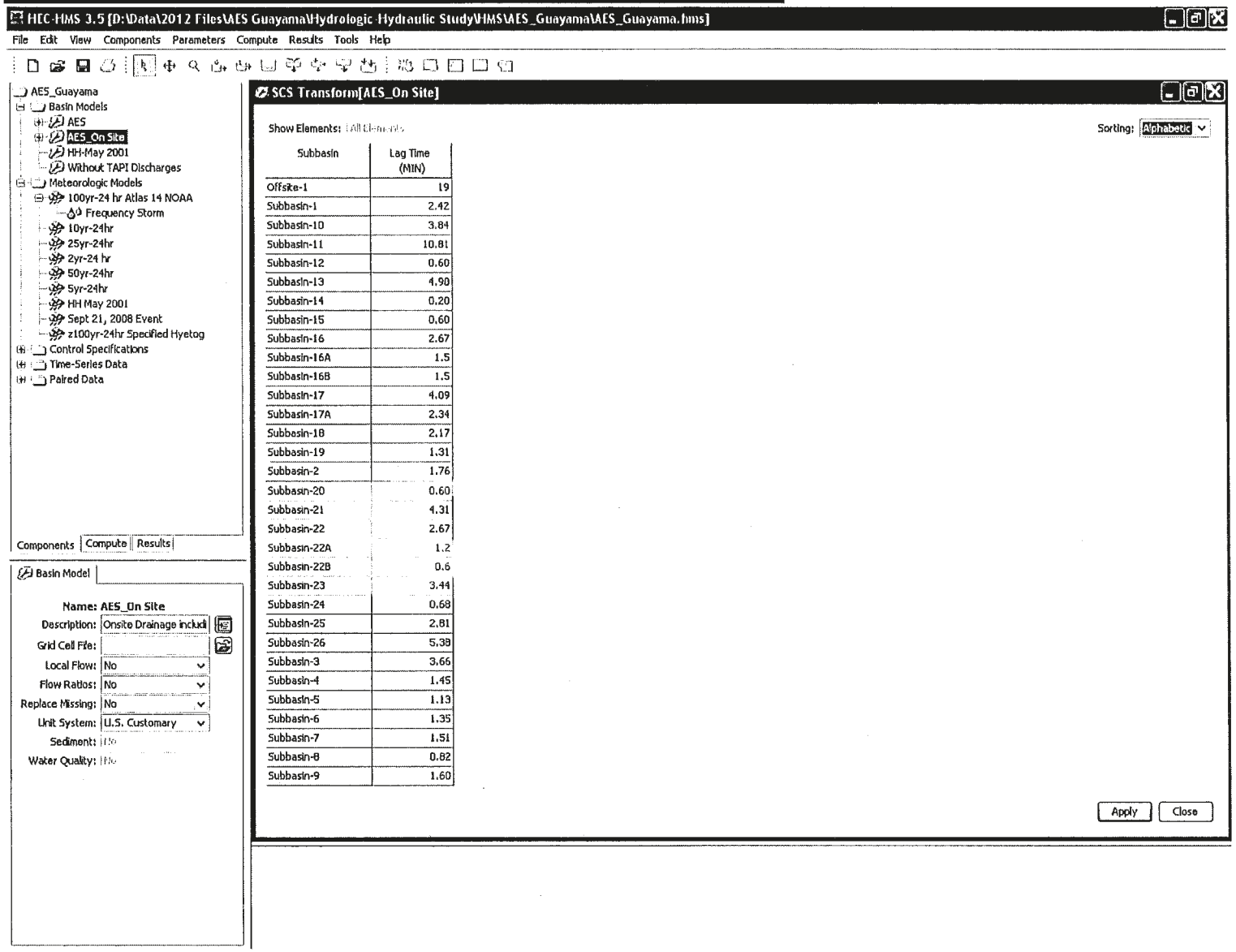
HEC-HMS

Project : AES_Guayama

Basin Model : AES_On Site

Apr 04 11:02:30 GMT-04:00 2012

INPUT DATA



Subbasin	Lag Time (MIN)
Offsite-1	19
Subbasin-1	2.42
Subbasin-10	3.84
Subbasin-11	10.81
Subbasin-12	0.60
Subbasin-13	4.90
Subbasin-14	0.20
Subbasin-15	0.60
Subbasin-16	2.67
Subbasin-16A	1.5
Subbasin-16B	1.5
Subbasin-17	4.09
Subbasin-17A	2.34
Subbasin-18	2.17
Subbasin-19	1.31
Subbasin-2	1.76
Subbasin-20	0.60
Subbasin-21	4.31
Subbasin-22	2.67
Subbasin-22A	1.2
Subbasin-22B	0.6
Subbasin-23	3.44
Subbasin-24	0.68
Subbasin-25	2.81
Subbasin-26	5.38
Subbasin-3	3.66
Subbasin-4	1.45
Subbasin-5	1.13
Subbasin-6	1.35
Subbasin-7	1.51
Subbasin-8	0.82
Subbasin-9	1.60

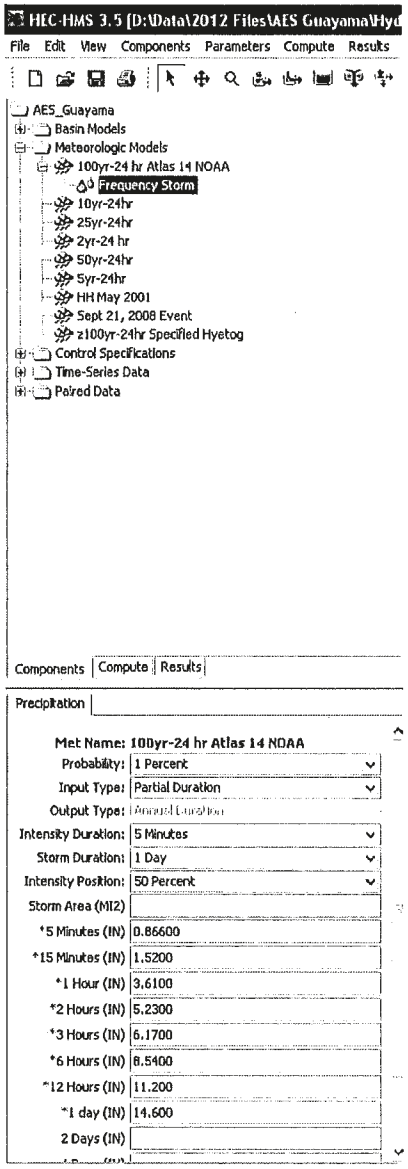
HEC-HMS

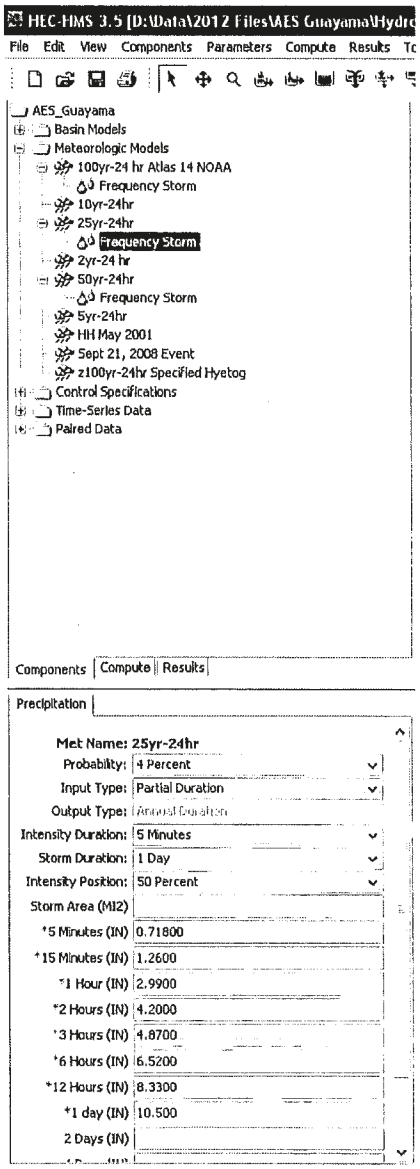
Project : AES_Guayama

Basin Model : AES_On Site

Apr 04 11:02:30 GMT-04:00 2012

INPUT DATA





HEC-HMS

Project : AES_Guayama

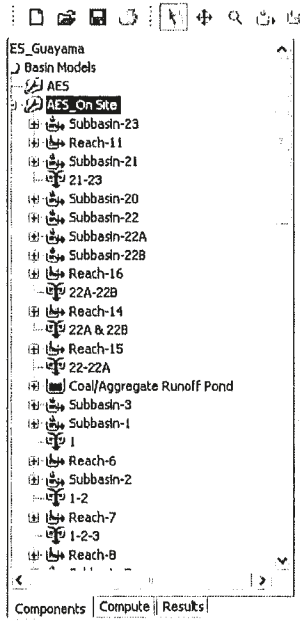
Basin Model : AES_On Site

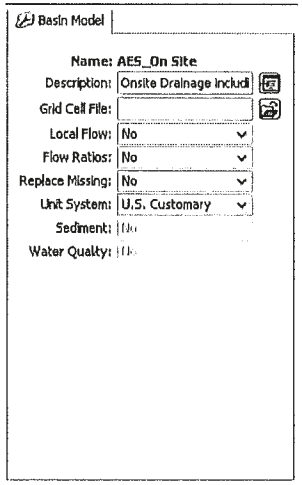
Apr 04 11:02:30 GMT-04:00 2012

INPUT DATA

HEC-HMS 3.5 [D:\Data\2012 Files\AES Guayama\Hydrologic-Hydraulic Study\HMS\AES_Guayama\AES_Guayama.hms]

File Edit View Components Parameters Compute Results Tools Help





Subbasin Area [AES_On Site]

Show Elements: All Elements

Sorting: Alphabetic

Subbasin	Area (MI2)
Offsite-1	0.0477098
Subbasin-1	0.0021904
Subbasin-10	0.0013822
Subbasin-11	0.0057085
Subbasin-12	0.0090255
Subbasin-13	0.0027575
Subbasin-14	0.0000336
Subbasin-15	0.0027572
Subbasin-16	0.0107332
Subbasin-16A	0.001272
Subbasin-16B	0.0004432
Subbasin-17	0.0087600
Subbasin-17A	0.0082626
Subbasin-18	0.0024521
Subbasin-19	0.0043645
Subbasin-2	0.0011618
Subbasin-20	0.0127892
Subbasin-21	0.0107468
Subbasin-22	0.0086448
Subbasin-22A	0.0020714
Subbasin-22B	.000685717
Subbasin-23	0.0167572
Subbasin-24	.000358303
Subbasin-25	0.0010560
Subbasin-26	.000532821
Subbasin-3	0.0040348
Subbasin-4	.00085483
Subbasin-5	0.0048927
Subbasin-6	0.0011907
Subbasin-7	0.0011023
Subbasin-8	.000329731
Subbasin-9	0.0021765

Apply Close

HEC-HMS

Project : AES_Guayama

Basin Model : AES_On Site

Apr 04 11:02:30 GMT-04:00 2012

25 YR-24HR HYDROLOGIC RESULTS

HEC-HMS 3.5 [D:\Data\2012 Files\AES Guayama\Hydrologic-Hydraulic Study\HMS\AES_Guayama\AES_Guayama.hms]

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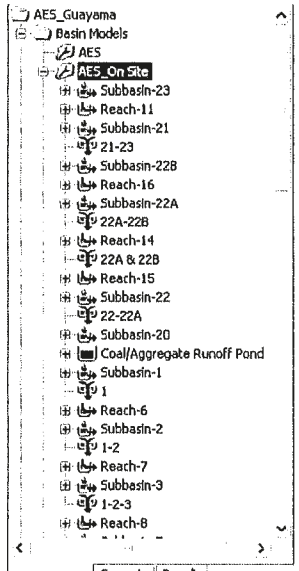
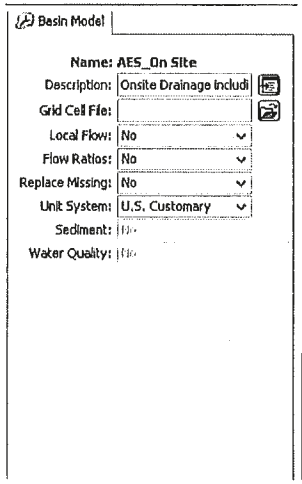




Global Summary Results for Run "AES On Site 25yr-24hr"

Project: AES_Guayama Simulation Run: AES On Site 25yr-24hr

Start of Run: 01Jan2012, 00:00 Basin Model: AES_On Site
End of Run: 03Jan2012, 00:00 Meteorologic Model: 25yr-24hr
Compute Time: 04Apr2012, 15:39:07 Control Specifications: AES_Guayama

Show Elements: All Elements Volume Units: (•) IN ( ) AC-FT Sorting: Alphabetic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Reach-5	0.0102169	41.6	01Jan2012, 12:06	9.30145
Reach-6	0.0021904	11.0	01Jan2012, 12:05	9.39981
Reach-7	0.0033522	16.5	01Jan2012, 12:05	9.39981
Reach-8	0.0073870	35.2	01Jan2012, 12:06	9.62943
Reach-9	0.0048927	27.4	01Jan2012, 12:04	10.25901
Storm Water Pond	0.0345219	132.2	01Jan2012, 12:08	6.75368
Storm Water Pond, 1...	0.0515645	176.1	01Jan2012, 12:08	7.45894
Subbasin-1	0.0021904	10.9	01Jan2012, 12:04	9.39981
Subbasin-10	0.0013822	5.9	01Jan2012, 12:05	8.56719
Subbasin-11	0.0057085	17.5	01Jan2012, 12:12	9.04925
Subbasin-12	0.0090255	50.1	01Jan2012, 12:03	10.25901
Subbasin-13	0.0027575	10.9	01Jan2012, 12:06	8.46479
Subbasin-14	.0000336	0.2	01Jan2012, 12:03	10.25901
Subbasin-15	0.0027572	15.0	01Jan2012, 12:03	9.54885
Subbasin-16	0.0107332	53.6	01Jan2012, 12:04	9.82020
Subbasin-16A	0.0012720	6.8	01Jan2012, 12:03	9.39970
Subbasin-16B	.0004432	2.4	01Jan2012, 12:03	10.25889
Subbasin-17	0.0087800	37.7	01Jan2012, 12:05	8.77105
Subbasin-17A	0.0082626	40.4	01Jan2012, 12:04	9.01135
Subbasin-18	0.0024521	11.8	01Jan2012, 12:03	8.51603
Subbasin-19	0.0043645	22.2	01Jan2012, 12:03	8.51603
Subbasin-2	0.0011618	6.1	01Jan2012, 12:03	9.39981
Subbasin-20	0.0127892	71.0	01Jan2012, 12:03	10.25901
Subbasin-21	0.0107468	46.4	01Jan2012, 12:05	9.14982
Subbasin-22	0.0086448	41.9	01Jan2012, 12:04	9.14982
Subbasin-22A	0.0020714	11.1	01Jan2012, 12:03	9.39970
Subbasin-22B	.000685717	3.7	01Jan2012, 12:03	9.39970
Subbasin-23	0.0167572	76.5	01Jan2012, 12:04	9.14982
Subbasin-24	.000358303	2.0	01Jan2012, 12:03	10.25901
Subbasin-25	0.0010560	4.8	01Jan2012, 12:04	8.38775
Subbasin-26	.000532821	2.2	01Jan2012, 12:06	9.93051
Subbasin-3	0.0040348	18.7	01Jan2012, 12:05	9.82020
Subbasin-4	.00085483	4.7	01Jan2012, 12:03	10.25901
Subbasin-5	0.0048927	27.0	01Jan2012, 12:03	10.25901
Subbasin-6	0.0011907	6.5	01Jan2012, 12:03	10.25901
Subbasin-7	0.0011023	5.9	01Jan2012, 12:03	9.83248
Subbasin-8	.000329731	1.8	01Jan2012, 12:03	10.25901
Subbasin-9	0.0021765	11.7	01Jan2012, 12:03	9.83248

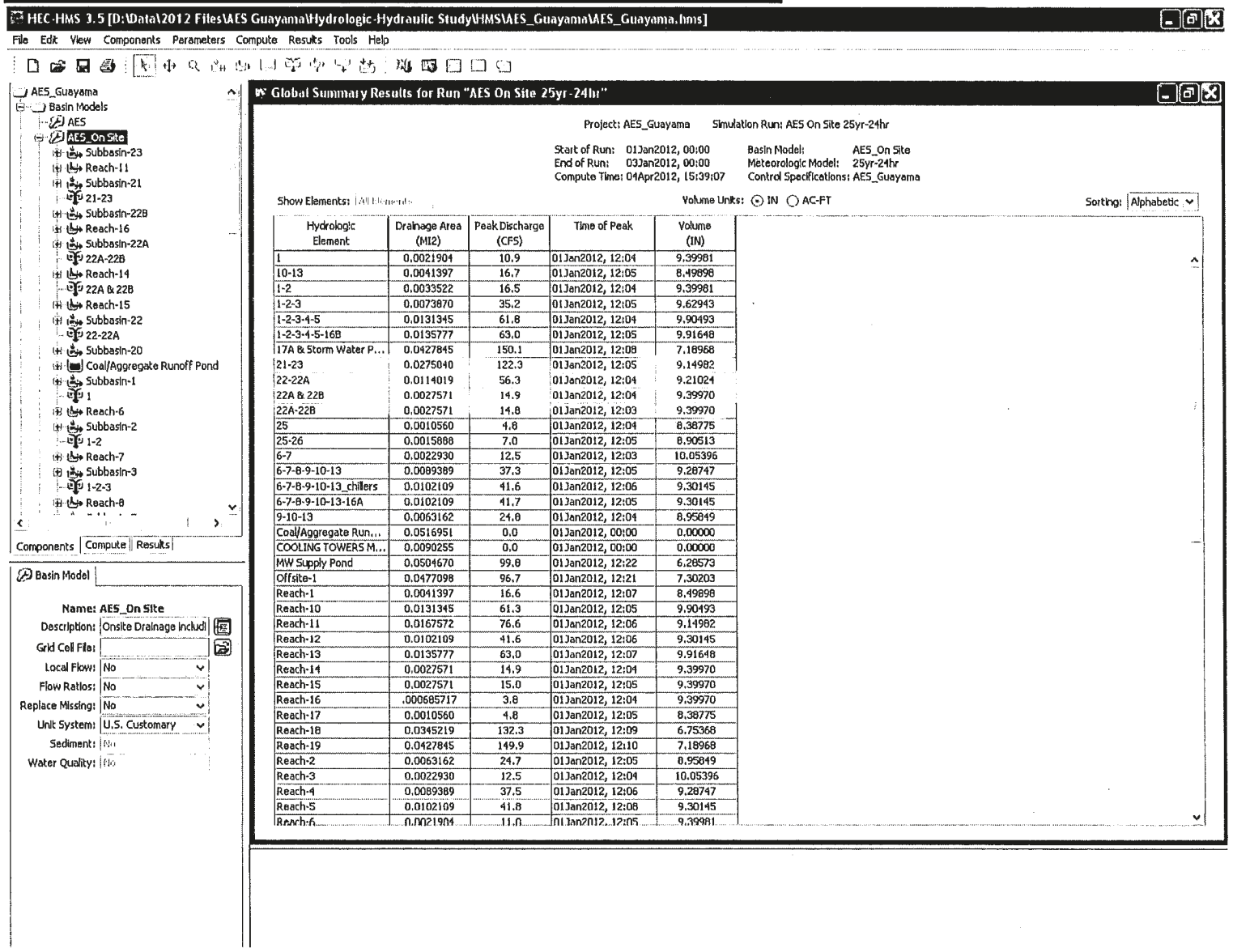
HEC-HMS

Project : AES_Guayama

Basin Model : AES_On Site

Apr 04 11:02:30 GMT-04:00 2012

25 YR-24HR HYDROLOGIC RESULTS



Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1	0.0021904	10.9	01Jan2012, 12:04	9.39981
10-13	0.0041397	16.7	01Jan2012, 12:05	8.49898
1-2	0.0033522	16.5	01Jan2012, 12:04	9.39981
1-2-3	0.0073870	35.2	01Jan2012, 12:05	9.62943
1-2-3-4-5	0.0131345	61.8	01Jan2012, 12:04	9.90493
1-2-3-4-5-16B	0.0135777	63.0	01Jan2012, 12:05	9.91648
17A & Storm Water P...	0.0427845	150.1	01Jan2012, 12:08	7.18968
21-23	0.0275040	122.3	01Jan2012, 12:05	9.14982
22-22A	0.0114019	56.3	01Jan2012, 12:04	9.21024
22A & 22B	0.0027571	14.9	01Jan2012, 12:04	9.39970
22A-22B	0.0027571	14.8	01Jan2012, 12:03	9.39970
25	0.0010560	4.8	01Jan2012, 12:04	8.38775
25-26	0.0015888	7.0	01Jan2012, 12:05	8.90513
6-7	0.0022930	12.5	01Jan2012, 12:03	10.05396
6-7-8-9-10-13	0.0089389	37.3	01Jan2012, 12:05	9.28747
6-7-8-9-10-13_chillers	0.0102109	41.6	01Jan2012, 12:06	9.30145
6-7-8-9-10-13-16A	0.0102109	41.7	01Jan2012, 12:05	9.30145
9-10-13	0.0063162	24.8	01Jan2012, 12:04	8.95849
Coal/Aggregate Run...	0.0516951	0.0	01Jan2012, 00:00	0.00000
COOLING TOWERS M...	0.0090255	0.0	01Jan2012, 00:00	0.00000
MW Supply Pond	0.0504670	99.8	01Jan2012, 12:22	6.28573
Offsite-1	0.0477098	96.7	01Jan2012, 12:21	7.30203
Reach-1	0.0041397	16.6	01Jan2012, 12:07	8.49898
Reach-10	0.0131345	61.3	01Jan2012, 12:05	9.90493
Reach-11	0.0167572	76.6	01Jan2012, 12:06	9.14982
Reach-12	0.0102109	41.6	01Jan2012, 12:06	9.30145
Reach-13	0.0135777	63.0	01Jan2012, 12:07	9.91648
Reach-14	0.0027571	14.9	01Jan2012, 12:04	9.39970
Reach-15	0.0027571	15.0	01Jan2012, 12:05	9.39970
Reach-16	.000685717	3.8	01Jan2012, 12:04	9.39970
Reach-17	0.0010560	4.8	01Jan2012, 12:05	8.38775
Reach-18	0.0345219	132.3	01Jan2012, 12:09	6.75368
Reach-19	0.0427845	149.9	01Jan2012, 12:10	7.18968
Reach-2	0.0063162	24.7	01Jan2012, 12:05	8.95849
Reach-3	0.0022930	12.5	01Jan2012, 12:04	10.05396
Reach-4	0.0089389	37.5	01Jan2012, 12:06	9.28747
Reach-5	0.0102109	41.8	01Jan2012, 12:08	9.30145
Reach-6	0.0021904	11.0	01Jan2012, 12:05	9.39981

Attachment 2: Concrete ditch CD-1 and CD-2 input and output data from the Hydrologic Engineering Center's River Analysis System (HEC-RAS) computer model.

* Culvert Control	* Outlet	* Weir Submerg	*	0.05	*
* Culv WS Inlet (m)	* 4.22	* Weir Max Depth (m)	*	0.42	*
* Culv WS Outlet (m)	* 4.18	* Weir Avg Depth (m)	*	0.09	*
* Culv Nml Depth (m)	*	* Weir Flow Area (m2)	*	1.66	*
* Culv Crt Depth (m)	* 0.31	* Min El Weir Flow (m)	*	4.34	*

****

CROSS SECTION

RIVER: South Concrete D
REACH: 1 RS: 293.5

INPUT
Description: Section 17 from Surveyor Drawing (CD-1)
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4	2.64	4.3	8.79	4.34	9.25	3.8	10.75	3.8
11.51	4.35	13.89	4.4	20	4.44	50	6		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	8.79	.013	11.51	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
8.79	11.51	105	105	105	.1	.3

Left Levee Station= 8.79 Elevation= 4.34

CROSS SECTION OUTPUT Profile #100yr-24hr

****

* E.G. Elev (m)	* 4.55	* Element	* Left OB	* Channel	* Right OB *
* Vel Head (m)	* 0.06	* Wt. n-Val.	* 0.030	* 0.013	* 0.030 *
* W.S. Elev (m)	* 4.48	* Reach Len. (m)	* 105.00	* 105.00	* 105.00 *
* Crit W.S. (m)	* 4.41	* Flow Area (m2)	* 1.88	* 1.52	* 0.66 *
* E.G. Slope (m/m)	*0.000741	* Area (m2)	* 1.88	* 1.52	* 0.66 *
* Q Total (m3/s)	* 2.66	* Flow (m3/s)	* 0.59	* 1.97	* 0.10 *
* Top Width (m)	* 20.83	* Top Width (m)	* 8.79	* 2.72	* 9.32 *
* Vel Total (m/s)	* 0.65	* Avg. Vel. (m/s)	* 0.31	* 1.29	* 0.16 *
* Max Chl Dpth (m)	* 0.68	* Hydr. Depth (m)	* 0.21	* 0.56	* 0.07 *
* Conv. Total (m3/s)	* 97.7	* Conv. (m3/s)	* 21.6	* 72.3	* 3.8 *
* Length Wtd. (m)	* 105.00	* Wetted Per. (m)	* 9.29	* 3.15	* 9.32 *
* Min Ch El (m)	* 3.80	* Shear (N/m2)	* 1.47	* 3.52	* 0.51 *
* Alpha	* 2.94	* Stream Power (N/m s)	* 0.46	* 4.54	* 0.08 *
* Frctn Loss (m)	* 0.10	* Cum Volume (1000 m3)	* 0.17	* 0.50	* 0.23 *
* C & E Loss (m)	* 0.01	* Cum SA (1000 m2)	* 1.16	* 0.72	* 1.68 *

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

Warning: The cross-section end points had to be extended vertically for the computed
water surface.

CROSS SECTION OUTPUT  Profile #25yr-24hr
**********************************************************************************
*******
* E.G. Elev (m)        *    4.52  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.05  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.47  * Reach Len. (m)      *  105.00  *  105.00  *
105.00  *
* Crit W.S. (m)        *    4.37  * Flow Area (m2)      *    1.81  *    1.50  *
0.58  *
* E.G. Slope (m/m)     *0.000531  * Area (m2)           *    1.81  *    1.50  *
0.58  *
* Q Total (m3/s)       *    2.17  * Flow (m3/s)         *    0.47  *    1.63  *
0.07  *
* Top Width (m)        *   20.67  * Top Width (m)       *    8.79  *    2.72  *
9.16  *
* Vel Total (m/s)      *    0.56  * Avg. Vel. (m/s)     *    0.26  *    1.08  *
0.12  *
* Max Chl Dpth (m)     *    0.68  * Hydr. Depth (m)     *    0.21  *    0.55  *
0.06  *
* Conv. Total (m3/s)   *    94.0  * Conv. (m3/s)        *    20.3  *    70.6  *
3.1  *
* Length Wtd. (m)      *  105.00  * Wetted Per. (m)     *    9.28  *    3.15  *
9.16  *
* Min Ch El (m)        *    3.80  * Shear (N/m2)        *    1.02  *    2.48  *
0.33  *
* Alpha                *    2.90  * Stream Power (N/m s) *    0.26  *    2.69  *
0.04  *
* Frctn Loss (m)       *    0.12  * Cum Volume (1000 m3) *    0.12  *    0.44  *
0.07  *
* C & E Loss (m)       *    0.02  * Cum SA (1000 m2)    *    0.70  *    0.72  *
0.95  *
**********************************************************************************
*******

Warning: The cross-section end points had to be extended vertically for the computed
water surface.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         energy was used.

CROSS SECTION OUTPUT  Profile #10yr-24hr
**********************************************************************************
*******
* E.G. Elev (m)        *    4.46  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.06  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.40  * Reach Len. (m)      *  105.00  *  105.00  *
105.00  *
* Crit W.S. (m)        *    4.27  * Flow Area (m2)      *    1.15  *    1.30  *
0.06  *
* E.G. Slope (m/m)     *0.000765  * Area (m2)           *    1.15  *    1.30  *
```

```
0.00  *
* C & E Loss (m)       *    0.01  * Cum SA (1000 m2)     *    0.00  *    0.67  *
0.00  *
*******************************************************************************
*******

Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         energy was used.

CROSS SECTION


RIVER: South Concrete D
REACH: 1                  RS: 188.5

INPUT
Description: Section 16 from Surveyor Drawing (CD-1)
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
     2.6    4.33    8.11    4.18    8.82    4.03    9.25    3.38   10.75    3.38
   11.18    3.97   15.19    4.12      20    4.12      47       6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
     2.6     .03    8.82    .013   11.18     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          8.82   11.18             99.27    97.8   96.53             .1       .3
Left Levee      Station=    8.82      Elevation=    4.03
Right Levee     Station=   11.18      Elevation=    3.97

CROSS SECTION OUTPUT  Profile #100yr-24hr
*******************************************************************************
*******
* E.G. Elev (m)        *    4.43  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.16  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.27  * Reach Len. (m)      *   99.27  *   97.80  *
96.53  *
* Crit W.S. (m)        *    4.27  * Flow Area (m2)      *    0.28  *    1.84  *
1.83  *
* E.G. Slope (m/m)     *0.001211  * Area (m2)           *    0.28  *    1.84  *
1.83  *
* Q Total (m3/s)       *    4.25  * Flow (m3/s)         *    0.05  *    3.56  *
0.64  *
* Top Width (m)        *   17.54  * Top Width (m)       *    4.15  *    2.36  *
11.03  *
* Vel Total (m/s)      *    1.08  * Avg. Vel. (m/s)     *    0.19  *    1.93  *
0.35  *
* Max Chl Dpth (m)     *    0.89  * Hydr. Depth (m)     *    0.07  *    0.78  *
0.17  *
* Conv. Total (m3/s)   *   122.1  * Conv. (m3/s)        *     1.6  *   102.2  *
18.4  *
* Length Wtd. (m)      *   97.74  * Wetted Per. (m)     *    4.17  *    3.01  *
11.04  *
* Min Ch El (m)        *    3.38  * Shear (N/m2)        *    0.80  *    7.27  *
1.97  *
* Alpha                *    2.71  * Stream Power (N/m s) *    0.15  *   14.04  *
0.69  *
```

* Frctn Loss (m)	*	0.15	* Cum Volume (1000 m3)	*	0.06	*	0.33	* 0.10 *
* C & E Loss (m)	*	0.01	* Cum SA (1000 m2)	*	0.48	*	0.45	* 0.61 *

****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #25yr-24hr

****

* E.G. Elev (m)	*	4.38	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.26	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	4.12	* Reach Len. (m)	*	99.27	*	97.80	* 96.53 *
* Crit W.S. (m)	*	4.12	* Flow Area (m2)	*	0.02	*	1.47	* 0.29 *
* E.G. Slope (m/m)	*	0.002302	* Area (m2)	*	0.02	*	1.47	* 0.29 *
* Q Total (m3/s)	*	3.46	* Flow (m3/s)	*	0.00	*	3.38	* 0.08 *
* Top Width (m)	*	6.71	* Top Width (m)	*	0.41	*	2.36	* 3.94 *
* Vel Total (m/s)	*	1.94	* Avg. Vel. (m/s)	*	0.20	*	2.29	* 0.28 *
* Max Chl Dpth (m)	*	0.74	* Hydr. Depth (m)	*	0.04	*	0.62	* 0.07 *
* Conv. Total (m3/s)	*	72.2	* Conv. (m3/s)	*	0.1	*	70.4	* 1.7 *
* Length Wtd. (m)	*	97.80	* Wetted Per. (m)	*	0.42	*	3.01	* 3.94 *
* Min Ch El (m)	*	3.38	* Shear (N/m2)	*	0.96	*	11.05	* 1.66 *
* Alpha	*	1.36	* Stream Power (N/m s)	*	0.19	*	25.34	* 0.47 *
* Frctn Loss (m)	*	0.22	* Cum Volume (1000 m3)	*	0.02	*	0.28	* 0.02 *
* C & E Loss (m)	*	0.00	* Cum SA (1000 m2)	*	0.22	*	0.45	* 0.26 *

****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical

depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #10yr-24hr

E.G. Elev (m)	4.29	Element	Left OB	Channel	Right OB	
Vel Head (m)	0.24	Wt. n-Val.	0.030	0.013	0.030	
W.S. Elev (m)	4.05	Reach Len. (m)	99.27	97.80	96.53	
Crit W.S. (m)	4.05	Flow Area (m2)	0.00	1.31	0.08	
E.G. Slope (m/m)	0.002468	Area (m2)	0.00	1.31	0.08	
Q Total (m3/s)	2.88	Flow (m3/s)	0.00	2.87	0.01	
Top Width (m)	4.49	Top Width (m)	0.08	2.36	2.05	
Vel Total (m/s)	2.08	Avg. Vel. (m/s)	0.07	2.19	0.19	
Max Chl Dpth (m)	0.67	Hydr. Depth (m)	0.01	0.55	0.04	
Conv. Total (m3/s)	58.0	Conv. (m3/s)	0.0	57.7	0.3	
Length Wtd. (m)	97.80	Wetted Per. (m)	0.08	3.01	2.05	
Min Ch El (m)	3.38	Shear (N/m2)	0.20	10.51	0.93	
Alpha	1.11	Stream Power (N/m s)	0.01	23.04	0.17	
Frctn Loss (m)	0.23	Cum Volume (1000 m3)	0.01	0.25	0.01	
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.14	0.45	0.16	

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #2yr-24hr

E.G. Elev (m)	4.03	Element	Left OB	Channel	Right OB

* Vel Head (m)	*	0.19	* Wt. n-Val.	*		*	0.013	*			
* W.S. Elev (m)	*	3.83	* Reach Len. (m)	*	99.27	*	97.80	*	96.53	*	
* Crit W.S. (m)	*	3.83	* Flow Area (m2)	*		*	0.82	*			
* E.G. Slope (m/m)	*	0.003004	* Area (m2)	*		*	0.82	*			
* Q Total (m3/s)	*	1.60	* Flow (m3/s)	*		*	1.60	*			
* Top Width (m)	*	2.13	* Top Width (m)	*		*	2.13	*			
* Vel Total (m/s)	*	1.95	* Avg. Vel. (m/s)	*		*	1.95	*			
* Max Chl Dpth (m)	*	0.45	* Hydr. Depth (m)	*		*	0.39	*			
* Conv. Total (m3/s)	*	29.2	* Conv. (m3/s)	*		*	29.2	*			
* Length Wtd. (m)	*	97.80	* Wetted Per. (m)	*		*	2.60	*			
* Min Ch El (m)	*	3.38	* Shear (N/m2)	*		*	9.28	*			
* Alpha	*	1.00	* Stream Power (N/m s)	*		*	18.12	*			
* Frctn Loss (m)	*	0.23	* Cum Volume (1000 m3)	*	0.00	*	0.17	*	0.00	*	
* C & E Loss (m)	*	0.02	* Cum SA (1000 m2)	*	0.00	*	0.43	*	0.00	*	

****
****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION

RIVER: South Concrete D
REACH: 1 RS: 90.7

INPUT
Description: Section 15 from Surveyor Drawing (CD-1)
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4.16	4.16	4.17	8.8	3.62	9.25	3.13	10.8	3.13
11.2	3.62	13	6						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	8.8	.013	11.2	.03

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          8.8    11.2               92.73   90.73     89            .1       .3
Left Levee      Station=     8.8       Elevation=    3.62
Right Levee     Station=    11.2       Elevation=    3.62

CROSS SECTION OUTPUT  Profile #100yr-24hr
*********************************************************************************
*******
* E.G. Elev (m)        *    4.21  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.28  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    3.93  * Reach Len. (m)      *   92.73  *   90.73  *
89.00  *
* Crit W.S. (m)        *    3.93  * Flow Area (m2)      *    0.40  *    1.71  *
0.04  *
* E.G. Slope (m/m)     *0.001912  * Area (m2)           *    0.40  *    1.71  *
0.04  *
* Q Total (m3/s)       *    4.25  * Flow (m3/s)         *    0.17  *    4.07  *
0.01  *
* Top Width (m)        *    5.22  * Top Width (m)       *    2.59  *    2.40  *
0.23  *
* Vel Total (m/s)      *    1.99  * Avg. Vel. (m/s)     *    0.42  *    2.39  *
0.30  *
* Max Chl Dpth (m)     *    0.80  * Hydr. Depth (m)     *    0.15  *    0.71  *
0.15  *
* Conv. Total (m3/s)   *    97.2  * Conv. (m3/s)        *     3.8  *    93.2  *
0.2  *
* Length Wtd. (m)      *   90.75  * Wetted Per. (m)     *    2.61  *    2.85  *
0.39  *
* Min Ch El (m)        *    3.13  * Shear (N/m2)        *    2.86  *   11.23  *
1.74  *
* Alpha                *    1.39  * Stream Power (N/m s) *   1.19  *   26.82  *
0.52  *
* Frctn Loss (m)       *    0.18  * Cum Volume (1000 m3) *   0.02  *    0.15  *
0.01  *
* C & E Loss (m)       *    0.00  * Cum SA (1000 m2)    *    0.15  *    0.22  *
0.07  *
*********************************************************************************
*******

Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program used critical depth for the water surface and continued on with the
calculations.
Warning: During the standard step iterations, when the assumed water surface was set
equal to critical
         depth, the calculated water surface came back below critical depth.  This
indicates that there
         is not a valid subcritical answer.  The program defaulted to critical
depth.
Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         water surface was used.

CROSS SECTION OUTPUT  Profile #25yr-24hr
*********************************************************************************
*******
* E.G. Elev (m)        *    4.10  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.26  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
```

* W.S. Elev (m)	*	3.83	* Reach Len. (m)	*	92.73	*	90.73	* 89.00 *
* Crit W.S. (m)	*	3.83	* Flow Area (m2)	*	0.19	*	1.48	* 0.02 *
* E.G. Slope (m/m)	*0.002107		* Area (m2)	*	0.19	*	1.48	* 0.02 *
* Q Total (m3/s)	*	3.46	* Flow (m3/s)	*	0.07	*	3.39	* 0.00 *
* Top Width (m)	*	4.38	* Top Width (m)	*	1.81	*	2.40	* 0.16 *
* Vel Total (m/s)	*	2.04	* Avg. Vel. (m/s)	*	0.34	*	2.29	* 0.25 *
* Max Chl Dpth (m)	*	0.70	* Hydr. Depth (m)	*	0.11	*	0.62	* 0.11 *
* Conv. Total (m3/s)	*	75.4	* Conv. (m3/s)	*	1.5	*	73.9	* 0.1 *
* Length Wtd. (m)	*	90.74	* Wetted Per. (m)	*	1.83	*	2.85	* 0.27 *
* Min Ch El (m)	*	3.13	* Shear (N/m2)	*	2.20	*	10.76	* 1.34 *
* Alpha	*	1.23	* Stream Power (N/m s)	*	0.76	*	24.60	* 0.33 *
* Frctn Loss (m)	*	0.19	* Cum Volume (1000 m3)	*	0.01	*	0.13	* 0.01 *
* C & E Loss (m)	*	0.00	* Cum SA (1000 m2)	*	0.11	*	0.22	* 0.06 *

****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #10yr-24hr

****

* E.G. Elev (m)	*	4.00	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.23	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	3.77	* Reach Len. (m)	*	92.73	*	90.73	* 89.00 *
* Crit W.S. (m)	*	3.76	* Flow Area (m2)	*	0.10	*	1.33	* 0.01 *
* E.G. Slope (m/m)	*0.002150		* Area (m2)	*	0.10	*	1.33	* 0.01 *
* Q Total (m3/s)	*	2.88	* Flow (m3/s)	*	0.03	*	2.85	* 0.00 *
* Top Width (m)	*	3.78	* Top Width (m)	*	1.27	*	2.40	* 0.11 *
* Vel Total (m/s)	*	2.01	* Avg. Vel. (m/s)	*	0.27	*	2.15	* 0.20 *
* Max Chl Dpth (m)	*	0.64	* Hydr. Depth (m)	*	0.08	*	0.55	*

RIVER: South Concrete D
REACH: 1 RS: 0

INPUT
Description: Section 13 from Surveyor Drawing (CD-1)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4.5	7.5	4.05	8.8	3.4	9.25	2.92	10.75	2.92
11.2	3.47	12.3	3.5	14	6				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	8.8	.013	11.2	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
8.8	11.2	10	10	.1	.3

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	4.00	Element	Left OB	Channel	Right OB		
Vel Head (m)	0.29	Wt. n-Val.	0.030	0.013	0.030		
W.S. Elev (m)	3.71	Reach Len. (m)					
Crit W.S. (m)	3.71	Flow Area (m2)	0.10	1.67	0.27		
E.G. Slope (m/m)	*0.002067	Area (m2)	0.10	1.67	0.27		
Q Total (m3/s)	4.25	Flow (m3/s)	0.04	4.07	0.14		
Top Width (m)	4.27	Top Width (m)	0.63	2.40	1.24		
Vel Total (m/s)	2.09	Avg. Vel. (m/s)	0.41	2.44	0.51		
Max Chl Dpth (m)	0.79	Hydr. Depth (m)	0.16	0.70	0.21		
Conv. Total (m3/s)	93.5	Conv. (m3/s)	0.9	89.6	3.0		
Length Wtd. (m)		Wetted Per. (m)	0.70	2.87	1.36		
Min Ch El (m)	2.92	Shear (N/m2)	2.83	11.81	3.97		
Alpha	1.31	Stream Power (N/m s)	1.16	28.79	2.03		
Frctn Loss (m)		Cum Volume (1000 m3)					
C & E Loss (m)		Cum SA (1000 m2)					

Warning: User specified water surface is not possible for the specified flow regime. The program used
critical depth as the starting water surface.

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	3.89	Element	Left OB	Channel	

Right OB *								
* Vel Head (m)	*	0.26	* Wt. n-Val.	*	0.030	*	0.013	*
0.030 *								
* W.S. Elev (m)	*	3.63	* Reach Len. (m)	*		*		*
*								
* Crit W.S. (m)	*	3.63	* Flow Area (m2)	*	0.05	*	1.47	*
0.17 *								
* E.G. Slope (m/m)	*0.002159		* Area (m2)	*	0.05	*	1.47	*
0.17 *								
* Q Total (m3/s)	*	3.46	* Flow (m3/s)	*	0.02	*	3.38	*
0.07 *								
* Top Width (m)	*	4.05	* Top Width (m)	*	0.46	*	2.40	*
1.19 *								
* Vel Total (m/s)	*	2.05	* Avg. Vel. (m/s)	*	0.34	*	2.29	*
0.40 *								
* Max Chl Dpth (m)	*	0.71	* Hydr. Depth (m)	*	0.12	*	0.61	*
0.14 *								
* Conv. Total (m3/s)	*	74.5	* Conv. (m3/s)	*	0.4	*	72.7	*
1.4 *								
* Length Wtd. (m)	*		* Wetted Per. (m)	*	0.52	*	2.87	*
1.26 *								
* Min Ch El (m)	*	2.92	* Shear (N/m2)	*	2.18	*	10.88	*
2.79 *								
* Alpha	*	1.23	* Stream Power (N/m s)	*	0.74	*	24.94	*
1.12 *								
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*		*
*								
* C & E Loss (m)	*		* Cum SA (1000 m2)	*		*		*
*								

****
****

Warning: User specified water surface is not possible for the specified flow regime. The program used
critical depth as the starting water surface.

CROSS SECTION OUTPUT Profile #10yr-24hr
****
****

* E.G. Elev (m)	*	3.80	* Element	*	Left OB	*	Channel	*
Right OB *								
* Vel Head (m)	*	0.24	* Wt. n-Val.	*	0.030	*	0.013	*
0.030 *								
* W.S. Elev (m)	*	3.56	* Reach Len. (m)	*		*		*
*								
* Crit W.S. (m)	*	3.56	* Flow Area (m2)	*	0.03	*	1.31	*
0.09 *								
* E.G. Slope (m/m)	*0.002288		* Area (m2)	*	0.03	*	1.31	*
0.09 *								
* Q Total (m3/s)	*	2.88	* Flow (m3/s)	*	0.01	*	2.85	*
0.02 *								
* Top Width (m)	*	3.86	* Top Width (m)	*	0.32	*	2.40	*
1.14 *								
* Vel Total (m/s)	*	2.03	* Avg. Vel. (m/s)	*	0.28	*	2.18	*
0.28 *								
* Max Chl Dpth (m)	*	0.64	* Hydr. Depth (m)	*	0.08	*	0.54	*
0.07 *								
* Conv. Total (m3/s)	*	60.2	* Conv. (m3/s)	*	0.2	*	59.6	*
0.5 *								
* Length Wtd. (m)	*		* Wetted Per. (m)	*	0.36	*	2.87	*
1.17 *								
* Min Ch El (m)	*	2.92	* Shear (N/m2)	*	1.62	*	10.23	*
1.63 *								

* Vel Total (m/s)	*	0.35	* Avg. Vel. (m/s)	*	0.24	*	0.55	* 0.14 *
* Max Chl Dpth (m)	*	0.47	* Hydr. Depth (m)	*	0.14	*	0.35	* 0.15 *
* Conv. Total (m3/s)	*	58.5	* Conv. (m3/s)	*	22.3	*	34.2	* 2.1 *
* Length Wtd. (m)	*		* Wetted Per. (m)	*	9.79	*	2.64	* 1.53 *
* Min Ch El (m)	*	4.93	* Shear (N/m2)	*	0.29	*	0.73	* 0.31 *
* Alpha	*	1.67	* Stream Power (N/m s)	*	0.07	*	0.40	* 0.04 *
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*		*
* C & E Loss (m)	*		* Cum SA (1000 m2)	*		*		*

****

CROSS SECTION OUTPUT Profile #2yr-24hr

****

* E.G. Elev (m)	*	5.40	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.00	* Wt. n-Val.	*	0.016	*	0.013	* 0.030 *
* W.S. Elev (m)	*	5.40	* Reach Len. (m)	*		*		*
* Crit W.S. (m)	*	5.21	* Flow Area (m2)	*	1.34	*	0.91	* 0.23 *
* E.G. Slope (m/m)	*0.000073		* Area (m2)	*	1.34	*	0.91	* 0.23 *
* Q Total (m3/s)	*	0.50	* Flow (m3/s)	*	0.19	*	0.29	* 0.02 *
* Top Width (m)	*	13.89	* Top Width (m)	*	9.79	*	2.60	* 1.50 *
* Vel Total (m/s)	*	0.20	* Avg. Vel. (m/s)	*	0.14	*	0.32	* 0.08 *
* Max Chl Dpth (m)	*	0.47	* Hydr. Depth (m)	*	0.14	*	0.35	* 0.15 *
* Conv. Total (m3/s)	*	58.5	* Conv. (m3/s)	*	22.3	*	34.2	* 2.1 *
* Length Wtd. (m)	*		* Wetted Per. (m)	*	9.79	*	2.64	* 1.53 *
* Min Ch El (m)	*	4.93	* Shear (N/m2)	*	0.10	*	0.25	* 0.11 *
* Alpha	*	1.67	* Stream Power (N/m s)	*	0.01	*	0.08	* 0.01 *
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*		*
* C & E Loss (m)	*		* Cum SA (1000 m2)	*		*		*

****

CROSS SECTION

RIVER: South Concrete D
REACH: 1 RS: 605

INPUT
Description: Section 20 from Surveyor Drawing (CD-2)

is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	5.43	Element	Left OB	Channel	Right OB	
Vel Head (m)	0.10	Wt. n-Val.	0.016	0.013	0.030	
W.S. Elev (m)	5.33	Reach Len. (m)	117.97	116.00	114.03	
Crit W.S. (m)	5.33	Flow Area (m2)	0.05	1.02	1.41	
E.G. Slope (m/m)	*0.001632	Area (m2)	0.05	1.02	1.41	
Q Total (m3/s)	2.17	Flow (m3/s)	0.01	1.62	0.54	
Top Width (m)	14.34	Top Width (m)	2.81	2.32	9.21	
Vel Total (m/s)	0.88	Avg. Vel. (m/s)	0.17	1.59	0.38	
Max Chl Dpth (m)	0.52	Hydr. Depth (m)	0.02	0.44	0.15	
Conv. Total (m3/s)	53.6	Conv. (m3/s)	0.2	40.0	13.4	
Length Wtd. (m)	115.36	Wetted Per. (m)	2.81	2.78	9.25	
Min Ch El (m)	4.81	Shear (N/m2)	0.28	5.86	2.44	
Alpha	2.51	Stream Power (N/m s)	0.05	9.31	0.94	
Frctn Loss (m)	0.16	Cum Volume (1000 m3)	0.14	0.35	0.50	
C & E Loss (m)	0.02	Cum SA (1000 m2)	2.41	1.41	4.19	

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #10yr-24hr

E.G. Elev (m)	5.40	Element	Left OB	Channel	Right OB	
Vel Head (m)	0.09	Wt. n-Val.	0.016	0.013	0.030	
W.S. Elev (m)	5.30	Reach Len. (m)	117.97	116.00	114.03	
Crit W.S. (m)	5.30	Flow Area (m2)	0.00	0.94		

* Max Chl Dpth (m)	*	0.33	* Hydr. Depth (m)	*		*	0.29	*	
* Conv. Total (m3/s)	*	18.2	* Conv. (m3/s)	*		*	18.2	*	
* Length Wtd. (m)	*	116.00	* Wetted Per. (m)	*		*	2.37	*	
* Min Ch El (m)	*	4.81	* Shear (N/m2)	*		*	7.40	*	
* Alpha	*	1.00	* Stream Power (N/m s)	*		*	12.43	*	
* Frctn Loss (m)	*	0.35	* Cum Volume (1000 m3)	*	0.04	*	0.22	*	0.01 *
* C & E Loss (m)	*	0.00	* Cum SA (1000 m2)	*	0.47	*	1.32	*	0.46 *

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION

RIVER: South Concrete D
REACH: 1 RS: 489

INPUT
Description: Section 19 from Surveyor Drawing (CD-2)
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-.81	5	0	4.7	2.19	4.88	8.84	4.91	9.25	4.44
10.75	4.44	11.16	4.87	12.9	4.62	20	4.69	25	6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-.81	.03	8.84	.013	11.16	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
8.84	11.16	93	91	89	.1	.3

Left Levee Station= 8.84 Elevation= 4.91
Right Levee Station= 11.16 Elevation= 4.87

CROSS SECTION OUTPUT Profile #100yr-24hr

* E.G. Elev (m)	*	5.00	* Element	*	Left OB	*	Channel	*	Right OB *

* Vel Head (m)	*	0.05	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	4.95	* Reach Len. (m)	*	93.00	*	91.00	* 89.00 *
* Crit W.S. (m)	*	4.88	* Flow Area (m2)	*	0.84	*	1.01	* 2.62 *
* E.G. Slope (m/m)	*0.001061		* Area (m2)	*	0.84	*	1.01	* 2.62 *
* Q Total (m3/s)	*	2.66	* Flow (m3/s)	*	0.18	*	1.30	* 1.17 *
* Top Width (m)	*	21.70	* Top Width (m)	*	9.53	*	2.32	* 9.85 *
* Vel Total (m/s)	*	0.59	* Avg. Vel. (m/s)	*	0.21	*	1.29	* 0.45 *
* Max Chl Dpth (m)	*	0.51	* Hydr. Depth (m)	*	0.09	*	0.43	* 0.27 *
* Conv. Total (m3/s)	*	81.7	* Conv. (m3/s)	*	5.5	*	40.1	* 36.1 *
* Length Wtd. (m)	*	90.36	* Wetted Per. (m)	*	9.58	*	2.72	* 9.90 *
* Min Ch El (m)	*	4.44	* Shear (N/m2)	*	0.91	*	3.86	* 2.76 *
* Alpha	*	2.58	* Stream Power (N/m s)	*	0.20	*	5.00	* 1.23 *
* Frctn Loss (m)	*	0.12	* Cum Volume (1000 m3)	*	0.14	*	0.26	* 0.35 *
* C & E Loss (m)	*	0.01	* Cum SA (1000 m2)	*	2.20	*	1.14	* 3.86 *

****

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #25yr-24hr

****

* E.G. Elev (m)	*	4.96	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.05	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	4.91	* Reach Len. (m)	*	93.00	*	91.00	* 89.00 *
* Crit W.S. (m)	*	4.87	* Flow Area (m2)	*	0.47	*	0.92	* 2.24 *
* E.G. Slope (m/m)	*0.001139		* Area (m2)	*	0.47	*	0.92	* 2.24 *
* Q Total (m3/s)	*	2.17	* Flow (m3/s)	*	0.07	*	1.15	* 0.94 *
* Top Width (m)	*	21.44	* Top Width (m)	*	9.42	*	2.32	* 9.70 *
* Vel Total (m/s)	*	0.60	* Avg. Vel. (m/s)	*	0.15	*	1.26	* 0.42 *
* Max Chl Dpth (m)	*	0.47	* Hydr. Depth (m)	*	0.05	*	0.40	* 0.23 *
* Conv. Total (m3/s)	*	64.2	* Conv. (m3/s)	*	2.1	*	34.2	* 27.9 *
* Length Wtd. (m)	*	90.39	* Wetted Per. (m)	*	9.47	*	2.72	* 9.74 *
* Min Ch El (m)	*	4.44	* Shear (N/m2)	*	0.55	*	3.77	* 2.56 *
* Alpha	*	2.57	* Stream Power (N/m s)	*	0.08	*	4.74	*

```
1.08  *
* Frctn Loss (m)       *    0.13  * Cum Volume (1000 m3) *    0.11  *    0.24  *
0.29  *
* C & E Loss (m)       *    0.00  * Cum SA (1000 m2)     *    1.69  *    1.14  *
3.11  *
********************************************************************************
*******

Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         water surface was used.

CROSS SECTION OUTPUT  Profile #10yr-24hr
********************************************************************************
*******
* E.G. Elev (m)        *    4.96  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.03  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.93  * Reach Len. (m)      *   93.00  *   91.00  *
89.00  *
* Crit W.S. (m)        *    4.87  * Flow Area (m2)      *    0.59  *    0.95  *
2.37  *
* E.G. Slope (m/m)     *0.000664  * Area (m2)           *    0.59  *    0.95  *
2.37  *
* Q Total (m3/s)       *    1.80  * Flow (m3/s)         *    0.08  *    0.93  *
0.79  *
* Top Width (m)        *   21.53  * Top Width (m)       *    9.46  *    2.32  *
9.75  *
* Vel Total (m/s)      *    0.46  * Avg. Vel. (m/s)     *    0.14  *    0.98  *
0.33  *
* Max Chl Dpth (m)     *    0.49  * Hydr. Depth (m)     *    0.06  *    0.41  *
0.24  *
* Conv. Total (m3/s)   *    69.8  * Conv. (m3/s)        *     3.1  *    36.1  *
30.6  *
* Length Wtd. (m)      *   90.61  * Wetted Per. (m)     *    9.50  *    2.72  *
9.80  *
* Min Ch El (m)        *    4.44  * Shear (N/m2)        *    0.41  *    2.27  *
1.57  *
* Alpha                *    2.59  * Stream Power (N/m s) *    0.06  *    2.23  *
0.52  *
* Frctn Loss (m)       *    0.12  * Cum Volume (1000 m3) *    0.08  *    0.20  *
0.13  *
* C & E Loss (m)       *    0.02  * Cum SA (1000 m2)     *    1.54  *    1.14  *
1.32  *
********************************************************************************
*******

Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross
sections.
Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         water surface was used.

CROSS SECTION OUTPUT  Profile #2yr-24hr
********************************************************************************
*******
* E.G. Elev (m)        *    4.91  * Element             *  Left OB *  Channel *
```

Right OB									
Vel Head (m)		0.14	Wt. n-Val.				0.013		
W.S. Elev (m)		4.77	Reach Len. (m)		93.00		91.00		89.00
Crit W.S. (m)		4.77	Flow Area (m2)				0.60		
E.G. Slope (m/m)		*0.002999	Area (m2)				0.60		
Q Total (m3/s)		1.00	Flow (m3/s)				1.00		
Top Width (m)		2.11	Top Width (m)				2.11		
Vel Total (m/s)		1.67	Avg. Vel. (m/s)				1.67		
Max Chl Dpth (m)		0.33	Hydr. Depth (m)				0.28		
Conv. Total (m3/s)		18.3	Conv. (m3/s)				18.3		
Length Wtd. (m)		91.00	Wetted Per. (m)				2.40		
Min Ch El (m)		4.44	Shear (N/m2)				7.34		
Alpha		1.00	Stream Power (N/m s)				12.26		
Frctn Loss (m)		0.30	Cum Volume (1000 m3)		0.04		0.15		0.01
C & E Loss (m)		0.00	Cum SA (1000 m2)		0.47		1.08		0.46

****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION

RIVER: South Concrete D
REACH: 1 RS: 398

INPUT
Description: (CD-2)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5.06	2.9	4.95	6.11	4.68	6.11	4.14	8	4.14
8	4.65	20	4.59	22	6				

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	4.83	Element	Left OB	Channel	Right OB	
Vel Head (m)	0.09	Wt. n-Val.	0.030	0.013	0.030	
W.S. Elev (m)	4.74	Reach Len. (m)	98.41	98.41	98.41	
Crit W.S. (m)	4.74	Flow Area (m2)	0.02	1.13	1.41	
E.G. Slope (m/m)	0.001740	Area (m2)	0.02	1.13	1.41	
Q Total (m3/s)	2.17	Flow (m3/s)	0.00	1.71	0.45	
Top Width (m)	14.76	Top Width (m)	0.67	1.89	12.21	
Vel Total (m/s)	0.85	Avg. Vel. (m/s)	0.13	1.52	0.32	
Max Chl Dpth (m)	0.60	Hydr. Depth (m)	0.03	0.60	0.12	
Conv. Total (m3/s)	51.9	Conv. (m3/s)	0.1	41.1	10.8	
Length Wtd. (m)	98.41	Wetted Per. (m)	0.67	3.45	12.76	
Min Ch El (m)	4.14	Shear (N/m2)	0.48	5.57	1.88	
Alpha	2.57	Stream Power (N/m s)	0.06	8.48	0.60	
Frctn Loss (m)	0.09	Cum Volume (1000 m3)	0.09	0.15	0.13	
C & E Loss (m)	0.02	Cum SA (1000 m2)	1.22	0.95	2.14	

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #10yr-24hr

E.G. Elev (m)	4.82	Element	Left OB	Channel	Right OB

98.41 *
* Crit W.S. (m) * 4.45 * Flow Area (m2) * * 0.58 *
*
* E.G. Slope (m/m) *0.003537 * Area (m2) * * 0.58 *
*
* Q Total (m3/s) * 1.00 * Flow (m3/s) * * 1.00 *
*
* Top Width (m) * 1.89 * Top Width (m) * * 1.89 *
*
* Vel Total (m/s) * 1.73 * Avg. Vel. (m/s) * * 1.73 *
*
* Max Chl Dpth (m) * 0.31 * Hydr. Depth (m) * * 0.31 *
*
* Conv. Total (m3/s) * 16.8 * Conv. (m3/s) * * 16.8 *
*
* Length Wtd. (m) * 98.41 * Wetted Per. (m) * * 2.50 *
*
* Min Ch El (m) * 4.14 * Shear (N/m2) * * 8.03 *
*
* Alpha * 1.00 * Stream Power (N/m s) * * 13.85 *
*
* Frctn Loss (m) * 0.08 * Cum Volume (1000 m3) * 0.04 * 0.10 *
0.01 *
* C & E Loss (m) * 0.04 * Cum SA (1000 m2) * 0.47 * 0.90 *
0.46 *
****
****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION

RIVER: South Concrete D
REACH: 1 RS: 300

INPUT
Description: Section 18 from Surveyor Drawing (CD-2)
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4	2.62	4.33	8.79	4.34	9.25	3.84	10.75	3.84
11.21	4.35	15.39	4.37	17.6	4.35	20	4.39	50	6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

****

0 .03 8.79 .013 11.21 .03

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
8.79 11.21 6.5 6.5 6.5 .1 .3
Left Levee Station= 8.79 Elevation= 4.34

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	4.56	Element	Left OB	Channel	Right OB
Vel Head (m)	0.06	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	4.50	Reach Len. (m)	6.50	6.50	6.50
Crit W.S. (m)	4.45	Flow Area (m2)	1.86	1.36	1.27
E.G. Slope (m/m)	*0.000789	Area (m2)	1.86	1.36	1.27
Q Total (m3/s)	2.66	Flow (m3/s)	0.60	1.78	0.29
Top Width (m)	21.97	Top Width (m)	8.79	2.42	10.76
Vel Total (m/s)	0.59	Avg. Vel. (m/s)	0.32	1.31	0.23
Max Chl Dpth (m)	0.66	Hydr. Depth (m)	0.21	0.56	0.12
Conv. Total (m3/s)	94.7	Conv. (m3/s)	21.2	63.3	10.2
Length Wtd. (m)	6.50	Wetted Per. (m)	9.31	2.87	10.77
Min Ch El (m)	3.84	Shear (N/m2)	1.55	3.66	0.92
Alpha	3.35	Stream Power (N/m s)	0.49	4.80	0.21
Frctn Loss (m)		Cum Volume (1000 m3)		0.03	
C & E Loss (m)		Cum SA (1000 m2)	1.22	0.73	1.74

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	4.53	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	4.49	Reach Len. (m)	6.50	6.50	6.50
Crit W.S. (m)	4.42	Flow Area (m2)	1.84	1.35	1.25
E.G. Slope (m/m)	*0.000536	Area (m2)	1.84	1.35	1.25
Q Total (m3/s)	2.17	Flow (m3/s)	0.48	1.45	0.23
Top Width (m)	21.93	Top Width (m)	8.79	2.42	10.72
Vel Total (m/s)	0.49	Avg. Vel. (m/s)	0.26	1.08	0.18
Max Chl Dpth (m)	0.65	Hydr. Depth (m)	0.21	0.56	0.12

* Conv. Total (m3/s)	*	93.6	* Conv. (m3/s)	*	20.8	*	62.8	* 9.9 *
* Length Wtd. (m)	*	6.50	* Wetted Per. (m)	*	9.30	*	2.87	* 10.72 *
* Min Ch El (m)	*	3.84	* Shear (N/m2)	*	1.04	*	2.47	* 0.61 *
* Alpha	*	3.35	* Stream Power (N/m s)	*	0.27	*	2.66	* 0.11 *
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*	0.03	* *
* C & E Loss (m)	*		* Cum SA (1000 m2)	*	0.76	*	0.73	* 1.01 *

****

CROSS SECTION OUTPUT Profile #10yr-24hr

****

* E.G. Elev (m)	*	4.48	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.06	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	4.42	* Reach Len. (m)	*	6.50	*	6.50	* 6.50 *
* Crit W.S. (m)	*	4.39	* Flow Area (m2)	*	1.15	*	1.16	* 0.47 *
* E.G. Slope (m/m)	*	0.000883	* Area (m2)	*	1.15	*	1.16	* 0.47 *
* Q Total (m3/s)	*	1.80	* Flow (m3/s)	*	0.29	*	1.45	* 0.06 *
* Top Width (m)	*	20.47	* Top Width (m)	*	8.79	*	2.42	* 9.26 *
* Vel Total (m/s)	*	0.65	* Avg. Vel. (m/s)	*	0.25	*	1.25	* 0.14 *
* Max Chl Dpth (m)	*	0.58	* Hydr. Depth (m)	*	0.13	*	0.48	* 0.05 *
* Conv. Total (m3/s)	*	60.6	* Conv. (m3/s)	*	9.6	*	48.8	* 2.1 *
* Length Wtd. (m)	*	6.50	* Wetted Per. (m)	*	9.23	*	2.87	* 9.26 *
* Min Ch El (m)	*	3.84	* Shear (N/m2)	*	1.08	*	3.51	* 0.44 *
* Alpha	*	3.04	* Stream Power (N/m s)	*	0.27	*	4.39	* 0.06 *
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*	0.02	* *
* C & E Loss (m)	*		* Cum SA (1000 m2)	*	0.66	*	0.73	* 0.43 *

****

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #2yr-24hr

****

* E.G. Elev (m)	*	4.42	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.03	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	4.39	* Reach Len. (m)	*	6.50	*	6.50	*

Attachment 3: Concrete ditch CD-6, CD-7 and CD-8 input and output data from the Hydrologic Engineering Center's River Analysis System (HEC-RAS) computer model.

CROSS SECTION

RIVER: Center Concrete
REACH: 1 RS: 262.7

INPUT
Description: downstream of 0.81 m Concrete Pipe (CD-6)
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-78.6	7	-58	4.73	0	4.7	17.35	4.7	18	4.5
18.4	4.4	19.25	4	19.7	3.8	20	4	20.8	4.4
21.1	4.5	21.9	4.97	25.6	5.42	28.6	5.53		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-78.6	.03	18.4	.013	20.8	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.4	20.8	22.7	22.7	.1	.3

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	4.73	Element	Left OB	Channel	Right OB	
Vel Head (m)	0.14	Wt. n-Val.	0.030	0.013	0.030	
W.S. Elev (m)	4.59	Reach Len. (m)	22.70	22.70	22.70	
Crit W.S. (m)		Flow Area (m2)	0.07	1.16	0.05	
E.G. Slope (m/m)	0.001403	Area (m2)	0.07	1.16	0.05	
Q Total (m3/s)	1.95	Flow (m3/s)	0.02	1.92	0.01	
Top Width (m)	3.55	Top Width (m)	0.70	2.40	0.45	
Vel Total (m/s)	1.52	Avg. Vel. (m/s)	0.26	1.65	0.27	
Max Chl Dpth (m)	0.79	Hydr. Depth (m)	0.10	0.48	0.11	
Conv. Total (m3/s)	52.1	Conv. (m3/s)	0.5	51.2	0.4	
Length Wtd. (m)	22.70	Wetted Per. (m)	0.72	2.69	0.50	
Min Ch El (m)	3.80	Shear (N/m2)	1.33	5.96	1.37	
Alpha	1.16	Stream Power (N/m s)	0.35	9.83	0.37	
Frctn Loss (m)	0.03	Cum Volume (1000 m3)	0.22	0.26	0.06	
C & E Loss (m)	0.01	Cum SA (1000 m2)	1.93	0.61	0.88	

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	4.67	Element	Left OB	Channel	

Right OB								
* Vel Head (m)	*	0.10	* Wt. n-Val.	*	0.030	*	0.013	*
0.030 *								
* W.S. Elev (m)	*	4.58	* Reach Len. (m)	*	22.70	*	22.70	*
22.70 *								
* Crit W.S. (m)	*		* Flow Area (m2)	*	0.06	*	1.13	*
0.04 *								
* E.G. Slope (m/m)	*0.001034		* Area (m2)	*	0.06	*	1.13	*
0.04 *								
* Q Total (m3/s)	*	1.59	* Flow (m3/s)	*	0.01	*	1.57	*
0.01 *								
* Top Width (m)	*	3.48	* Top Width (m)	*	0.65	*	2.40	*
0.43 *								
* Vel Total (m/s)	*	1.29	* Avg. Vel. (m/s)	*	0.21	*	1.39	*
0.22 *								
* Max Chl Dpth (m)	*	0.78	* Hydr. Depth (m)	*	0.09	*	0.47	*
0.10 *								
* Conv. Total (m3/s)	*	49.4	* Conv. (m3/s)	*	0.4	*	48.7	*
0.3 *								
* Length Wtd. (m)	*	22.70	* Wetted Per. (m)	*	0.67	*	2.69	*
0.47 *								
* Min Ch El (m)	*	3.80	* Shear (N/m2)	*	0.91	*	4.26	*
0.93 *								
* Alpha	*	1.14	* Stream Power (N/m s)	*	0.19	*	5.91	*
0.20 *								
* Frctn Loss (m)	*	0.03	* Cum Volume (1000 m3)	*	0.16	*	0.24	*
0.03 *								
* C & E Loss (m)	*	0.00	* Cum SA (1000 m2)	*	1.70	*	0.61	*
0.67 *								

****
****

CROSS SECTION OUTPUT Profile #10yr-24hr
****
****

* E.G. Elev (m)	*	4.63	* Element	*	Left OB	*	Channel	*
Right OB *								
* Vel Head (m)	*	0.07	* Wt. n-Val.	*	0.030	*	0.013	*
0.030 *								
* W.S. Elev (m)	*	4.56	* Reach Len. (m)	*	22.70	*	22.70	*
22.70 *								
* Crit W.S. (m)	*		* Flow Area (m2)	*	0.05	*	1.08	*
0.04 *								
* E.G. Slope (m/m)	*0.000832		* Area (m2)	*	0.05	*	1.08	*
0.04 *								
* Q Total (m3/s)	*	1.33	* Flow (m3/s)	*	0.01	*	1.31	*
0.01 *								
* Top Width (m)	*	3.39	* Top Width (m)	*	0.59	*	2.40	*
0.40 *								
* Vel Total (m/s)	*	1.14	* Avg. Vel. (m/s)	*	0.18	*	1.21	*
0.18 *								
* Max Chl Dpth (m)	*	0.76	* Hydr. Depth (m)	*	0.08	*	0.45	*
0.09 *								
* Conv. Total (m3/s)	*	46.1	* Conv. (m3/s)	*	0.3	*	45.6	*
0.2 *								
* Length Wtd. (m)	*	22.70	* Wetted Per. (m)	*	0.61	*	2.69	*
0.43 *								
* Min Ch El (m)	*	3.80	* Shear (N/m2)	*	0.65	*	3.29	*
0.67 *								
* Alpha	*	1.12	* Stream Power (N/m s)	*	0.12	*	3.99	*
0.12 *								
* Frctn Loss (m)	*	0.03	* Cum Volume (1000 m3)	*	0.11	*	0.22	*
0.02 *								

```
* C & E Loss (m)       *    0.00  * Cum SA (1000 m2)     *    1.50  *    0.61  *
0.48  *
********************************************************************************
*******

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than
        0.7 or greater than 1.4.  This may indicate the need for additional cross
sections.

CROSS SECTION OUTPUT  Profile #2yr-24hr
********************************************************************************
*******
* E.G. Elev (m)        *    4.50  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.04  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.46  * Reach Len. (m)      *   22.70  *   22.70  *
22.70  *
* Crit W.S. (m)        *          * Flow Area (m2)      *    0.01  *    0.85  *
0.01  *
* E.G. Slope (m/m)     *0.000620  * Area (m2)           *    0.01  *    0.85  *
0.01  *
* Q Total (m3/s)       *    0.75  * Flow (m3/s)         *    0.00  *    0.75  *
0.00  *
* Top Width (m)        *    2.81  * Top Width (m)       *    0.23  *    2.40  *
0.18  *
* Vel Total (m/s)      *    0.87  * Avg. Vel. (m/s)     *    0.08  *    0.89  *
0.08  *
* Max Chl Dpth (m)     *    0.66  * Hydr. Depth (m)     *    0.03  *    0.35  *
0.03  *
* Conv. Total (m3/s)   *    30.1  * Conv. (m3/s)        *     0.0  *    30.1  *
0.0  *
* Length Wtd. (m)      *   22.70  * Wetted Per. (m)     *    0.24  *    2.69  *
0.18  *
* Min Ch El (m)        *    3.80  * Shear (N/m2)        *    0.17  *    1.91  *
0.17  *
* Alpha                *    1.02  * Stream Power (N/m s) *    0.01  *    1.69  *
0.01  *
* Frctn Loss (m)       *    0.03  * Cum Volume (1000 m3) *    0.00  *    0.13  *
0.00  *
* C & E Loss (m)       *    0.01  * Cum SA (1000 m2)     *    0.00  *    0.54  *
0.00  *
********************************************************************************
*******

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than
        0.7 or greater than 1.4.  This may indicate the need for additional cross
sections.

CROSS SECTION


RIVER: Center Concrete
REACH: 1                RS: 240

INPUT
Description: This section is located to the north east of the coal pile and to
             the south of the storm water pond (CD-6)
Station Elevation Data    num=      10
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
********************************************************************************
```

0	4.71	9.6	4.5	15.4	4.37	16.2	4	16.5	3.86
16.7	4	17.8	4.42	21.7	5	25	5.39	27.9	5.44

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.03	15.4	.013	17.8	.03	25	.016

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.4	17.8	106	106	.1	.3

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	4.69	Element	Left OB	Channel	Right OB
Vel Head (m)	0.12	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	4.57	Reach Len. (m)	106.00	106.00	106.00
Crit W.S. (m)	4.57	Flow Area (m2)	0.88	1.02	0.07
E.G. Slope (m/m)	*0.001618	Area (m2)	0.88	1.02	0.07
Q Total (m3/s)	1.95	Flow (m3/s)	0.25	1.68	0.02
Top Width (m)	12.34	Top Width (m)	8.94	2.40	1.00
Vel Total (m/s)	0.99	Avg. Vel. (m/s)	0.29	1.64	0.24
Max Chl Dpth (m)	0.71	Hydr. Depth (m)	0.10	0.43	0.07
Conv. Total (m3/s)	48.5	Conv. (m3/s)	6.3	41.8	0.4
Length Wtd. (m)	106.00	Wetted Per. (m)	8.94	2.63	1.01
Min Ch El (m)	3.86	Shear (N/m2)	1.57	6.15	1.17
Alpha	2.41	Stream Power (N/m s)	0.45	10.12	0.27
Frctn Loss (m)	0.16	Cum Volume (1000 m3)	0.21	0.24	0.06
C & E Loss (m)	0.01	Cum SA (1000 m2)	1.82	0.56	0.86

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #25yr-24hr

```
*******
* E.G. Elev (m)        *    4.64  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.12  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.52  * Reach Len. (m)      *  106.00  *  106.00  *
106.00  *
* Crit W.S. (m)        *    4.52  * Flow Area (m2)      *    0.52  *    0.91  *
0.04  *
* E.G. Slope (m/m)     *0.001756  * Area (m2)           *    0.52  *    0.91  *
0.04  *
* Q Total (m3/s)       *    1.59  * Flow (m3/s)         *    0.13  *    1.45  *
0.01  *
* Top Width (m)        *    9.95  * Top Width (m)       *    6.86  *    2.40  *
0.69  *
* Vel Total (m/s)      *    1.08  * Avg. Vel. (m/s)     *    0.25  *    1.59  *
0.19  *
* Max Chl Dpth (m)     *    0.66  * Hydr. Depth (m)     *    0.08  *    0.38  *
0.05  *
* Conv. Total (m3/s)   *    37.9  * Conv. (m3/s)        *     3.1  *    34.6  *
0.2  *
* Length Wtd. (m)      *  106.00  * Wetted Per. (m)     *    6.86  *    2.63  *
0.70  *
* Min Ch El (m)        *    3.86  * Shear (N/m2)        *    1.32  *    5.96  *
0.88  *
* Alpha                *    1.98  * Stream Power (N/m s) *   0.33  *    9.48  *
0.17  *
* Frctn Loss (m)       *    0.16  * Cum Volume (1000 m3) *   0.15  *    0.22  *
0.03  *
* C & E Loss (m)       *    0.01  * Cum SA (1000 m2)    *    1.61  *    0.56  *
0.65  *
********************************************************************************
*******

Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program used critical depth for the water surface and continued on with the
calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to critical
         depth, the calculated water surface came back below critical depth.  This
indicates that there
         is not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION OUTPUT  Profile #10yr-24hr
********************************************************************************
*******
* E.G. Elev (m)        *    4.60  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.12  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.48  * Reach Len. (m)      *  106.00  *  106.00  *
106.00  *
* Crit W.S. (m)        *    4.48  * Flow Area (m2)      *    0.29  *    0.82  *
0.01  *
* E.G. Slope (m/m)     *0.001941  * Area (m2)           *    0.29  *    0.82  *
0.01  *
* Q Total (m3/s)       *    1.33  * Flow (m3/s)         *    0.06  *    1.27  *
0.00  *
```

```
*
* Frctn Loss (m)        *    0.34  * Cum Volume (1000 m3) *          *    0.12  *
*
* C & E Loss (m)        *    0.00  * Cum SA (1000 m2)     *          *    0.49  *
*
********************************************************************************
*******

Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program used critical depth for the water surface and continued on with the
calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to critical
         depth, the calculated water surface came back below critical depth.  This
indicates that there
         is not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION


RIVER: Center Concrete
REACH: 1                 RS: 134

INPUT
Description: (CD-6)
Station Elevation Data    num=      10
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0       5    14.5    3.89    22.4    3.92    23.4     3.5    23.7    3.35
      24     3.5    24.9    3.92    28.8       4    51.3     4.5      59    4.88

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
       0     .03    22.4    .013    24.9     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          22.4    24.9              134     134     134             .1       .3

CROSS SECTION OUTPUT  Profile #100yr-24hr
********************************************************************************
*******
* E.G. Elev (m)         *    4.13  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)          *    0.09  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)         *    4.04  * Reach Len. (m)      *  134.00  *  134.00  *
134.00  *
* Crit W.S. (m)         *    4.04  * Flow Area (m2)      *    1.25  *    1.00  *
0.37  *
* E.G. Slope (m/m)      *0.001415  * Area (m2)           *    1.25  *    1.00  *
0.37  *
* Q Total (m3/s)        *    1.95  * Flow (m3/s)         *    0.39  *    1.48  *
0.07  *
* Top Width (m)         *   18.26  * Top Width (m)       *    9.90  *    2.50  *
5.85  *
* Vel Total (m/s)       *    0.74  * Avg. Vel. (m/s)     *    0.31  *    1.48  *
0.20  *
```

* Max Chl Dpth (m)	*	0.69	* Hydr. Depth (m)	*	0.13	*	0.40	*	0.06 *
* Conv. Total (m3/s)	*	51.8	* Conv. (m3/s)	*	10.4	*	39.5	*	1.9 *
* Length Wtd. (m)	*	134.00	* Wetted Per. (m)	*	9.91	*	2.75	*	5.85 *
* Min Ch El (m)	*	3.35	* Shear (N/m2)	*	1.75	*	5.07	*	0.87 *
* Alpha	*	3.04	* Stream Power (N/m s)	*	0.55	*	7.49	*	0.17 *
* Frctn Loss (m)	*	0.22	* Cum Volume (1000 m3)	*	0.10	*	0.13	*	0.04 *
* C & E Loss (m)	*	0.01	* Cum SA (1000 m2)	*	0.82	*	0.30	*	0.50 *

****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #25yr-24hr

****

* E.G. Elev (m)	*	4.09	* Element	*	Left OB	*	Channel	*	Right OB *
* Vel Head (m)	*	0.08	* Wt. n-Val.	*	0.030	*	0.013	*	0.030 *
* W.S. Elev (m)	*	4.01	* Reach Len. (m)	*	134.00	*	134.00	*	134.00 *
* Crit W.S. (m)	*	4.01	* Flow Area (m2)	*	0.96	*	0.93	*	0.21 *
* E.G. Slope (m/m)	*	0.001386	* Area (m2)	*	0.96	*	0.93	*	0.21 *
* Q Total (m3/s)	*	1.59	* Flow (m3/s)	*	0.26	*	1.29	*	0.03 *
* Top Width (m)	*	16.55	* Top Width (m)	*	9.52	*	2.50	*	4.53 *
* Vel Total (m/s)	*	0.75	* Avg. Vel. (m/s)	*	0.27	*	1.39	*	0.16 *
* Max Chl Dpth (m)	*	0.66	* Hydr. Depth (m)	*	0.10	*	0.37	*	0.05 *
* Conv. Total (m3/s)	*	42.7	* Conv. (m3/s)	*	6.9	*	34.8	*	0.9 *
* Length Wtd. (m)	*	134.00	* Wetted Per. (m)	*	9.53	*	2.75	*	4.53 *
* Min Ch El (m)	*	3.35	* Shear (N/m2)	*	1.37	*	4.60	*	0.64 *
* Alpha	*	2.80	* Stream Power (N/m s)	*	0.37	*	6.40	*	0.10 *
* Frctn Loss (m)	*	0.23	* Cum Volume (1000 m3)	*	0.07	*	0.12	*	0.02 *
* C & E Loss (m)	*	0.01	* Cum SA (1000 m2)	*	0.75	*	0.30	*	

0.38 *
****
****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #10yr-24hr
****
****

* E.G. Elev (m)	* 4.07	* Element	* Left OB	* Channel	* Right OB	*
* Vel Head (m)	* 0.08	* Wt. n-Val.	* 0.030	* 0.013	* 0.030	*
* W.S. Elev (m)	* 3.99	* Reach Len. (m)	* 134.00	* 134.00	* 134.00	*
* Crit W.S. (m)	* 3.99	* Flow Area (m2)	* 0.72	* 0.87	* 0.11	*
* E.G. Slope (m/m)	*0.001392	* Area (m2)	* 0.72	* 0.87	* 0.11	*
* Q Total (m3/s)	* 1.33	* Flow (m3/s)	* 0.16	* 1.15	* 0.01	*
* Top Width (m)	* 15.01	* Top Width (m)	* 9.18	* 2.50	* 3.33	*
* Vel Total (m/s)	* 0.78	* Avg. Vel. (m/s)	* 0.23	* 1.33	* 0.13	*
* Max Chl Dpth (m)	* 0.64	* Hydr. Depth (m)	* 0.08	* 0.35	* 0.03	*
* Conv. Total (m3/s)	* 35.6	* Conv. (m3/s)	* 4.4	* 30.9	* 0.4	*
* Length Wtd. (m)	* 134.00	* Wetted Per. (m)	* 9.19	* 2.75	* 3.33	*
* Min Ch El (m)	* 3.35	* Shear (N/m2)	* 1.07	* 4.30	* 0.46	*
* Alpha	* 2.51	* Stream Power (N/m s)	* 0.24	* 5.72	* 0.06	*
* Frctn Loss (m)	* 0.24	* Cum Volume (1000 m3)	* 0.05	* 0.11	* 0.01	*
* C & E Loss (m)	* 0.01	* Cum SA (1000 m2)	* 0.68	* 0.30	* 0.27	*

****
****

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical

depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #2yr-24hr

E.G. Elev (m)		3.95	Element		Left OB		Channel	Right OB
Vel Head (m)		0.12	Wt. n-Val.				0.013	
W.S. Elev (m)		3.83	Reach Len. (m)		134.00		134.00	134.00
Crit W.S. (m)		3.83	Flow Area (m2)				0.49	
E.G. Slope (m/m)		0.003155	Area (m2)				0.49	
Q Total (m3/s)		0.75	Flow (m3/s)				0.75	
Top Width (m)		2.09	Top Width (m)				2.09	
Vel Total (m/s)		1.54	Avg. Vel. (m/s)				1.54	
Max Chl Dpth (m)		0.48	Hydr. Depth (m)				0.23	
Conv. Total (m3/s)		13.4	Conv. (m3/s)				13.4	
Length Wtd. (m)		134.00	Wetted Per. (m)				2.30	
Min Ch El (m)		3.35	Shear (N/m2)				6.56	
Alpha		1.00	Stream Power (N/m s)				10.09	
Frctn Loss (m)		0.42	Cum Volume (1000 m3)				0.06	
C & E Loss (m)		0.00	Cum SA (1000 m2)				0.26	

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Center Concrete
REACH: 1 RS: 0

INPUT
Description: Most downstream section (CD-6)

Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4.5	12.5	3.44	13	3	13.6	3	14.45	3.42
14.98	3.5	17.98	3.9						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	12.5	.013	14.45	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
12.5	14.45	10	10	.1	.3

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	3.81	Element	Left OB	Channel	Right OB
Vel Head (m)	0.17	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	3.64	Reach Len. (m)			
Crit W.S. (m)	3.64	Flow Area (m2)	0.24	0.96	0.17
E.G. Slope (m/m)	0.001856	Area (m2)	0.24	0.96	0.17
Q Total (m3/s)	1.95	Flow (m3/s)	0.07	1.82	0.05
Top Width (m)	5.89	Top Width (m)	2.36	1.95	1.58
Vel Total (m/s)	1.43	Avg. Vel. (m/s)	0.31	1.90	0.32
Max Chl Dpth (m)	0.64	Hydr. Depth (m)	0.10	0.49	0.11
Conv. Total (m3/s)	45.3	Conv. (m3/s)	1.7	42.3	1.3
Length Wtd. (m)		Wetted Per. (m)	2.37	2.21	1.60
Min Ch El (m)	3.00	Shear (N/m2)	1.82	7.89	1.93
Alpha	1.66	Stream Power (N/m s)	0.56	14.99	0.62
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

Warning: User specified water surface is not possible for the specified flow regime. The program used
critical depth as the starting water surface.

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	3.74	Element	Left OB	Channel	Right OB
Vel Head (m)	0.17	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	3.58	Reach Len. (m)			

* Crit W.S. (m)	*	3.58	* Flow Area (m2)	*	0.11	*	0.84	* 0.08 *
* E.G. Slope (m/m)	*0.002099		* Area (m2)	*	0.11	*	0.84	* 0.08 *
* Q Total (m3/s)	*	1.59	* Flow (m3/s)	*	0.03	*	1.54	* 0.02 *
* Top Width (m)	*	4.66	* Top Width (m)	*	1.61	*	1.95	* 1.10 *
* Vel Total (m/s)	*	1.54	* Avg. Vel. (m/s)	*	0.25	*	1.84	* 0.27 *
* Max Chl Dpth (m)	*	0.58	* Hydr. Depth (m)	*	0.07	*	0.43	* 0.08 *
* Conv. Total (m3/s)	*	34.7	* Conv. (m3/s)	*	0.6	*	33.6	* 0.5 *
* Length Wtd. (m)	*		* Wetted Per. (m)	*	1.61	*	2.21	* 1.11 *
* Min Ch El (m)	*	3.00	* Shear (N/m2)	*	1.40	*	7.77	* 1.55 *
* Alpha	*	1.38	* Stream Power (N/m s)	*	0.36	*	14.30	* 0.42 *
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*		*
* C & E Loss (m)	*		* Cum SA (1000 m2)	*		*		*

****

Warning: User specified water surface is not possible for the specified flow regime. The program used
critical depth as the starting water surface.

CROSS SECTION OUTPUT Profile #10yr-24hr

****

* E.G. Elev (m)	*	3.69	* Element	*	Left OB	*	Channel	* Right OB *
* Vel Head (m)	*	0.16	* Wt. n-Val.	*	0.030	*	0.013	* 0.030 *
* W.S. Elev (m)	*	3.52	* Reach Len. (m)	*		*		*
* Crit W.S. (m)	*	3.52	* Flow Area (m2)	*	0.04	*	0.73	* 0.03 *
* E.G. Slope (m/m)	*0.002406		* Area (m2)	*	0.04	*	0.73	* 0.03 *
* Q Total (m3/s)	*	1.33	* Flow (m3/s)	*	0.01	*	1.31	* 0.01 *
* Top Width (m)	*	3.62	* Top Width (m)	*	0.97	*	1.95	* 0.70 *
* Vel Total (m/s)	*	1.65	* Avg. Vel. (m/s)	*	0.19	*	1.80	* 0.22 *
* Max Chl Dpth (m)	*	0.52	* Hydr. Depth (m)	*	0.04	*	0.37	* 0.05 *
* Conv. Total (m3/s)	*	27.1	* Conv. (m3/s)	*	0.2	*	26.8	* 0.2 *
* Length Wtd. (m)	*		* Wetted Per. (m)	*	0.97	*	2.21	* 0.71 *
* Min Ch El (m)	*	3.00	* Shear (N/m2)	*	0.97	*	7.78	* 1.17 *
* Alpha	*	1.17	* Stream Power (N/m s)	*	0.19	*	14.01	* 0.26 *
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*		*
* C & E Loss (m)	*		* Cum SA (1000 m2)	*		*		*

RIVER: Center Concrete
REACH: 1 RS: 371

INPUT
Description: downstream of 0.25 m Plastic Pipe (CD-7)
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6	9.5	5.7	28.4	5.5	43.1	5.1	43.4	5
44.4	4.58	45.13	5	45.4	5.1	50.8	5.5	53.6	5.6
61.2	6								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	43.1	.013	45.4	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
43.1	45.4	41	40	39	.1	.3

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	5.10	Element	Left OB	Channel	Right OB
Vel Head (m)	0.11	Wt. n-Val.		0.013	
W.S. Elev (m)	4.99	Reach Len. (m)	41.00	40.00	39.00
Crit W.S. (m)	4.99	Flow Area (m2)		0.35	
E.G. Slope (m/m)	0.003304	Area (m2)		0.35	
Q Total (m3/s)	0.51	Flow (m3/s)		0.51	
Top Width (m)	1.71	Top Width (m)		1.71	
Vel Total (m/s)	1.44	Avg. Vel. (m/s)		1.44	
Max Chl Dpth (m)	0.41	Hydr. Depth (m)		0.21	
Conv. Total (m3/s)	8.9	Conv. (m3/s)		8.9	
Length Wtd. (m)	40.01	Wetted Per. (m)		1.90	
Min Ch El (m)	4.58	Shear (N/m2)		6.03	
Alpha	1.00	Stream Power (N/m s)		8.69	
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.03	0.10	0.00
C & E Loss (m)	0.03	Cum SA (1000 m2)	2.21	0.86	0.92

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)

is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	5.06	Element	Left OB	Channel	Right OB
Vel Head (m)	0.10	Wt. n-Val.		0.013	
W.S. Elev (m)	4.96	Reach Len. (m)	41.00	40.00	39.00
Crit W.S. (m)	4.96	Flow Area (m2)		0.30	
E.G. Slope (m/m)	*0.003394	Area (m2)		0.30	
Q Total (m3/s)	0.42	Flow (m3/s)		0.42	
Top Width (m)	1.57	Top Width (m)		1.57	
Vel Total (m/s)	1.38	Avg. Vel. (m/s)		1.38	
Max Chl Dpth (m)	0.38	Hydr. Depth (m)		0.19	
Conv. Total (m3/s)	7.1	Conv. (m3/s)		7.1	
Length Wtd. (m)	40.00	Wetted Per. (m)		1.75	
Min Ch El (m)	4.58	Shear (N/m2)		5.71	
Alpha	1.00	Stream Power (N/m s)		7.90	
Frctn Loss (m)	0.03	Cum Volume (1000 m3)	0.02	0.09	0.00
C & E Loss (m)	0.02	Cum SA (1000 m2)	1.87	0.86	0.69

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there
is not a valid subcritical answer. The program defaulted to critical depth.

```
39.00  *
* Crit W.S. (m)        *    4.86  * Flow Area (m2)        *          *    0.17  *
    *
* E.G. Slope (m/m)     *0.003777  * Area (m2)             *          *    0.17  *
    *
* Q Total (m3/s)       *    0.20  * Flow (m3/s)           *          *    0.20  *
    *
* Top Width (m)        *    1.17  * Top Width (m)         *          *    1.17  *
    *
* Vel Total (m/s)      *    1.20  * Avg. Vel. (m/s)       *          *    1.20  *
    *
* Max Chl Dpth (m)     *    0.28  * Hydr. Depth (m)       *          *    0.14  *
    *
* Conv. Total (m3/s)   *     3.3  * Conv. (m3/s)          *          *     3.3  *
    *
* Length Wtd. (m)      *   40.00  * Wetted Per. (m)       *          *    1.31  *
    *
* Min Ch El (m)        *    4.58  * Shear (N/m2)          *          *    4.73  *
    *
* Alpha                *    1.00  * Stream Power (N/m s)  *          *    5.67  *
    *
* Frctn Loss (m)       *    0.07  * Cum Volume (1000 m3)  *    0.00  *    0.05  *
0.00  *
* C & E Loss (m)       *    0.01  * Cum SA (1000 m2)      *    0.05  *    0.74  *
0.01  *
*********************************************************************************
*******

Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program used critical depth for the water surface and continued on with the
calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross
sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to critical
         depth, the calculated water surface came back below critical depth.  This
indicates that there
         is not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION


RIVER: Center Concrete
REACH: 1                    RS: 331

INPUT
Description: (CD-7)
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
     -66       6       0       5     7.3    4.67     7.7     4.5     8.5    4.16
    9.25     4.5    9.75     4.7    10.5       5   11.54    5.35    12.5     5.5
    14.7    5.82    17.4     5.9   21.14       6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
**********************************************
     -66      .03      7.3     .013     9.75      .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
           7.3    9.75                54    52.7      50             .1        .3

CROSS SECTION OUTPUT  Profile #100yr-24hr
**********************************************************************************
*******
* E.G. Elev (m)        *    4.81  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.01  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.80  * Reach Len. (m)      *   54.00  *   52.70  *
50.00  *
* Crit W.S. (m)        *          * Flow Area (m2)      *    0.18  *    0.91  *
0.01  *
* E.G. Slope (m/m)     *0.000210  * Area (m2)           *    0.18  *    0.91  *
0.01  *
* Q Total (m3/s)       *    0.51  * Flow (m3/s)         *    0.01  *    0.50  *
0.00  *
* Top Width (m)        *    5.53  * Top Width (m)       *    2.83  *    2.45  *
0.25  *
* Vel Total (m/s)      *    0.46  * Avg. Vel. (m/s)     *    0.08  *    0.54  *
0.06  *
* Max Chl Dpth (m)     *    0.64  * Hydr. Depth (m)     *    0.06  *    0.37  *
0.05  *
* Conv. Total (m3/s)   *    35.2  * Conv. (m3/s)        *     1.0  *    34.2  *
0.1  *
* Length Wtd. (m)      *   52.76  * Wetted Per. (m)     *    2.84  *    2.67  *
0.26  *
* Min Ch El (m)        *    4.16  * Shear (N/m2)        *    0.13  *    0.70  *
0.09  *
* Alpha                *    1.35  * Stream Power (N/m s) *   0.01  *    0.38  *
0.01  *
* Frctn Loss (m)       *    0.00  * Cum Volume (1000 m3) *   0.03  *    0.08  *
0.00  *
* C & E Loss (m)       *    0.00  * Cum SA (1000 m2)    *    2.16  *    0.78  *
0.91  *
**********************************************************************************
*******

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)
is less than
        0.7 or greater than 1.4.  This may indicate the need for additional cross
sections.

CROSS SECTION OUTPUT  Profile #25yr-24hr
**********************************************************************************
*******
* E.G. Elev (m)        *    4.73  * Element             *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.02  * Wt. n-Val.          *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.72  * Reach Len. (m)      *   54.00  *   52.70  *
50.00  *
* Crit W.S. (m)        *          * Flow Area (m2)      *    0.03  *    0.71  *
0.00  *
* E.G. Slope (m/m)     *0.000332  * Area (m2)           *    0.03  *    0.71  *
0.00  *
* Q Total (m3/s)       *    0.42  * Flow (m3/s)         *    0.00  *    0.41  *
0.00  *
* Top Width (m)        *    3.55  * Top Width (m)       *    1.06  *    2.45  *
```

0.04								
* Vel Total (m/s)	*	0.56	* Avg. Vel. (m/s)	*	0.05	*	0.58	*
0.02								
* Max Chl Dpth (m)	*	0.56	* Hydr. Depth (m)	*	0.02	*	0.29	*
0.01								
* Conv. Total (m3/s)	*	22.8	* Conv. (m3/s)	*	0.1	*	22.8	*
0.0								
* Length Wtd. (m)	*	52.74	* Wetted Per. (m)	*	1.06	*	2.67	*
0.05								
* Min Ch El (m)	*	4.16	* Shear (N/m2)	*	0.08	*	0.87	*
0.03								
* Alpha	*	1.06	* Stream Power (N/m s)	*	0.00	*	0.51	*
0.00								
* Frctn Loss (m)	*	0.00	* Cum Volume (1000 m3)	*	0.02	*	0.07	*
0.00								
* C & E Loss (m)	*	0.00	* Cum SA (1000 m2)	*	1.85	*	0.78	*
0.69								

****
****

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #10yr-24hr

****
****

* E.G. Elev (m)	*	4.68	* Element	*	Left OB	*	Channel	*
Right OB *								
* Vel Head (m)	*	0.02	* Wt. n-Val.	*		*	0.013	*
*								
* W.S. Elev (m)	*	4.66	* Reach Len. (m)	*	54.00	*	52.70	*
50.00								
* Crit W.S. (m)	*		* Flow Area (m2)	*		*	0.58	*
*								
* E.G. Slope (m/m)	*0.000440		* Area (m2)	*		*	0.58	*
*								
* Q Total (m3/s)	*	0.35	* Flow (m3/s)	*		*	0.35	*
*								
* Top Width (m)	*	2.34	* Top Width (m)	*		*	2.34	*
*								
* Vel Total (m/s)	*	0.60	* Avg. Vel. (m/s)	*		*	0.60	*
*								
* Max Chl Dpth (m)	*	0.50	* Hydr. Depth (m)	*		*	0.25	*
*								
* Conv. Total (m3/s)	*	16.7	* Conv. (m3/s)	*		*	16.7	*
*								
* Length Wtd. (m)	*	52.73	* Wetted Per. (m)	*		*	2.55	*
*								
* Min Ch El (m)	*	4.16	* Shear (N/m2)	*		*	0.98	*
*								
* Alpha	*	1.00	* Stream Power (N/m s)	*		*	0.59	*
*								
* Frctn Loss (m)	*	0.00	* Cum Volume (1000 m3)	*	0.01	*	0.06	*
0.00								
* C & E Loss (m)	*	0.00	* Cum SA (1000 m2)	*	1.60	*	0.78	*
0.50								

****
****

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than

0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #2yr-24hr

E.G. Elev (m)		4.53	Element		Left OB		Channel		Right OB	
Vel Head (m)		0.03	Wt. n-Val.				0.013			
W.S. Elev (m)		4.50	Reach Len. (m)		54.00		52.70		50.00	
Crit W.S. (m)			Flow Area (m2)				0.27			
E.G. Slope (m/m)		0.001090	Area (m2)				0.27			
Q Total (m3/s)		0.20	Flow (m3/s)				0.20			
Top Width (m)		1.57	Top Width (m)				1.57			
Vel Total (m/s)		0.74	Avg. Vel. (m/s)				0.74			
Max Chl Dpth (m)		0.34	Hydr. Depth (m)				0.17			
Conv. Total (m3/s)		6.1	Conv. (m3/s)				6.1			
Length Wtd. (m)		52.71	Wetted Per. (m)				1.71			
Min Ch El (m)		4.16	Shear (N/m2)				1.68			
Alpha		1.00	Stream Power (N/m s)				1.25			
Frctn Loss (m)		0.01	Cum Volume (1000 m3)		0.00		0.04		0.00	
C & E Loss (m)		0.01	Cum SA (1000 m2)		0.05		0.68		0.01	

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Center Concrete
REACH: 1 RS: 278.3

INPUT
Description: upstream of 0.81 m Concrete Pipe (CD-7)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5.5	11.4	4.4	12.7	3.92	13.9	4.4	14	4.5
15	5	18.5	5.5	21.3	5.6				

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.03	11.4	.013	13.9	.03	18.5	.016

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
11.4	13.9	15.6	15.6	.1	.3

CROSS SECTION OUTPUT Profile #100yr-24hr

E.G. Elev (m)	4.81	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	4.80	Reach Len. (m)	15.60	15.60	15.60
Crit W.S. (m)	4.30	Flow Area (m2)	0.84	1.61	0.13
E.G. Slope (m/m)	0.000027	Area (m2)	0.84	1.61	0.13
Q Total (m3/s)	0.51	Flow (m3/s)	0.05	0.45	0.01
Top Width (m)	7.38	Top Width (m)	4.17	2.50	0.71
Vel Total (m/s)	0.20	Avg. Vel. (m/s)	0.06	0.28	0.05
Max Chl Dpth (m)	0.88	Hydr. Depth (m)	0.20	0.64	0.18
Conv. Total (m3/s)	98.7	Conv. (m3/s)	9.6	87.9	1.2
Length Wtd. (m)	15.60	Wetted Per. (m)	4.19	2.68	0.82
Min Ch El (m)	3.92	Shear (N/m2)	0.05	0.16	0.04
Alpha	1.82	Stream Power (N/m s)	0.00	0.04	0.00
Frctn Loss (m)		Cum Volume (1000 m3)		0.01	
C & E Loss (m)		Cum SA (1000 m2)	1.97	0.65	0.89

CROSS SECTION OUTPUT Profile #25yr-24hr

E.G. Elev (m)	4.73	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.030	0.013	0.030
W.S. Elev (m)	4.72	Reach Len. (m)	15.60	15.60	15.60
Crit W.S. (m)	4.27	Flow Area (m2)	0.54	1.41	0.08
E.G. Slope (m/m)	0.000029	Area (m2)	0.54	1.41	0.08
Q Total (m3/s)	0.42	Flow (m3/s)	0.03	0.38	0.00
Top Width (m)	6.40	Top Width (m)	3.35	2.50	0.55
Vel Total (m/s)	0.21	Avg. Vel. (m/s)	0.05	0.27	0.04
Max Chl Dpth (m)	0.80	Hydr. Depth (m)	0.16	0.56	0.14
Conv. Total (m3/s)	76.6	Conv. (m3/s)	5.4	70.6	0.6
Length Wtd. (m)	15.60	Wetted Per. (m)	3.37	2.68	

```
0.64  *
* Min Ch El (m)        *    3.92  * Shear (N/m2)          *    0.05  *    0.15  *
0.03  *
* Alpha                *    1.63  * Stream Power (N/m s)  *    0.00  *    0.04  *
0.00  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3)  *          *    0.01  *
      *
* C & E Loss (m)       *          * Cum SA (1000 m2)      *    1.73  *    0.65  *
0.67  *
*************************************************************************************
*******

CROSS SECTION OUTPUT  Profile #10yr-24hr
*************************************************************************************
*******
* E.G. Elev (m)        *    4.67  * Element              *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.00  * Wt. n-Val.           *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.67  * Reach Len. (m)       *   15.60  *   15.60  *
15.60  *
* Crit W.S. (m)        *    4.24  * Flow Area (m2)       *    0.38  *    1.27  *
0.05  *
* E.G. Slope (m/m)     *0.000030  * Area (m2)            *    0.38  *    1.27  *
0.05  *
* Q Total (m3/s)       *    0.35  * Flow (m3/s)          *    0.02  *    0.33  *
0.00  *
* Top Width (m)        *    5.74  * Top Width (m)        *    2.80  *    2.50  *
0.44  *
* Vel Total (m/s)      *    0.21  * Avg. Vel. (m/s)      *    0.05  *    0.26  *
0.04  *
* Max Chl Dpth (m)     *    0.75  * Hydr. Depth (m)      *    0.13  *    0.51  *
0.12  *
* Conv. Total (m3/s)   *    63.4  * Conv. (m3/s)         *     3.3  *    59.8  *
0.4  *
* Length Wtd. (m)      *   15.60  * Wetted Per. (m)      *    2.81  *    2.68  *
0.52  *
* Min Ch El (m)        *    3.92  * Shear (N/m2)         *    0.04  *    0.14  *
0.03  *
* Alpha                *    1.50  * Stream Power (N/m s) *    0.00  *    0.04  *
0.00  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3) *          *    0.01  *
      *
* C & E Loss (m)       *          * Cum SA (1000 m2)     *    1.53  *    0.65  *
0.48  *
*************************************************************************************
*******

CROSS SECTION OUTPUT  Profile #2yr-24hr
*************************************************************************************
*******
* E.G. Elev (m)        *    4.52  * Element              *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.00  * Wt. n-Val.           *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    4.52  * Reach Len. (m)       *   15.60  *   15.60  *
15.60  *
* Crit W.S. (m)        *    4.18  * Flow Area (m2)       *    0.07  *    0.89  *
0.01  *
* E.G. Slope (m/m)     *0.000036  * Area (m2)            *    0.07  *    0.89  *
0.01  *
* Q Total (m3/s)       *    0.20  * Flow (m3/s)          *    0.00  *    0.20  *
0.00  *
```

* Top Width (m)	*	3.84	* Top Width (m)	*	1.20	*	2.50	*	0.13	*
* Vel Total (m/s)	*	0.21	* Avg. Vel. (m/s)	*	0.03	*	0.22	*	0.02	*
* Max Chl Dpth (m)	*	0.60	* Hydr. Depth (m)	*	0.06	*	0.36	*	0.05	*
* Conv. Total (m3/s)	*	33.2	* Conv. (m3/s)	*	0.3	*	32.9	*	0.0	*
* Length Wtd. (m)	*	15.60	* Wetted Per. (m)	*	1.21	*	2.68	*	0.18	*
* Min Ch El (m)	*	3.92	* Shear (N/m2)	*	0.02	*	0.12	*	0.01	*
* Alpha	*	1.14	* Stream Power (N/m s)	*	0.00	*	0.03	*	0.00	*
* Frctn Loss (m)	*		* Cum Volume (1000 m3)	*		*	0.01	*		
* C & E Loss (m)	*		* Cum SA (1000 m2)	*	0.01	*	0.58	*	0.00	*

****

CULVERT

RIVER: Center Concrete
REACH: 1 RS: 270

INPUT
Description:
Distance from Upstream XS = 1.4
Deck/Roadway Width = 12.9
Weir Coefficient = 1.4
Upstream Deck/Roadway Coordinates
num= 9

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
0	5.5	11.4	5.5	11.4	5.5
13.9	5.5	13.9	5.5	14	5.5
15	5.5	18.5	5.5	21.3	5.5

Upstream Bridge Cross Section Data
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5.5	11.4	4.4	12.7	3.92	13.9	4.4	14	4.5
15	5	18.5	5.5	21.3	5.6				

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.03	11.4	.013	13.9	.03	18.5	.016

Bank Sta: Left	Right	Coeff Contr.	Expan.
11.4	13.9	.1	.3

Downstream Deck/Roadway Coordinates
num= 13

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
-78.6	7	-58	4.73	0	5.5
17.35	5.5	18	5.5	18.4	5.5
18.4	5.5	20.8	5.5	20.8	5.5
21.1	5.5	21.9	5.5	25.6	5.5

that the normal
depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #25yr-24hr Culv Group: Culvert #1

Q Culv Group (m3/s)	0.42	Culv Full Len (m)			
# Barrels	1	Culv Vel US (m/s)		0.85	
Q Barrel (m3/s)	0.42	Culv Vel DS (m/s)		0.85	
E.G. US. (m)	4.73	Culv Inv El Up (m)		3.94	
W.S. US. (m)	4.72	Culv Inv El Dn (m)		3.90	
E.G. DS (m)	4.67	Culv Frctn Ls (m)		0.04	
W.S. DS (m)	4.58	Culv Exit Loss (m)		0.00	
Delta EG (m)	0.05	Culv Entr Loss (m)		0.02	
Delta WS (m)	0.15	Q Weir (m3/s)			
E.G. IC (m)	4.50	Weir Sta Lft (m)			
E.G. OC (m)	4.73	Weir Sta Rgt (m)			
Culvert Control	Outlet	Weir Submerg			
Culv WS Inlet (m)	4.67	Weir Max Depth (m)			
Culv WS Outlet (m)	4.64	Weir Avg Depth (m)			
Culv Nml Depth (m)	0.67	Weir Flow Area (m2)			
Culv Crt Depth (m)	0.39	Min El Weir Flow (m)		5.50	

CULVERT OUTPUT Profile #10yr-24hr Culv Group: Culvert #1

Q Culv Group (m3/s)	0.35	Culv Full Len (m)			
# Barrels	1	Culv Vel US (m/s)		0.75	
Q Barrel (m3/s)	0.35	Culv Vel DS (m/s)		0.74	
E.G. US. (m)	4.67	Culv Inv El Up (m)		3.94	
W.S. US. (m)	4.67	Culv Inv El Dn (m)		3.90	
E.G. DS (m)	4.63	Culv Frctn Ls (m)		0.03	
W.S. DS (m)	4.56	Culv Exit Loss (m)		0.00	
Delta EG (m)	0.04	Culv Entr Loss (m)		0.01	
Delta WS (m)	0.11	Q Weir (m3/s)			
E.G. IC (m)	4.44	Weir Sta Lft (m)			
E.G. OC (m)	4.67	Weir Sta Rgt (m)			
Culvert Control	Outlet	Weir Submerg			
Culv WS Inlet (m)	4.63	Weir Max Depth (m)			
Culv WS Outlet (m)	4.60	Weir Avg Depth (m)			
Culv Nml Depth (m)	0.57	Weir Flow Area (m2)			
Culv Crt Depth (m)	0.35	Min El Weir Flow (m)		5.50	

CULVERT OUTPUT Profile #2yr-24hr Culv Group: Culvert #1

Q Culv Group (m3/s)	0.20	Culv Full Len (m)			
# Barrels	1	Culv Vel US (m/s)		0.53	
Q Barrel (m3/s)	0.20	Culv Vel DS (m/s)		0.50	
E.G. US. (m)	4.52	Culv Inv El Up (m)		3.94	
W.S. US. (m)	4.52	Culv Inv El Dn (m)		3.90	
E.G. DS (m)	4.50	Culv Frctn Ls (m)		0.01	
W.S. DS (m)	4.46	Culv Exit Loss (m)		0.00	
Delta EG (m)	0.02	Culv Entr Loss (m)		0.01	
Delta WS (m)	0.06	Q Weir (m3/s)			
E.G. IC (m)	4.30	Weir Sta Lft (m)			
E.G. OC (m)	4.52	Weir Sta Rgt (m)			
Culvert Control	Outlet	Weir Submerg			
Culv WS Inlet (m)	4.50	Weir Max Depth (m)			
Culv WS Outlet (m)	4.49	Weir Avg Depth (m)			
Culv Nml Depth (m)	0.40	Weir Flow Area (m2)			
Culv Crt Depth (m)	0.26	Min El Weir Flow (m)		5.50	

```
* South Concrete D1              100yr-24hr       *
  Known WS = 3.59 *
* South Concrete D1              25yr-24hr        *
   Known WS = 3.1 *
* South Concrete D1              10yr-24hr        *
 Normal S = 0.029 *
* South Concrete D1              2yr-24hr         *
 Normal S = 0.029 *
* Swale           1              100yr-24hr       *
  Known WS = 3.38 *
* Swale           1              25yr-24hr        *
 Normal S = 0.026 *
* Swale           1              10yr-24hr        *
 Normal S = 0.026 *
* Swale           1              2yr-24hr         *
 Normal S = 0.026 *
* West Concrete Di1              100yr-24hr       *
   Known WS = 4.2 *
* West Concrete Di1              25yr-24hr        *
  Known WS = 3.91 *
* West Concrete Di1              10yr-24hr        *
  Known WS = 3.84 *
* West Concrete Di1              2yr-24hr         *
  Known WS = 3.65 *
*********************************************************************************************
**********

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

GEOMETRY DATA

Geometry Title: AES OnSite
Geometry File : D:\Data\2012 Files\AES Guayama\Hydrologic-Hydraulic
Study\HEC-RAS\AES_Guayama.g05

CROSS SECTION


RIVER: Center Concrete
REACH: 1                    RS: 384.5

INPUT
Description: upstream of 0.25 m Plastic Pipe (CD-8)
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0       6      15     5.5    27.5    5.06    27.5    4.83   28.13    4.83
   28.13    5.06    28.4       5    43.2     5.5    58.6     5.7

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .03    27.5    .013   28.13     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
          27.5   28.13              13.5    13.5    13.5             .1       .3

CROSS SECTION OUTPUT  Profile #100yr-24hr
*********************************************************************************************
*******
* E.G. Elev (m)         *    5.36  * Element              *  Left OB *  Channel *
Right OB *
* Vel Head (m)          *    0.00  * Wt. n-Val.           *   0.030  *   0.013  *
```

```
0.030  *
* W.S. Elev (m)        *    5.36  * Reach Len. (m)        *   13.50  *   13.50  *
13.50  *
* Crit W.S. (m)        *    4.99  * Flow Area (m2)        *    1.31  *    0.34  *
2.05  *
* E.G. Slope (m/m)     *0.000008  * Area (m2)             *    1.31  *    0.34  *
2.05  *
* Q Total (m3/s)       *    0.13  * Flow (m3/s)           *    0.03  *    0.03  *
0.06  *
* Top Width (m)        *   20.32  * Top Width (m)         *    8.64  *    0.63  *
11.05  *
* Vel Total (m/s)      *    0.04  * Avg. Vel. (m/s)       *    0.03  *    0.10  *
0.03  *
* Max Chl Dpth (m)     *    0.53  * Hydr. Depth (m)       *    0.15  *    0.53  *
0.19  *
* Conv. Total (m3/s)   *    46.6  * Conv. (m3/s)          *    12.5  *    11.8  *
22.3  *
* Length Wtd. (m)      *   13.50  * Wetted Per. (m)       *    8.65  *    1.09  *
11.06  *
* Min Ch El (m)        *    4.83  * Shear (N/m2)          *    0.01  *    0.02  *
0.01  *
* Alpha                *    2.49  * Stream Power (N/m s)  *    0.00  *    0.00  *
0.00  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3)  *          *    0.01  *
    *
* C & E Loss (m)       *          * Cum SA (1000 m2)      *    2.27  *    0.88  *
0.99  *
*******************************************************************************
*******

CROSS SECTION OUTPUT  Profile #25yr-24hr
*******************************************************************************
*******
* E.G. Elev (m)        *    5.35  * Element              *  Left OB *  Channel *
Right OB *
* Vel Head (m)         *    0.00  * Wt. n-Val.           *   0.030  *   0.013  *
0.030  *
* W.S. Elev (m)        *    5.35  * Reach Len. (m)       *   13.50  *   13.50  *
13.50  *
* Crit W.S. (m)        *    4.97  * Flow Area (m2)       *    1.20  *    0.33  *
1.91  *
* E.G. Slope (m/m)     *0.000006  * Area (m2)            *    1.20  *    0.33  *
1.91  *
* Q Total (m3/s)       *    0.11  * Flow (m3/s)          *    0.03  *    0.03  *
0.05  *
* Top Width (m)        *   19.53  * Top Width (m)        *    8.26  *    0.63  *
10.65  *
* Vel Total (m/s)      *    0.03  * Avg. Vel. (m/s)      *    0.02  *    0.09  *
0.03  *
* Max Chl Dpth (m)     *    0.52  * Hydr. Depth (m)      *    0.15  *    0.52  *
0.18  *
* Conv. Total (m3/s)   *    42.6  * Conv. (m3/s)         *    11.1  *    11.3  *
20.2  *
* Length Wtd. (m)      *   13.50  * Wetted Per. (m)      *    8.26  *    1.09  *
10.66  *
* Min Ch El (m)        *    4.83  * Shear (N/m2)         *    0.01  *    0.02  *
0.01  *
* Alpha                *    2.56  * Stream Power (N/m s)  *    0.00  *    0.00  *
0.00  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3)  *          *    0.01  *
    *
* C & E Loss (m)       *          * Cum SA (1000 m2)      *    1.93  *    0.88  *
0.76  *
```

```
4.35  *
* Min Ch El (m)        *    4.83  * Shear (N/m2)          *    0.02  *    0.09  *
0.04  *
* Alpha                *    3.13  * Stream Power (N/m s) *    0.00  *    0.02  *
0.00  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3) *          *    0.00  *
      *
* C & E Loss (m)       *          * Cum SA (1000 m2)     *    0.06  *    0.75  *
0.04  *
*********************************************************************************
*******

CULVERT


RIVER: Center Concrete
REACH: 1                    RS: 380

INPUT
Description:
Distance from Upstream XS =       1
Deck/Roadway Width        =    12.4
Weir Coefficient          =     1.4
Upstream  Deck/Roadway Coordinates
    num=        6
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*************************************************************************
       0       6              15     5.5             27.5    5.32
   28.13    5.32            43.2     5.5             58.6     5.7

Upstream Bridge Cross Section Data
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0       6      15     5.5    27.5    5.06    27.5    4.83   28.13    4.83
   28.13    5.06    28.4       5    43.2     5.5    58.6     5.7

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .03    27.5    .013   28.13     .03

Bank Sta: Left   Right    Coeff Contr.    Expan.
          27.5   28.13             .1        .3

Downstream  Deck/Roadway Coordinates
    num=        8
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*************************************************************************
       0       6              9.5     5.7             28.4     5.5
    43.1     5.1            45.4     5.1             50.8     5.5
    53.6     5.6            61.2       6

Downstream Bridge Cross Section Data
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0       6     9.5     5.7    28.4     5.5    43.1     5.1    43.4       5
    44.4    4.58   45.13       5    45.4     5.1    50.8     5.5    53.6     5.6
    61.2       6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
**********************************************
       0     .03    43.1    .013    45.4     .03

Bank Sta: Left   Right    Coeff Contr.   Expan.
          43.1    45.4             .1       .3

Upstream Embankment side slope                 =       0 horiz. to 1.0 vertical
Downstream Embankment side slope               =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins            =
Energy head used in spillway design            =
Spillway height used in design                 =
Weir crest shape                               = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1      Circular     .25
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
               1.1    12.4     .011     .011        0                    .5
      1
Upstream   Elevation =  4.83
           Centerline Station =  27.7
Downstream Elevation =  4.77
           Centerline Station =  44

CULVERT OUTPUT  Profile #100yr-24hr  Culv Group:  Culvert #1
*********************************************************************
* Q Culv Group (m3/s)  *    0.08  * Culv Full Len (m)     *   11.00  *
* # Barrels            *       1  * Culv Vel US (m/s)     *    1.61  *
* Q Barrel (m3/s)      *    0.08  * Culv Vel DS (m/s)     *    1.70  *
* E.G. US. (m)         *    5.36  * Culv Inv El Up (m)    *    4.83  *
* W.S. US. (m)         *    5.36  * Culv Inv El Dn (m)    *    4.77  *
* E.G. DS (m)          *    5.10  * Culv Frctn Ls (m)     *    0.16  *
* W.S. DS (m)          *    4.99  * Culv Exit Loss (m)    *    0.04  *
* Delta EG (m)         *    0.26  * Culv Entr Loss (m)    *    0.07  *
* Delta WS (m)         *    0.37  * Q Weir (m3/s)         *    0.05  *
* E.G. IC (m)          *    5.37  * Weir Sta Lft (m)      *   24.07  *
* E.G. OC (m)          *    5.36  * Weir Sta Rgt (m)      *   32.27  *
* Culvert Control      *  Outlet  * Weir Submerg          *    0.00  *
* Culv WS Inlet (m)    *    5.08  * Weir Max Depth (m)    *    0.05  *
* Culv WS Outlet (m)   *    4.99  * Weir Avg Depth (m)    *    0.03  *
* Culv Nml Depth (m)   *    0.25  * Weir Flow Area (m2)   *    0.22  *
* Culv Crt Depth (m)   *    0.22  * Min El Weir Flow (m)  *    5.32  *
*********************************************************************

Note:    The normal depth exceeds the height of the culvert.  The program assumes
that the normal
         depth is equal to the height of the culvert.

CULVERT OUTPUT  Profile #25yr-24hr  Culv Group:  Culvert #1
*********************************************************************
* Q Culv Group (m3/s)  *    0.08  * Culv Full Len (m)     *   11.09  *
* # Barrels            *       1  * Culv Vel US (m/s)     *    1.58  *
* Q Barrel (m3/s)      *    0.08  * Culv Vel DS (m/s)     *    1.68  *
* E.G. US. (m)         *    5.35  * Culv Inv El Up (m)    *    4.83  *
* W.S. US. (m)         *    5.35  * Culv Inv El Dn (m)    *    4.77  *
* E.G. DS (m)          *    5.06  * Culv Frctn Ls (m)     *    0.15  *
* W.S. DS (m)          *    4.96  * Culv Exit Loss (m)    *    0.08  *
```

* Delta EG (m)	* 0.29	* Culv Entr Loss (m)	*	0.06	*
* Delta WS (m)	* 0.39	* Q Weir (m3/s)	*	0.03	*
* E.G. IC (m)	* 5.35	* Weir Sta Lft (m)	*	24.87	*
* E.G. OC (m)	* 5.35	* Weir Sta Rgt (m)	*	31.30	*
* Culvert Control	* Outlet	* Weir Submerg	*	0.00	*
* Culv WS Inlet (m)	* 5.08	* Weir Max Depth (m)	*	0.04	*
* Culv WS Outlet (m)	* 4.99	* Weir Avg Depth (m)	*	0.02	*
* Culv Nml Depth (m)	* 0.25	* Weir Flow Area (m2)	*	0.13	*
* Culv Crt Depth (m)	* 0.22	* Min El Weir Flow (m)	*	5.32	*

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #10yr-24hr Culv Group: Culvert #1

* Q Culv Group (m3/s)	* 0.08	* Culv Full Len (m)	*	11.11	*
* # Barrels	* 1	* Culv Vel US (m/s)	*	1.59	*
* Q Barrel (m3/s)	* 0.08	* Culv Vel DS (m/s)	*	1.69	*
* E.G. US. (m)	* 5.35	* Culv Inv El Up (m)	*	4.83	*
* W.S. US. (m)	* 5.35	* Culv Inv El Dn (m)	*	4.77	*
* E.G. DS (m)	* 5.03	* Culv Frctn Ls (m)	*	0.15	*
* W.S. DS (m)	* 4.94	* Culv Exit Loss (m)	*	0.11	*
* Delta EG (m)	* 0.33	* Culv Entr Loss (m)	*	0.06	*
* Delta WS (m)	* 0.42	* Q Weir (m3/s)	*	0.01	*
* E.G. IC (m)	* 5.35	* Weir Sta Lft (m)	*	25.68	*
* E.G. OC (m)	* 5.35	* Weir Sta Rgt (m)	*	30.32	*
* Culvert Control	* Outlet	* Weir Submerg	*	0.00	*
* Culv WS Inlet (m)	* 5.08	* Weir Max Depth (m)	*	0.03	*
* Culv WS Outlet (m)	* 4.99	* Weir Avg Depth (m)	*	0.01	*
* Culv Nml Depth (m)	* 0.25	* Weir Flow Area (m2)	*	0.07	*
* Culv Crt Depth (m)	* 0.22	* Min El Weir Flow (m)	*	5.32	*

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #2yr-24hr Culv Group: Culvert #1

* Q Culv Group (m3/s)	* 0.05	* Culv Full Len (m)	*		*
* # Barrels	* 1	* Culv Vel US (m/s)	*	1.13	*
* Q Barrel (m3/s)	* 0.05	* Culv Vel DS (m/s)	*	1.30	*
* E.G. US. (m)	* 5.14	* Culv Inv El Up (m)	*	4.83	*
* W.S. US. (m)	* 5.14	* Culv Inv El Dn (m)	*	4.77	*
* E.G. DS (m)	* 4.94	* Culv Frctn Ls (m)	*	0.07	*
* W.S. DS (m)	* 4.86	* Culv Exit Loss (m)	*	0.10	*
* Delta EG (m)	* 0.20	* Culv Entr Loss (m)	*	0.03	*
* Delta WS (m)	* 0.27	* Q Weir (m3/s)	*		*
* E.G. IC (m)	* 5.13	* Weir Sta Lft (m)	*		*
* E.G. OC (m)	* 5.14	* Weir Sta Rgt (m)	*		*
* Culvert Control	* Outlet	* Weir Submerg	*		*
* Culv WS Inlet (m)	* 5.04	* Weir Max Depth (m)	*		*
* Culv WS Outlet (m)	* 4.95	* Weir Avg Depth (m)	*		*
* Culv Nml Depth (m)	* 0.21	* Weir Flow Area (m2)	*		*
* Culv Crt Depth (m)	* 0.18	* Min El Weir Flow (m)	*	5.32	*

Note: During subcritical analysis, the culvert direct step method, the solution went to normal depth.

CROSS SECTION

Attachment 4: Improvements to the run-on and run-off control system.

NOTE: UNIPRO TO PROVIDE BMPS FOR EROSION/SEDIMENTATION CONTROLS & TO DESIGNED STORMWATER MONITORING SAMPLE COLLECTION STATION

AREA- 4 & 5 DESIGN CONSIDERATIONS

1ST CONCERN: POTENTIAL RUNOFF OVERFLOW OFFSITE
SOLUTION: ONSITE STORMWATER RUNOFF VOLUME TO BE MANAGED AT THE SOUTHEAST OF THE AES FACILITY AND THEN REROUTED INTO A CULVERT STRUCTURE TO BE LOCATED AT THE SOUTHERN FACILITY ENTRANCE.
2ND CONCERN: POTENTIAL UNAUTHORIZED RUNOFF OVERFLOW OFFSITE
SOLUTION: STORM WATER RUNOFF GENERATED FROM THE ASHPILE WILL BE CONVEYED THROUGH THE EXISTING PERIMETER DITCH WHICH DRAINS INTO THE COAL PILE RUNOFF POND.

DESIGN CRITERIA

100 YRS-24 HR PEAK FLOW		MINIMUM STORAGE VOLUME REQUIRED AT PONDING AREA TO THE SOUTHEAST OF THE AES FACILITY	FLOW VELOCITY INTERCEPTED BY PARALLEL GRATES	CONCRETE ROUGHNESS MANNING'S COEFFICIENT
CONVEYED THROUGH CULVERT	CONVEYED BY DITCH AND SOUTH PERIMETER ROAD			
0.64 M^3/S	2.66 M^3/S	0.043 ACRE-FT	1.52 M/S	0.013

NOTE: FULL LENGTH OF BERM IS NOT SHOWN IN THIS DRAWING. FOR FULL LENGTH, PLEASE REFER TO THE MODEL SPACE IN THE AUTOCAD DRAWING FILE

7. CONTINUOS BERM ALONG EAST FENCE
   - MINIMUM HEIGHT ALONG BERM = 0.46 MTS (1.5 FT)
   - APPROXIMATE LENGTH = 182 M

6. CONTINUOS BERM ALONG SOUTHEAST FENCE
   - MINIMUM TOP ELEVATION ALONG BERM = 2.50 MTS MSL (INCLUDING 1FT OF FREEBOARD)
   - APPROXIMATE LENGTH = 130 M

8. CONCRETE DITCH BANK
   - INCREASE EASTERN DITCH OUTER BANK HEIGHT AT LEAST 0.30 M FROM THE BEGINNING OF THE DITCH DOWNSTREAM TO APPROXIMATELY 184 M (AS SHOWN)

9. CONTINUOS CONCRETE CURB ALONG BORDER
   - MINIMUM HEIGHT = 0.30 M
   - APPROXIMATE LENGTH = 51.70 M
   - DRAINS INTO THE INLET GRATE LOCATED DOWNSTREAM

10. CONTINUOS BERM OR CURB
    - MINIMUM TOP ELEVATION ALONG BERM/CURB = 5.95 MTS MSL (INCLUDING 1FT OF FREEBOARD)
    - LENGTH = 108.40 M
    - ROAD GRADING TOWARDS THE CONCRETE DITCH (TO BE DESIGNED BY UNIPRO), FOR PURPOSES OF THE HYDRAULIC ANALYSIS A 2% SLOPE WAS ASSUMED

5. TWO PARALLEL INLET GRATES DRAINING INTO THE BOX CULVERT
   - GRATE TYPE = P-30
   - LENGTH = 9.64 M (EACH INLET GRATE)
   - WIDTH = 0.80 M (EACH INLET GRATE)
   - INLET GRATE CONSTRUCTION MUST BE ABLE TO WITHSTAND EXPECTED D-10 HEAVY TRAFFIC EQUIPMENT (TO BE DETERMINED BY UNIPRO)

4. GRADING
   - REGRADE GROUND SURFACE WITH THE NECESSARY SLOPE TO END AT THE CULVERT I.E. OF 1.70 M MSL

3. TWO CELL CONCRETE BOX CULVERT
   - 0.78M X 0.78 M
   - LENGTH = 17.55 M
   - ENTRANCE I.E. 1.70M MSL
   - OUTLET I.E. = 1.68 M MSL
   - SLOPE = 0.11%
   - WINGWALLS (ENTRANCE & EXIT); FLARED 30 TO 75 DEGREES
   - SOUTHERN WINGWALL AT ENTRANCE TO BE EXTENDED DOWN TO SOUTHEAST BERM

1. STORMWATER DISCHARGE MONITORING SAMPLE COLLECTION STATION (TO BE DESIGNED BY UNIPRO)

2. ENERGY DISSIPATOR & OUTFALL MONITORING COLLECTION SAMPLE STRUCTURE (TO BE DESIGNED BY UNIPRO)
   - DESIGN VELOCITY = 5.11 FT/S

BERM DIVISION

BERM DIVISION

SOURCE: TOPOGRAPHIC SURVEY MAP OF THE AES FACILITY AND SURROUNDINGS PROVIDED BY ARC SURVEYING & MAPPING, INC.

CES Caribe Environmental Services
www.caribeenvironmental.com

AES FACILITY
ENGINEERING ANALYSIS
HYDROLOGIC/HYDRAULIC STUDY
GUAYAMA, PUERTO RICO

AREA-4 & 5

PROJECT NO.
11-0034

FIGURE 4

7/31/2012 2:02 PM

2012 DRAWINGS\11-0034 AES Guayama\HH Study\Engineering Analysis\Final\