MEMORANDUM

TO: File

FROM: Robin Cort

DATE: December 1, 1995

SUBJECT: Interest Rates for Present Worth Analysis

The following technical memorandum, TM-DD1 Uses an interest rate of 7.5% for present worth cost comparisons. This memorandum was prepared prior to the project cost estimate, which uses a 6.5% interest rate. Because the present worth analysis in this memorandum is used for internal comparison only, and is not carried forward into the final cost analysis, the difference in the interest rates does not affect the conclusions presented in this memorandum.

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Memorandum

SANTA ROSA SUBREGIONAL LONG-TERM WASTEWATER PROJECT
DIRECT DISCHARGE WATER BALANCE
TM-DD-1

TO: Ed Braunner (City of Santa Rosa)
Dan Carlson (City of Santa Rosa)
Marie Meredith (City of Santa Rosa)

FROM: Jessamy Zagel Trisler (Parsons ES)

DATE: 18 October 1995

GENERAL

One of the alternatives being examined for disposal of reclaimed water is an expansion of the current discharge program to include direct discharge to the Russian River upstream of the SCWA water supply intake wells. Currently, direct discharge is permitted to the Laguna de Santa Rosa through outfalls from the existing system. Discharges of 1 percent of Russian River flow are allowed from October 1 through May 15 after flow in the Russian River has reached 1,000 cfs. Discharges of up to 5 percent are allowed with special permission from the Regional Water Quality Control Board. Under the Direct Discharge Alternative (Alternative 5), the maximum permitted discharge rate would be 20 percent of Russian River flow. The reclaimed water to be discharged would first flow to Delta pond. From Delta pond a pump station would pump the water through a pipeline to the outfall at the River. The purpose of this memorandum is to:

- present the components of the direct discharge (alternative 5) water balance system,
- determine pipeline and pump station sizing,
- develop present worth costs for the different alternatives,
- recommend an appropriate pipeline and pump station selection, and
- present the capacity of the existing system to handle the flows indicated in the Monthly Water Balance Model.

Another aspect of the Direct Discharge Alternative is the outlet structure to the Russian River. Appendix A presents a discussion and conceptual design of this structure.

RIVER FLOW SCENARIOS

Water balance analyses were performed for three different river flow scenarios: 10 year high flow, annual average flow and 10 year low flow. This approach was used to examine the feasibility of direct discharge over a range of frequently occurring flows, while limiting it to a reasonable pump station, piping, outlet structure design range. Note that these flows are given as monthly flows, not daily. Peak and minimum daily flows within the month may vary significantly from the average daily.

WATER BALANCE

The direct discharge water balance system examines disposal scenarios based upon the monthly reclaimed water produced, the monthly irrigation demands, direct discharge flow to the river in total and as a percentage of the River's flow and the residual volume to be held in storage. The monthly reclaimed water produced data are derived from reclaimed water flows generated by the Water Balance Model[1] and a frequency analysis of the generated flows. The 95 percentile total annual flow was selected for use in the analysis to provide a 1/20 reliability consistent with that of the Water Balance Model. Technical Memorandum Monthly Reclaimed Water Volume Projections from the Water Balance Model (TM-WBM-8) presents a detailed explanation of the derivation of these flows. Use of the 95 percent annual reclaimed water flow provides a more conservative basis for design when used in conjunction with the monthly river flows. With a higher reclaimed water flow, the difference between an average daily flow at 95 percent and an average daily flow over the period of record to the storage/disposal system should more closely reflect peak daily values. Russian River flows used in the water balance for direct discharge are based upon hydrologic analyses performed by Dames and Moore[2].

Irrigation demands are based upon recorded 1994 data obtained from the Santa Rosa Reclamation System 1994 Annual Report (Table 1 - Irrigation Demands), plus the interim plan irrigation demands as set forth in the June 16, 1994 BPU Adopted Alternative 6 description. These demands are presented in Table 1.

For each river flow scenario, four discharge options are examined:

- Option A - Direct Discharge limited to a maximum of 20 percent of the Russian River flows between October 1 and May 15.

- Option B - Direct Discharge limited to a maximum of 20 percent of the Russian River flows between October 1 and May 15 after River flows meet or exceed 1,000 cfs.

- Option C - Direct Discharge limited to a maximum of 20 percent of the Russian River flows between October 1 and May 15 and a maximum of 1 percent at all other times.

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[1]For further information on the Water Balance Model, see Technical Memoranda "Water Balance Model - Overall Summary and Results Based upon Latest Estimate of ADWF-WBM-7."

[2] Average Annual, 10 Year High, and 10 Year Low flows are from analyses by Dames and Moore performed under Tasks 38.2 and 38.4 of this project.

This option was analyzed to determine if operation of the system year-round provides a benefit through pump and pipe size reduction and ease of operation.

- Option D - Direct Discharge limited to a maximum of 20 percent of the Russian River flows between October 1 and May 15 and a maximum of 5 percent at all other times. This option was analyzed to determine if operation of the system year-round provides a benefit through pump and pipe size reduction and ease of operation.

Other factors considered in the water balance include: eliminate the need for additional storage; minimize the range of flows discharged to the river for cost effective pipeline and pump sizing; attempt to empty storage in September. This analysis does not attempt to follow the storage curve currently in use. Storage facilities could be full much of the year, depending upon the Option used. An attempt has been made to bring storage down to a minimum of 100 MG in the month of September. Current storage capacity of the system is 1,500 million gallons.

The results of the water balance analysis are presented in Tables 2 through 7D. Conclusions and recommendations derived from these tables are presented below.

PIPELINE AND PUMP STATION SIZING

Pipeline and pump station sizing are based on the range of flows occurring for each discharge option and river flow scenario in the water balance. The maximum and minimum average daily flows are calculated from the average monthly flow for each option. The respective velocity for a range of pipe diameters is calculated. Using the Hazen-Williams equation, the unit friction loss is calculated. When this unit loss is multiplied by the pipe length the total friction loss is determined. When added to the static head on the pipeline (the difference in head between the pipeline high point elevation and the starting elevation, i.e., Delta pond), a system Total Dynamic Head (TDH) is determined. The TDH is used to determine the necessary total horsepower to pump to the discharge point from Delta pond. The piping analysis is based on the following criteria:

- Piping Material: Steel, cement mortar lined and coated
- C value: C=120
- Velocity Range: 1.5 to 7 feet per second (fps).

Table 8 presents the piping and pump station sizing analysis and results. Conclusions and recommendations derived from this table are presented below.

PRESENT WORTH COSTS

Table 8 also presents present worth costs for the recommended pipe and pump station for each discharge option. Costs for each option were determined using the following costing information:

- Pipe costs, including material costs, obtained from a local manufacturer; excavation, bedding and backfill costs were derived from Means Construction Cost Guide for 1994, updated to 1995;

- Pump station costs are from the cost curves developed by Parsons ES based on prior completed projects. Pump costs are for total installed horsepower, which is calculated as required horsepower, plus a standby pump;

- Interest, I = 8 percent;

- Interest period, n = 20 years;

- Pumping Period = 1 year; and

- Pumping 24 hours a day[3], year round, at an energy rate of 0.05837 dollars per kilowatt-hour[4] (which includes peak rates) ($/kW-hr)

There are two existing pump stations which supply irrigation water to the northern irrigation areas. Pump station locations and capacities are as follows:

- Delta Pond: Pumps - 2 @ 350 Hp, 11,000 gpm, 85 Ft. TDH; 1 @ 75 Hp, 5,000 gpm;

- Denner Ranch Road: Pumps - 3 @ 150 Hp, 2,000 gpm; 1 @ 75 Hp, 1,200 gpm.

Where possible, these pump stations with minor modifications (additional pipelines) will be utilized.

CONCLUSIONS AND RECOMMENDATIONS

A comparison of the three river flow scenarios and the four discharge options for each scenario is presented in Table 9. Several conclusions can be drawn from the results presented in this table.

- The highest percentage discharge shown in Table 9 is 10 percent on a monthly average. However, this is assuming the storage facilities are utilized on a different operating scenario than is currently used. Also, peak and minimum daily Russian River flows may vary considerably during any given month. Thus, if the daily flow discharged is kept at 26.67 MGD (the maximum flow from Table 9 for Option A), the percent of river flow could fluctuate between 5 and 20 percent from day to day. During very low flow periods a 20 percent maximum may be necessary to achieve the required discharge of reclaimed water.

[3] Pump rate based on information in Technical Memorandum P-6 dated 1 June 1995.
[4] Energy rates based on information presented in a Parsons ES analysis dated 11 April 1995 and PG&E Schedule E-20 dated 30 June 1993.

- Option A would require discharge of up to 20 percent of river flow on an average monthly basis during the period of October 1 through May 15, with no discharge during the remainder of the year. Peak flows of up to 20 percent could be expected when 20 percent of river flow is 26.67 MGD. Existing pumps at Delta pond could be used, new piping would be required.

- Option B limits discharge to the same period with the further limiting factor of discharge only after river flow exceeds 1,000 cfs. This option is not viable for the 10 Year Low Flow scenario. Based on an average monthly and average daily flow, the Russian River flow does not exceed 1,000 cfs on an average monthly basis during a 10-year low flow period and no discharge would be allowed.

- Option C requires a flow range that cannot be efficiently provided by the existing pump stations.

- Option D fulfills the demands of each scenario with low flow velocities lower than 1.5 fps. There is a possibility of deposition of solids at these low velocities which would be flushed during higher flow periods. Storage is required for Option D if a relatively uniform flow is used. Maintaining a 5 percent discharge during the irrigation season requires a lower discharge during the wet season thus requiring more storage. With pumping taking place over a longer period than Discharge Option A, and the need for additional storage, the operation is a little more complex and is thus not recommended.

Option A is recommended based on a 20 percent discharge rate, with no need for additional storage and a short period of operation. However, this Option is dependent upon regulatory approval of a 20 percent project and discharge to the Russian River from October 1 through May 15 with no minimum or a lower minimum Russian River flow (approximately 250 cfs) criteria. The existing pump station at Delta pond can be used to send water to the direct discharge site. An additional 48-inch line will run north parallel to the existing 27-inch. Prior to entering the Denner Ranch Pump Station the existing 27-inch line will be tapped and valved to allow flows from both the 27-inch and the new 48-inch line to combine in a 54-inch line to the river discharge site. Figure 1 presents a schematic of these facilities.

EXISTING SYSTEM

Currently, direct discharge outlets to the Laguna de Santa Rosa and hence to the Russian River are located throughout the system. Total capacity of the outlet structures is approximately 60 MGD. However, flow into the Laguna is limited by the same permit as the discharge to the Russian River, thus the maximum discharge would be 20 percent of the Russian River flow. The most frequently used discharge locations are at Meadowlane and Delta Ponds. There are two discharge points at Meadowlane, a baffled outlet structure with a 24-inch pipe from the ponds and a 36-inch outlet with a “stilling”-type basin and venturi meter outlet. At Delta Pond, a 24-inch open-pipe outlet is located near the Pump Station. A second outlet from Delta Pond, a 36-inch pipe, exits the pond from the west.

From the monthly water balance, Option A, the following are the maximum discharge flows and possible discharges from the existing outfalls at Meadowlane and Delta Ponds.

Month	Maximum Required Discharge Flow (MGD)	Discharge Required from Each Pond (MGD)			Maximum Equivalent Velocity (fps)
		Total	24-inch	36-inch	
Nov	25.0	12.50	3.85	8.65	1.89
Dec	25.8	12.90	3.97	8.93	1.95
Jan	25.8	12.90	3.97	8.93	1.95
Feb	24.7	12.35	3.80	8.55	1.87
Mar	25.8	12.90	3.97	8.93	1.95
Apr	26.7	13.35	4.11	9.24	2.02

Clearly, these discharge velocities are available. Therefore, the existing system is capable of discharging the projected flows. At lower flows (less than the 95 percentile used in the Water Balance), discharge can still be divided between the two ponds and between the two outlets from each pond. Another option is to discharge from a single pond and a single outlet at that pond for lower flows. Flow capacity for the 36-inch outlet at 5 fps is 22.8 MGD. Flows up to 22.8 MGD could be discharged through a single 36-inch outlet at either Delta or Meadowlane Pond. Flow capacity for the 24-inch outlet at 5 fps is 10.15 MGD. Flows up to 10.15 MGD could be discharged at a single 24-inch outlet at either pond.

PARSONS ENGINEERING SCIENCE, INC.

Client CITY OF SANTA ROSA | Job No. 723129.31011 | Sheet 1 of ____

Subject DIRECT DISCHARGE SKETCH | By JZT | Date 6/2/95

FIGURE 1 | Checked ____ | Rev. ____

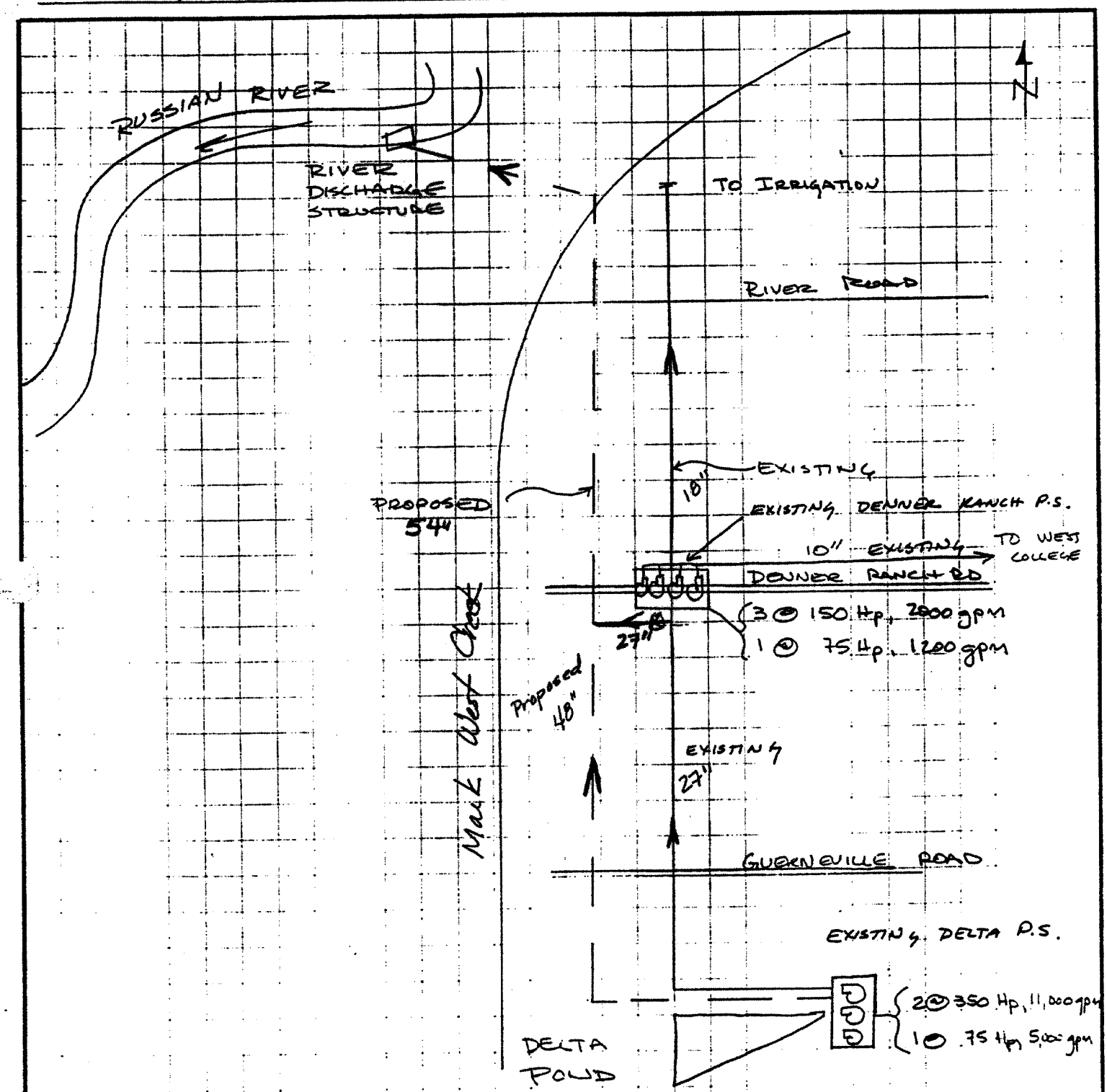

FIGURE 1.

DIRECT DISCHARGE FACILITIES SCHEMATIC

TABLE 1

CITY OF SANTA ROSA

Irrigation Demands[1]

Month	1994 Reclamation Annual Report Flows (MG/Month)	HBA June 16, 1994 Interim Irr. Demands (MG/Month)	Total Irrigation Demands (MG/Month)
O	334	55	389
N	25	4	29
D	0	0	0
J	0	0	0
F	0	0	0
M	56	9	65
A	221	36	257
M	404	66	470
J	621	102	723
J	931	153	1084
A	747	123	870
S	433	71	504
Totals	3772	620	4392

[1] Data obtained from City of Santa Rosa 1994 Annual Reclamation System Report.

TABLE 2

CITY OF SANTA ROSA

RUSSIAN RIVER STAGE-FLOW INFORMATION

10-Year Low Flows

Month	Guerneville Gage	Direct Discharge Outfall	
	Flow (cfs)	Flow (cfs)	Flow (MGD)
O	154	143	92
N	348	279	180
D	593	454	293
J	798	654	422
F	1,254	959	620
M	1,225	929	600
A	536	445	288
M	314	265	171
J	160	145	94
J	108	109	71
A	103	108	70
S	108	109	71

Notes:

1. The Direct Discharge outlet is 9.1miles upstream of the Guerville gage.

2. From analysis by Dames and Moore, Technical Memorandum No. T-2 dated December 30, 1988.

TABLE 3A

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year Low Flows - Discharge Option A

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	540	29	87	434	10.0
D	791	800	0	-9	425	8.8
J	1,007	800	0	207	632	6.1
F	881	691	0	190	822	4.0
M	966	800	65	101	923	4.3
A	783	800	257	-274	648	9.3
M	681	0	470	211	859	0.0
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from October 1 through May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow from the Subregional Reclamation Storage Table in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 2.

TABLE 3B

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year Low Flows - Discharge Option B

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	0	29	627	974	0.0
D	791	0	0	791	1,765	0.0
J	1,007	0	0	1,007	2,772	0.0
F	881	0	0	881	3,653	0.0
M	966	0	65	901	4,554	0.0
A	783	0	257	526	5,079	0.0
M	681	0	470	211	5,290	0.0
J	631	0	723	-92	5,198	0.0
J	622	0	1,084	-462	4,736	0.0
A	588	0	870	-282	4,454	0.0
S	581	0	504	77	4,531	0.0
Totals	8,823	0	4,392			

Maximum Additional Storage Needed (MG) 3,790

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from Oct. 1 through May 15 after daily flow exceeds 1,000 cfs.

(3) Assumes irrigation flow of 100% of 1994 existing flow from the Subregional Reclamation Storage Table in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 2.

TABLE 3C

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year Low Flows - Discharge Option C

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	285	389	-38	62	10.0
N	656	540	29	87	149	10.0
D	791	740	0	51	200	8.1
J	1,007	740	0	267	467	5.7
F	881	537	0	344	811	3.1
M	966	740	65	161	972	4.0
A	783	700	257	-174	797	8.1
M	681	55	470	156	953	1.0
J	631	28	723	-120	833	1.0
J	622	22	1,084	-484	349	1.0
A	588	22	870	-304	45	1.0
S	581	22	504	55	100	1.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River limited to a Maximum of 1% of Russian River flows to be discharged year round and a max. of 20% from Oct 1 to May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow from the Subregional Reclamation Storage Table in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 2.

TABLE 3D

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year Low Flows - Discharge Option D

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	142	389	105	205	5.0
N	656	540	29	87	292	10.0
D	791	650	0	141	433	7.1
J	1,007	650	0	357	790	5.0
F	881	470	0	411	1,201	2.7
M	966	650	65	251	1,452	3.5
A	783	600	257	-74	1,377	7.0
M	681	265	470	-54	1,323	5.0
J	631	140	723	-232	1,091	5.0
J	622	110	1,084	-572	519	5.0
A	588	109	870	-391	128	5.0
S	581	105	504	-28	100	5.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River limited to a Maximum of 5% of Russian River flows to be discharged year round and a max. of 20% from Oct 1 to May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow from the Subregional Reclamation Storage Table in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 2.

TABLE 4

CITY OF SANTA ROSA

RUSSIAN RIVER STAGE-FLOW INFORMATION

Average Annual Flows

Month	Guerneville Gage		Healdsburg Gage		Direct Discharge Area		
	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (MGD)
O	238	23	252	78	245	52	159
N	693	25	475	79	576	54	372
D	3,336	30	2,100	81	2,682	57	1,733
J	6,850	33	4,500	82	5,603	59	3,622
F	6,675	33	3,900	82	5,203	59	3,363
M	4,200	31	2,600	81	3,368	57	2,177
A	1,400	26	1,000	70	1,145	54	740
M	688	25	558	79	618	54	400
J	290	23	250	78	269	52	174
J	175	23	205	78	191	52	123
A	169	22	201	78	186	52	120
S	185	23	201	78	193	52	125

From analysis by Dames and Moore, 19 April 1995.

TABLE 5A

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

Average Annual Flows - Discharge Option A

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	245	389	2	102	5.0
N	656	555	29	72	174	5.0
D	791	625	0	166	340	1.2
J	1,007	625	0	382	722	0.6
F	881	540	0	341	1,063	0.6
M	966	625	65	276	1,339	0.9
A	783	625	257	-99	1,239	2.8
M	681	591	470	-380	859	4.8
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from October 1 through May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 4.

TABLE 5B

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

Average Annual Flows - Discharge Option B

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	0	29	627	974	0.0
D	791	925	0	-134	840	1.7
J	1,007	925	0	82	922	0.8
F	881	800	0	81	1,003	0.8
M	966	925	65	-24	979	1.4
A	783	856	257	-330	648	3.9
M	681	0	470	211	859	0.0
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from Oct. 1 through May 15 after daily flow exceeds 1,000 cfs.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 4.

TABLE 5C

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

Average Annual Flows - Discharge Option C

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	245	389	2	102	5.0
N	656	555	29	72	174	5.0
D	791	675	0	116	290	1.3
J	1,007	675	0	332	622	0.6
F	881	500	0	381	1,003	0.5
M	966	670	65	231	1,234	1.0
A	783	600	257	-74	1,159	2.7
M	681	349	470	-138	1,021	2.8
J	631	51	723	-143	878	1.0
J	622	37	1,084	-499	379	1.0
A	588	37	870	-319	60	1.0
S	581	37	504	40	100	1.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River limited to a Maximum of 1% of Russian River flows to be discharged year round and a max. of 20% from Oct 1 to May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 4.

TABLE 5D

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

Average Annual Flows - Discharge Option D

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	245	389	2	102	5.0
N	656	555	29	72	174	5.0
D	791	675	0	116	290	1.3
J	1,007	675	0	332	622	0.6
F	881	500	0	381	1,003	0.5
M	966	675	65	226	1,229	1.0
A	783	650	257	-124	1,104	2.9
M	681	456	470	-245	859	3.7
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River limited to a Maximum of 5% of Russian River flows to be discharged year round and a max. of 20% from Oct 1 to May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 4.

TABLE 6

CITY OF SANTA ROSA

RUSSIAN RIVER FLOW INFORMATION

10-Year High Flows

Month	Guerneville Gage		Healdsburg Gage		Direct Discharge Area		
	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (MGD)
O	420	24	364	79	390	53	252
N	2,960	29	1,850	80	2,372	56	1,533
D	11,440	37	6,300	83	8,758	61	5,661
J	13,433	39	8,775	85	11,003	63	7,112
F	13,300	39	7,425	84	10,167	63	6,571
M	9,150	35	4,900	83	6,936	60	4,483
A	5,950	33	4,050	82	4,942	59	3,194
M	1,360	26	963	79	1,150	54	743
J	526	24	435	79	478	53	309
J	242	23	245	78	244	52	157
A	228	23	251	78	240	52	155
S	253	23	256	78	255	52	165

From analysis by Dames and Moore, 19 April 1995.

TABLE 7A

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year High Flows - Discharge Option A

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	750	29	-123	224	1.6
D	791	775	0	16	240	0.4
J	1,007	775	0	232	472	0.4
F	881	606	0	275	747	0.3
M	966	775	65	126	873	0.6
A	783	750	257	-224	648	0.8
M	681	0	470	211	859	0.0
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from October 1 through May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 6.

TABLE 7B

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year High Flows - Discharge Option B

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	750	29	-123	224	1.6
D	791	775	0	16	240	0.4
J	1,007	775	0	232	472	0.4
F	881	606	0	275	747	0.3
M	966	775	65	126	873	0.6
A	783	750	257	-224	648	0.8
M	681	0	470	211	859	0.0
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from Oct. 1 through May 15 after daily flow exceeds 1,000 cfs.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 6.

TABLE 7C

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year High Flows - Discharge Option C

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	251	389	-4	96	3.2
N	656	600	29	27	123	1.3
D	791	675	0	116	239	0.4
J	1,007	675	0	332	571	0.3
F	881	490	0	391	962	0.3
M	966	675	65	226	1,188	0.5
A	783	600	257	-74	1,113	0.6
M	681	225	470	-14	1,099	1.0
J	631	90	723	-182	917	1.0
J	622	50	1,084	-512	405	1.0
A	588	50	870	-332	73	1.0
S	581	50	504	27	100	1.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River limited to a Maximum of 1% of Russian River flows to be discharged year round and a max. of 20% from Oct 1 to May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 6.

TABLE 7D

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year High Flows - Discharge Option D

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	240	389	7	107	3.1
N	656	410	29	217	324	0.9
D	791	475	0	316	640	0.3
J	1,007	475	0	532	1,172	0.2
F	881	345	0	536	1,708	0.2
M	966	475	65	426	2,134	0.3
A	783	411	257	115	2,248	0.4
M	681	410	470	-199	2,049	1.8
J	631	460	723	-552	1,497	5.0
J	622	245	1,084	-707	790	5.0
A	588	240	870	-522	268	5.0
S	581	245	504	-168	100	5.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 748

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River limited to a Maximum of 5% of Russian River flows to be discharged year round and a max. of 20% from Oct 1 to May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow as estimated from the Subregional Reclamation Storage Curve in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 6.

Table 8

SELECT ROUTES FOR TRANSMISSION LINES (TL) TO DIRECT DISCHARGE

PRELIMINARY SIZING OF PIPES AND PUMP STATION TDH

Mat'l & Installation Cost	
Pipe Dia. (in)	Pipe Cost ($/LF)
12	44
18	59
24	67
30	117
36	121
42	141
48	146
54	181
60	207

PW Factor	11.81
i (%)	7.5
n (years)	30
Pump. Period (yr)	1
Energy ($/kW-hr)	0.05837 with Peak

Pump n 0.8
Motor n 0.92
C = 120

Option	Length (Feet)	Flow (MGD)	Flow (GPM)	Flow (CFS).	Est.[1] Pipe Dia. @ V=2fps	Pipe[2] Diameter	Velocity in Pipe (fps)	Unit Loss (ft/100ft)	Hf (ft)	Static Head (ft)	TDH (ft)	Total Pump HP	Pipe Cost ($)	Pump Sta.[3,4] ($)	Construction ($)	Energy Use (kW-h/yr)	Energy Cost ($/yr)	PW Energy ($)	Total PW Cost ($)
10 Year Low Russian River Flows																			
Option A	51,500	26.67	18,519	37.88	59	30	7.72	0.759	391	90	481	3,056							
Maximum Flow						36	5.36	0.313	161	90	251	1,595							
						42	3.94	0.148	76	90	166	1,055							
						48	3.01	0.077	40	90	130	824							
						54	2.38	0.043	22	90	112	714	9,329,722	0	9,329,722	4,666,778	272,400	3,217,147	12,546,869
						60	1.93	0.026	13	90	103	657							
Option A	51,500	16.00	12,500	25.57	48	30	5.21	0.367	189	90	279	1,196							
Minimum Flow						36	3.62	0.151	78	90	168	720							
						42	2.66	0.071	37	90	127	544							
						48	2.03	0.037	19	90	109	468							
						54	1.61	0.021	11	90	101	432							
						60	1.30	0.013	6	90	96	414							
Option B	51,500	0.00	0	0.00	0	24	0.00	0.000	0	90	90	0							
Maximum Flow						30	0.00	0.000	0	90	90	0							
						36	0.00	0.000	0	90	90	0							
						42	0.00	0.000	0	90	90	0							
						48	0.00	0.000	0	90	90	0							
						54	0.00	0.000	0	90	90	0							
Option B	51,500	0.00	0	0.00	0	24	0.00	0.000	0	90	90	0							
Minimum Flow						30	0.00	0.000	0	90	90	0							
						36	0.00	0.000	0	90	90	0							
						42	0.00	0.000	0	90	90	0							
						48	0.00	0.000	0	90	90	0							
						54	0.00	0.000	0	90	90	0							
Option C	51,500	23.87	16,577	33.91	56	30	6.91	0.619	319	90	409	2,324							
Maximum Flow						36	4.80	0.255	131	90	221	1,258							
						42	3.52	0.120	62	90	152	864							
						48	2.70	0.063	32	90	122	696							
						54	2.13	0.035	18	90	108	616	9,329,722	0	9,329,722	4,023,316	234,841	2,773,564	12,103,286
						60	1.73	0.021	11	90	101	574							

Table 8

SELECT ROUTES FOR TRANSMISSION LINES (TL) TO DIRECT DISCHARGE

PRELIMINARY SIZING OF PIPES AND PUMP STATION TDH

Mat'l & Installation Cost

Pipe Dia. (in)	Pipe Cost ($/LF)
12	44
18	59
24	67
30	117
36	121
42	141
48	146
54	181
60	207

PW Factor	11.81
i (%)	7.5
n (years)	30
Pump. Period (yr)	1
Energy ($/kW-hr)	0.05837 with Peak

Pump n	0.8
Motor n	0.92

Option	Length (Feet)	Flow (MGD)	Flow (GPM)	Flow (CFS)	2 Est.[1] Pipe Dia. @ V=2fps	Pipe[2] Diameter	Velocity in Pipe (fps)	120 C=120 Unit Loss (ft/100ft)	Hf (ft)	Static Head (ft)	TDH (ft)	Total Pump HP	Pipe Cost ($)	Pump Sta.[3,4] ($)	Construction ($)	Energy Use (kW-h/yr)	Energy Cost ($/yr)	PW Energy ($)	Total PW Cost ($)
Option C	28,000	0.71	493	1.01	10	30	0.21	0.001	0	90	90	15							
Minimum Flow						36	0.14	0.000	0	90	90	15							
						42	0.10	0.000	0	90	90	15							
						48	0.08	0.000	0	90	90	15							
						54	0.06	0.000	0	90	90	15							
						60	0.05	0.000	0	90	90	15							
Option D	51,500	20.97	14,561	29.79	52	24	9.48	1.441	742	90	832	4,157							
Maximum Flow						30	6.07	0.487	251	90	341	1,702							
						36	4.21	0.200	103	90	193	965							
						42	3.10	0.095	49	90	139	693							
						48	2.37	0.049	25	90	115	577							
						54	1.87	0.028	14	90	104	521	9,329,722	0	9,329,722	3,406,944	198,863	2,348,652	11,678,375
Option D	51,500	3.52	2,442	5.00	21	24	1.59	0.053	27	90	117	98							
Minimum Flow						30	1.02	0.018	9	90	99	83							
						36	0.71	0.007	4	90	94	79							
						42	0.52	0.003	2	90	92	77							
						48	0.40	0.002	1	90	91	76							
						54	0.31	0.001	1	90	91	76							
Average Annual Russian River Flows																			
Option A	51,500	20.83	14,468	29.60	52	30	6.03	0.481	248	90	338	1,676							
Maximum Flow						36	4.19	0.198	102	90	192	953							
						42	3.08	0.094	48	90	138	686							
						48	2.36	0.049	25	90	115	572							
						54	1.86	0.028	14	90	104	517	9,329,722	0	9,329,722	3,379,598	197,267	2,329,801	11,659,523
						60	1.51	0.016	8	90	98	489							
Option A	51,500	7.90	5,488	11.23	32	30	2.29	0.080	41	90	131	247							
Minimum Flow						36	1.59	0.033	17	90	107	201							
						42	1.17	0.016	8	90	98	185							
						48	0.89	0.008	4	90	94	177							
						54	0.71	0.005	2	90	92	174							
						60	0.57	0.003	1	90	91	172							

Table 8

SELECT ROUTES FOR TRANSMISSION LINES (TL) TO DIRECT DISCHARGE

PRELIMINARY SIZING OF PIPES AND PUMP STATION TDH

														Met'l & Installation Cost					
														Pipe Dia. (in)	Pipe Cost ($/LF)				
														12	44				
														18	59				
														24	67	PW Factor	11.81		
														30	117	i (%)	7.5		
														36	121	n (years)	30		
														42	141	Pump. Period (yr)	1		
										Pump n	0.8			48	146	Energy ($/kW-hr)	0.05837	with Peak	
					2			120		Motor n	0.92			54	181				
					Est.[1]			C = 120						60	207				
Option	Length (Feet)	Flow (MGD)	Flow (GPM)	Flow (CFS)	Pipe Dia. @ V = 2fps	Pipe[2] Diameter	Velocity in Pipe (fps)	Unit Loss (ft/100ft)	Hf (ft)	Static Head (ft)	TDH (ft)	Total Pump HP	Pipe Cost ($)	Pump Sta.[3,4] ($)	Construction ($)	Energy Use (kW-h/yr)	Energy Cost ($/yr)	PW Energy ($)	Total P ($)
Option B	51,500	29.84	20,721	42.39	62	30	8.64	0.935	481	90	571	4,062							
Maximum Flow						36	6.00	0.385	198	90	288	2,049							
						42	4.41	0.182	94	90	184	1,306							
						48	3.37	0.095	49	90	139	988							
						54	2.67	0.054	28	90	118	836	9,329,722	0	9,329,722	5,462,362	318,838	3,765,601	13,0
						60	2.16	0.032	17	90	107	757							
Option B	51,500	28.57	19,841	40.59	61	30	8.27	0.863	444	90	534	3,637							
Minimum Flow						36	5.74	0.355	183	90	273	1,858							
						42	4.22	0.168	86	90	176	1,201							
						48	3.23	0.088	45	90	135	920							
						54	2.55	0.049	25	90	115	786							
						60	2.07	0.030	15	90	105	716							
Option C	51,500	21.77	15,121	30.93	53	30	6.30	0.522	269	90	359	1,861							
Maximum Flow						36	4.38	0.215	111	90	201	1,041							
						42	3.22	0.102	52	90	142	738							
						48	2.46	0.053	27	90	117	609							
						54	1.94	0.030	15	90	105	547	9,329,722	0	9,329,722	3,573,170	208,566	2,463,245	11,7
						60	1.58	0.018	9	90	99	515							
Option C	28,000	1.19	829	1.70	12	30	0.35	0.002	1	90	91	28							
Minimum Flow						36	0.24	0.001	0	90	90	26							
						42	0.18	0.000	0	90	90	26							
						48	0.13	0.000	0	90	90	26							
						54	0.11	0.000	0	90	90	26							
						60	0.09	0.000	0	90	90	26							
Option D	51,500	21.77	15,121	30.93	53	30	6.30	0.522	269	90	359	1,861							
Maximum Flow						36	4.38	0.215	111	90	201	1,041							
						42	3.22	0.102	52	90	142	738							
						48	2.46	0.053	27	90	117	609							
						54	1.94	0.030	15	90	105	547	9,329,722	0	9,329,722	3,573,170	208,566	2,463,245	11,7
						60	1.58	0.018	9	90	99	515							

Table 8

SELECT ROUTES FOR TRANSMISSION LINES (TL) TO DIRECT DISCHARGE

PRELIMINARY SIZING OF PIPES AND PUMP STATION TDH

Mat'l & Installation Cost	
Pipe Dia. (in)	Pipe Cost ($/LF)
12	44
18	59
24	67
30	117
36	121
42	141
48	146
54	181
60	207

PW Factor	11.81		
i (%)	7.5		
n (years)	30		
Pump. Period (yr)	1		
Energy ($/kW-hr)	0.05837	with Peak	

Pump n 0.8
Motor n 0.92

2 | 120 | C = 120

Option	Length (Feet)	Flow (MGD)	Flow (GPM)	Flow (CFS)	Est.[1] Pipe Dia. @ V = 2fps	Pipe[2] Diameter	Velocity in Pipe (fps)	Unit Lose (ft/100ft)	Hf (ft)	Static Head (ft)	TDH (ft)	Total Pump HP	Pipe Cost ($)	Pump Sta.[3,4] ($)	Construction ($)	Energy Use (kW-h/yr)	Energy Cost ($/yr)	PW Energy ($)	Total P ($)
Option D	51,500	7.90	5,488	11.23	32	30	2.29	0.080	41	90	131	247							
Minimum Flow						36	1.59	0.033	17	90	107	201							
						42	1.17	0.016	8	90	98	185							
						48	0.89	0.008	4	90	94	177							
						54	0.71	0.005	2	90	92	174							
						60	0.57	0.003	1	90	91	172							
10 Year High Russian River Flows																			
Option A	51,500	25.00	17,361	35.52	57	30	7.24	0.674	347	90	437	2,603							
Maximum Flow						36	5.02	0.277	143	90	233	1,387							
						42	3.69	0.131	68	90	158	938							
						48	2.83	0.068	35	90	125	746							
						54	2.23	0.039	20	90	110	654	9,329,722	0	9,329,722	4,277,000	249,648	2,948,445	12,2
						60	1.81	0.023	12	90	102	607							
Option A	51,500	21.64	15,030	30.75	53	30	6.26	0.516	266	90	356	1,834							
Minimum Flow						36	4.35	0.213	109	90	199	1,028							
						42	3.20	0.100	52	90	142	731							
						48	2.45	0.052	27	90	117	603							
						54	1.93	0.030	15	90	105	543							
						60	1.57	0.018	9	90	99	511							
Option B	51,500	25.00	17,361	35.52	57	30	7.24	0.674	347	90	437	2,603							
Maximum Flow						36	5.02	0.277	143	90	233	1,387							
						42	3.69	0.131	68	90	158	938							
						48	2.83	0.068	35	90	125	746							
						54	2.23	0.039	20	90	110	654	9,329,722	0	9,329,722	4,277,000	249,648	2,948,445	12,2
						60	1.81	0.023	12	90	102	607							
Option B	51,500	21.64	15,028	30.74	53	30	6.26	0.516	266	90	356	1,834							
Minimum Flow						36	4.35	0.212	109	90	199	1,028							
						42	3.20	0.100	52	90	142	731							
						48	2.45	0.052	27	90	117	603							
						54	1.93	0.030	15	90	105	543							
						60	1.57	0.018	9	90	99	511							

Table 8

SELECT ROUTES FOR TRANSMISSION LINES (TL) TO DIRECT DISCHARGE

PRELIMINARY SIZING OF PIPES AND PUMP STATION TDH

Met'l & Installation Cost	
Pipe Dia. (in)	Pipe Cost ($/LF)
12	44
18	59
24	67
30	117
36	121
42	141
48	146
54	181
60	207

					2			120		Pump n	0.8			PW Factor	11.81				
					Est.[1]			C = 120		Motor n	0.92			I (%)	7.5				
	Length	Flow	Flow	Flow	Pipe Dia.	Pipe[2]	Velocity in	Unit Loss	Hf	Static Head	TDH	Total Pump	Pipe Cost	Pump Sta.[3,4]	Construction	Energy Use	Energy Cost	PW Energy	Total PW Cost
Option	(Feet)	(MGD)	(GPM)	(CFS)	@ V = 2fps	Diameter	Pipe (fps)	(ft/100ft)	(ft)	(ft)	(ft)	HP	($)	($)	($)	(kW-h/yr)	($/yr)	($)	($)
Option C	51,500	21.77	15,118	30.93	53	24	9.84	1.545	796	90	886	4,593							
Maximum Flow						30	6.30	0.522	269	90	359	1,860							
						36	4.38	0.215	111	90	201	1,041							
						42	3.21	0.101	52	90	142	738							
						48	2.46	0.053	27	90	117	608							
						54	1.94	0.030	15	90	105	547	9,329,722	0	9,329,722	3,572,296	208,515	2,462,642	11,792,364
Option C	28,000	1.61	1,120	2.29	14	24	0.73	0.013	4	90	94	36							
Minimum Flow						30	0.47	0.004	1	90	91	35							
						36	0.32	0.002	0	90	90	35							
						42	0.24	0.001	0	90	90	35							
						48	0.18	0.000	0	90	90	35							
						54	0.14	0.000	0	90	90	35							
Option D	51,500	15.33	10,646	21.78	45	24	6.93	0.807	416	90	506	1,847							
Maximum Flow						30	4.44	0.273	140	90	230	842							
						36	3.08	0.112	58	90	148	540							
						42	2.26	0.053	27	90	117	429							
						48	1.73	0.028	14	90	104	381							
						54	1.37	0.016	8	90	98	358	9,329,722	0	9,329,722	2,340,233	136,599	1,613,292	10,943,014
Option D	51,500	7.74	5,376	11.00	32	24	3.50	0.228	117	90	207	383							
Minimum Flow						30	2.24	0.077	40	90	130	239							
						36	1.56	0.032	16	90	106	196							
						42	1.14	0.015	8	90	98	180							
						48	0.88	0.008	4	90	94	173							
						54	0.69	0.004	2	90	92	170							

[1] Pipe Diameter estimated based on a set pipe velocity of 2 fps.

[2] Pipe Diameter set at a commom pipe size. Velocity in the pipe at the given flow is calculated in the column to the right.

[3] Based on the conceptual design cost curves *used for the Screening Report (from ACWD/USD Water Reuse Survey)* adjusted for the San Francisco January 16, 1995 ENR cost index of 6525.

[4] Installed Hp. Assume installed Hp = calculated Hp + standby pump. (Existing PS has 3 pumps: 2@350 hp, 11,000 gpm, 85 TDH; 1@75 hp, 5,000 gpm.)

TABLE 9
Santa Rosa Subregional Long-Term Wastewater Project
Direct Discharge Comparison of Options

Option	River Flow Scenario	Highest % of River Flow	Flow Range[4] Maximum (mgd)	Flow Range[4] Minimum (mgd)	Additional Storage Required (mgy)	Pipe Diameter (in)	Pump Station (Hp)	Total Present Worth Cost[3] ($)
	10 Year High	1.6	25.00	21.64	0	54	-	12,300,000
A	Average Annual	5.0	20.83	7.90	0	54	-	11,700,000
	10 Year Low	10.0	26.67	18.00	0	54	-	12,600,000
	10 Year High	1.6	25.00	21.64	0	54	-	12,300,000
B	Average Annual	3.9	29.84	28.57	0	54	-	13,100,000
	10 Year Low[1]	0.0	0.00	0.00	3,790	-	-	-
	10 Year High[5]	3.2	21.77	1.61	0	54	-	11,800,000
C	Average Annual[5]	5.0	21.77	1.19	0	54	-	11,800,000
	10 Year Low[5]	10.0	23.87	0.71	0	54	-	12,100,000
	10 Year High[2]	5.0	15.33	7.74	0	54	-	11,000,000
D	Average Annual[2]	5.0	21.77	7.90	0	54	-	11,800,000
	10 Year Low[2]	10.0	20.97	3.52	748	54	-	11,700,000

[1] Average daily flow in the Russian River does not exceed 1,000 cfs.

[2] Pump and Pipeline design for min. and max. flows, low flow velocities are less than 1.5 fps. Existing pump facilities and pipelines are used where possible. See Figure 1.

[3] Cost includes pipe costs, energy costs, and, when indicated, new pumps including a standby pump.

[4] From Tables 3A through 7D.

[5] The low flow is too low to be accommodated by the existing pump station and piping. See Figure 1.

Appendix A

TECHNICAL MEMORANDUM

TO: File

FROM: Ronald Christensen, P.E.

DATE: 7 August, 1995

RE: Santa Rosa Subregional Long-Term Wastewater Project (Job No. 723129)
Design of the Russian River Outlet for the Direct Discharge Alternative to the Russian River

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This memorandum documents the proposed design for an outlet for direct discharge of treated wastewater to the Russian River. The major design criteria are presented along with the suggested design.

DESIGN CRITERIA

1. The outlet must be designed to withstand major flooding events and must be protected from erosion. The outlet was sited on the Russian River along a reach with relatively stable banks and where the direction of river flow is parallel to the bank so that there is a minimal tendency for bank erosion. The limits of the flood plain were determined from previously prepared flood plain maps (by others) for the purpose of evaluating possible rapid infiltration basins for treated wastewater. The Russian River can have substantial increases of flow during floods. The flood plain of the river extends from its normal banks across the lower lying river bottom lands a distance of several thousand feet to the edge of the hills on each side of the river valley. Thus, the outlet must be designed for submergence and capable of withstanding increased scouring velocities during floods.

2. Foaming at the Russian River discharge outlet is considered to be a potential problem. Discussion with Tuck Vath of the Regional Water Control Board staff indicated that the community of Windsor was having problems with foaming at their wastewater outfall, located upstream on the Russian River. He indicated that entrained air may be the cause of foaming. Discussion with Randy Piazza at the Santa Rosa Laguna Wastewater Plant indicated that foaming has occurred at the Laguna Plant's baffled outlet structure, located on one of the ponds across from the plant which discharges into Laguna de Santa Rosa Creek. Randy indicated that the pumping of the water from the pond and the turbulence at the baffled outlet was causing the foaming. He indicated that the presence of nitrates and phosphates in the discharge water contributed to the problem. He indicated the new modifications that reduce nitrates and phosphates in the water in the treatment plant should decrease the problem. Regardless, it appears prudent to design the outlet to prevent air from becoming entrained into the discharge water and reduce turbulence to prevent foaming.

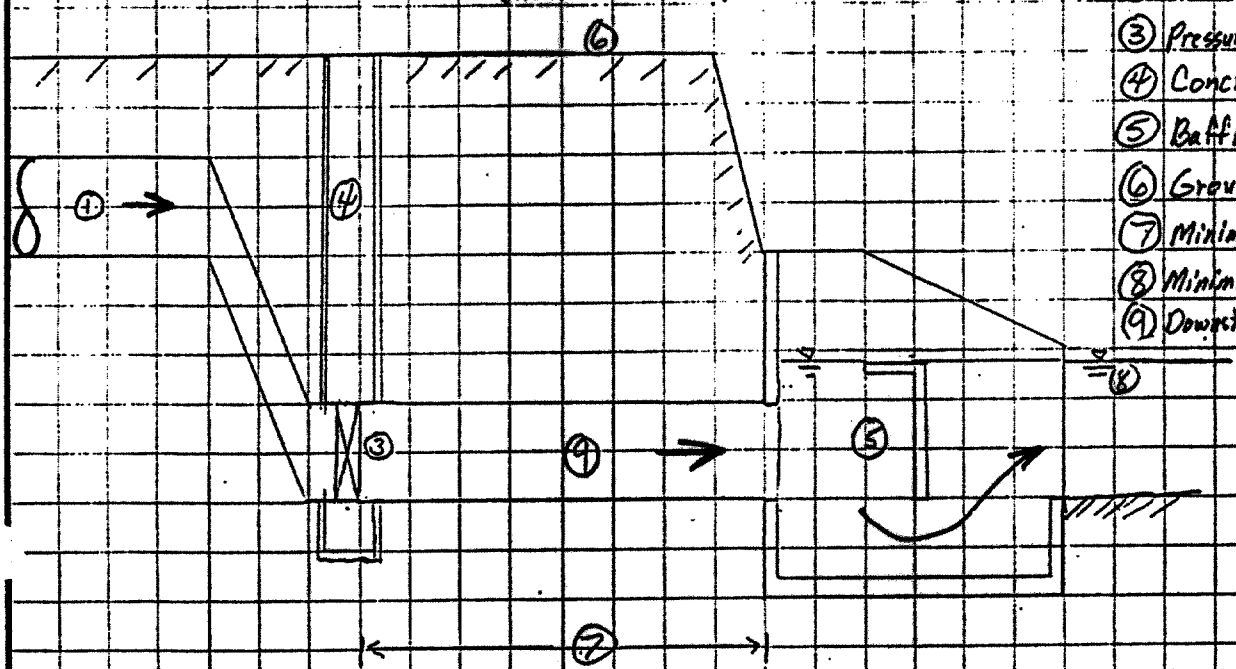
3. The discharge pipeline will have a high point in its profile (approximate elevation 170 feet) between 7000 and 8000 feet upstream of the discharge outlet. The discharge into the Russian River will be at about elevation 45 feet. Thus, the head from the high point in the profile to the outlet will be approximately 125 feet. Uncontrolled open channel flow will occur, creating a vacuum in the pipe. Installation of an air/vacuum valve would solve this problem, but would be noisy and would allow air to become entrained in the water. Installation of a concrete box at the high point and design of the pipeline from the box to the river for open channel flow with a stand pipe allowing air to enter the pipe just downstream of the box would also solve the vacuum problem, but again would be noisy and would again have a tendency to entrain air. It appears that downstream control at the outlet is the only viable option to prevent air entrainment. A pressure sustaining valve installation that sustains upstream pressure to just above elevation 170 feet would appear to be the best solution. The valve system would be designed to keep the last section of the pipeline full and thereby protect the pipeline from erosion damage and prevent air from being sucked into the pipeline at the high point. The valve would release water into the outlet at pressures equivalent to that at the river.

4. The discharge outlet box needs to blend as much as possible with the surroundings. To accomplish this, suitable vegetation such as native bushes and brush should be planted on the slopes and adjacent to the outlet box that will grow and shield the box from view.

DESIGN

The suggested conceptual design is shown on the following sheets. It consists of a valve box set some 40 feet back from the river outlet, with two 24-inch valves set to sustain upstream pressure above elevation 170 feet. The outlet pipe leading from the valve box discharges at a velocity of less than 2.5 fps into a concrete baffled outlet box approximately 8.5 feet in width and approximately 9 feet in depth. The outlet box would be recessed into the bank and set facing downstream at an angle of approximately 45 to 60 degrees. The top of the outlet pipe as it comes into the outlet box would be set below the normal low water surface elevation to prevent mixing of air into the water downstream of the valves. This design should provide for the least disturbance of flow discharging to the Russian River and should prevent foaming, while also protecting the upstream pipeline from vacuum conditions. Proper design of the installation would allow it to function during submergence. The recessing of the outlet box into the bank at an angle, with possibly some large cobble riprap surrounding the box, should protect the box from erosion during high river flows.

Conceptual Design
Cross Section
(not to scale)



① Incoming pipe
② Valve box (see note 2)
③ Pressure sustaining valves
④ Concrete valve vault
⑤ Baffled outlet (see detail)
⑥ Ground profile
⑦ Minimum of 40' distance
⑧ Minimum water surface
⑨ Downstream pipe (see note 1)

notes: 2. The pipe downstream of the valve should be sized, if possible, for a maximum velocity of 2.0 ft/s at design flow to provide cleaning velocity w/ minimum turbulence.

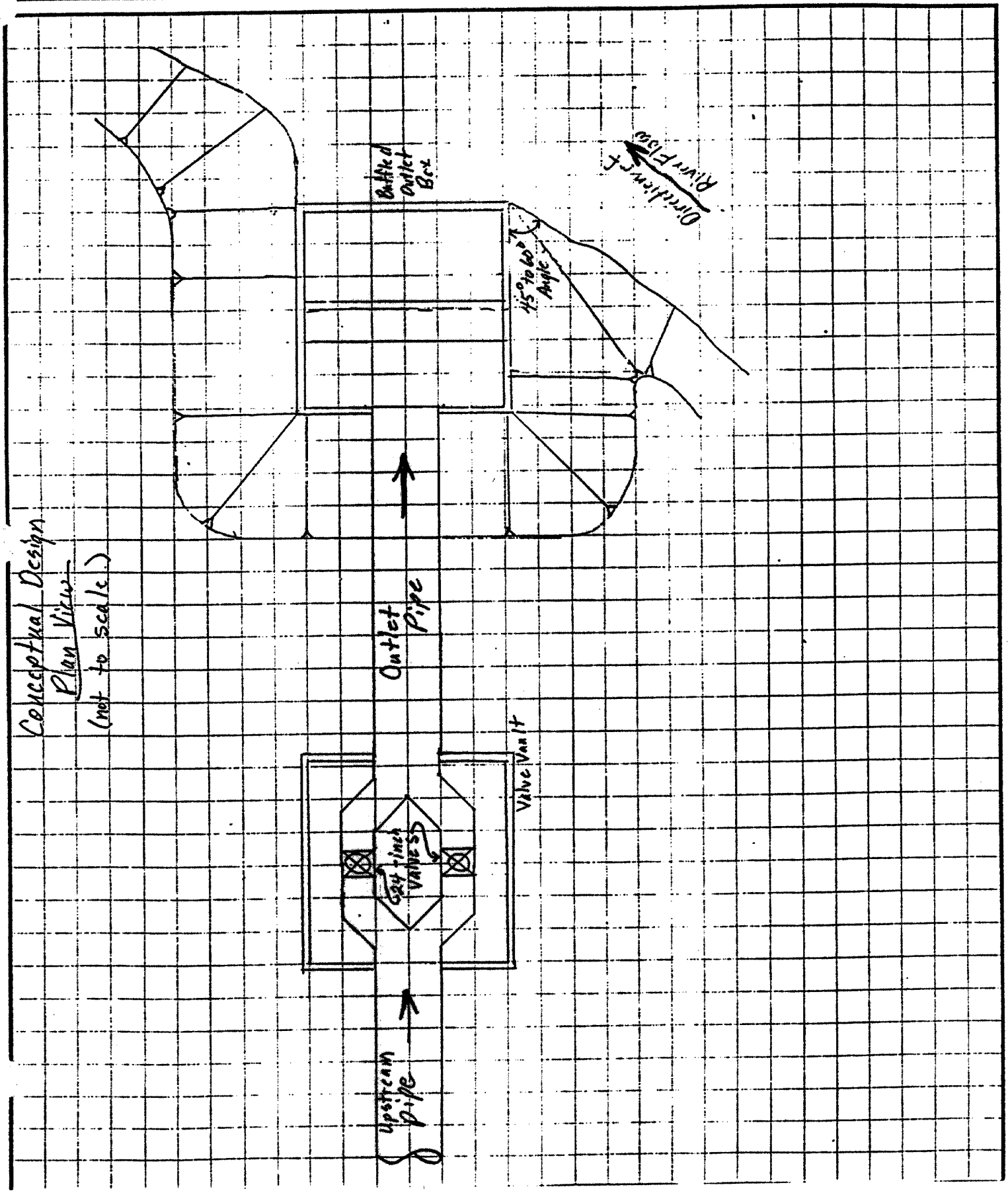
3. The pressure sustaining valves should be set to maintain an upstream pressure of elev. 170' to protect the upstream pipeline from negative pressures at the high point of the line.

PARSONS ENGINEERING SCIENCE, INC.

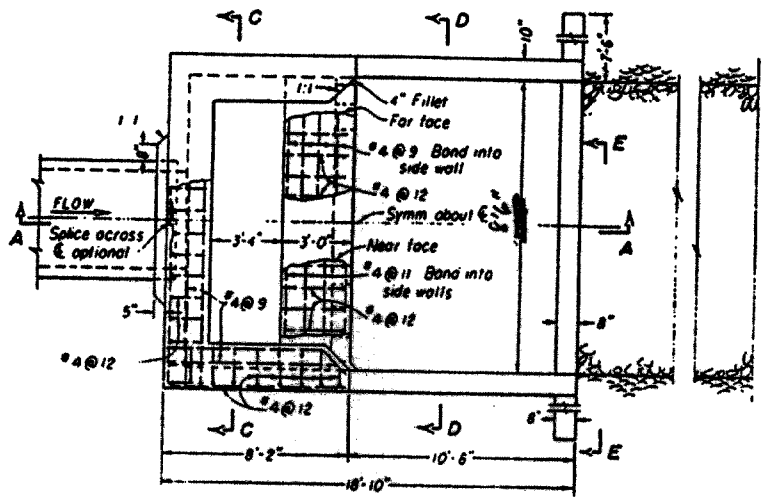
Client _____ Job No. _____ Sheet 4 of 5

Subject _____ By _____ Date _____

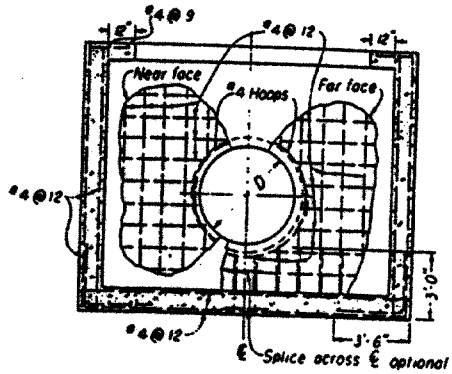
_____ Checked _____ Rev. _____



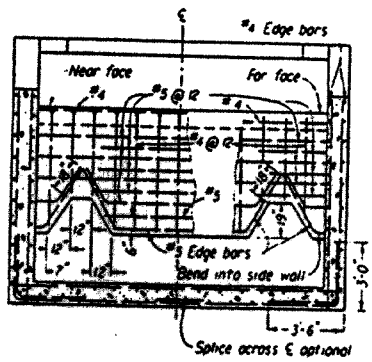
Conceptual Design
Plan View
(not to scale)



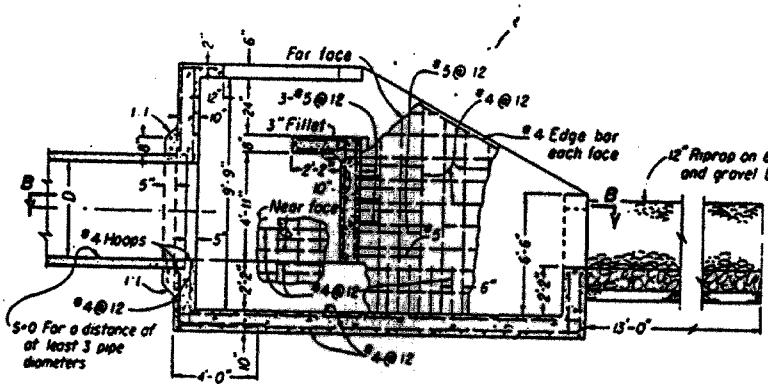
PLAN



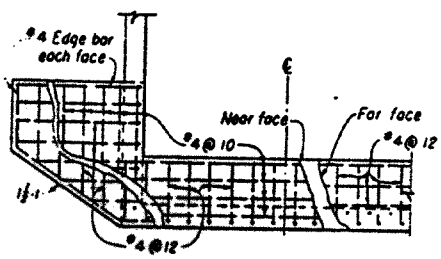
SECTION C-C



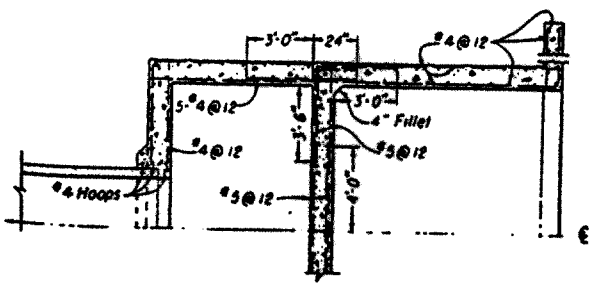
SECTION D-D



SECTION A-A



ELEVATION E-E



SECTION B-B

ESTIMATED QUANTITIES

Concrete	29.6 Cu Yds
Reinforcement Steel	2,790 Lbs

Figure 6-19. **Type 9 baffled outlet. 103-D-1348**