CITY of MODESTO

Domestic Wastewater

# Near Term Capacity Study

## Final

March 2006

carollo engineers

City of Modesto
Wastewater Treatment Master Plan
Jennings Road Secondary Treatment Facility

# DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY

**FINAL**

March 2006


March 21, 2006

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City of Modesto
Wastewater Treatment Master Plan
Jennings Road Secondary Treatment Facility

# DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY

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# DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY

## 1.0 INTRODUCTION

A program to provide long-term wastewater treatment and disposal capacity at the Jennings Road Secondary Treatment Facility for future growth is being developed under the Wastewater Master Plan. Allowing for planning, permitting, design, and construction, it is anticipated that the first phase of the long-term project will not be fully implemented until 2011. Furthermore, the City expects additional residential and commercial development will be occurring in the near term. Whereas wastewater treatment capability is adequate, the Jennings Road facility is operating at its rated disposal capacity, depending on climatic conditions and flows in the San Joaquin River. The purpose of this study is to evaluate disposal alternatives to safely accommodate domestic wastewater contributions from the projected near term development.

A recent analysis performed by the City of Modesto (City), indicates that there are approximately 7,728 equivalent dwelling units (EDUs) currently in process with development rights. Additionally, the City anticipates that development entitlement will be sought for an additional 5,000 new EDUs over the next five years (from 2006 to 2011). Accordingly, a total of 12,728 additional EDUs are projected through 2011. It is estimated that a wastewater flow of 3.7 million gallons per day (mgd) will be generated by the projected development.

The available capacity of the City's effluent disposal system at the Jennings Road facility depends on climatic conditions and river flows. Under the conditions of the lowest 10th percentile river flow (i.e., a 10 percent chance of occurring in any year) and average rainfall, the total existing effluent disposal system has a rated average annual capacity of 28.2 mgd. Of this amount, the annual average flow capacity utilized by segregated process water from industry has been as high as 4 mgd. As a consequence, available domestic wastewater disposal capacity is 24.2 mgd under low flow river conditions. Current (2005) average daily domestic flows to the Jennings Road facility are 25.8 mgd. The combined domestic (exclusive segregated industrial process water) effluent disposal capacity requirements through 2011 are estimated to be 29.5 mgd. As a consequence, the City has a domestic wastewater capacity need of up to 5.3 mgd at year 2011.

Flow contributions to the disposal system greater than available capacity will result in one or more of the following conditions:

- Land application in excess of required agronomic rates.
- Storage volumes and resultant freeboard in violation of current waste discharge requirements.
- Non-permitted overflows from storage reservoirs and/or irrigation areas.

- Discharge to the San Joaquin River in violation of required dilution and/or allowed discharge period.

Exceeding any of the above conditions could result in fines from regulatory agencies. Discharges to the river or the land are regulated by the Central Valley Regional Water Quality Control Board (RWQCB). Storage pond levels are regulated by the State Division of Dam Safety (Dam Safety). Depending on the violation, some exceedances would result in minimum mandatory fines of $3,000 per occurrence. Other violations are at the discretion of the agency. Continued violations would lead to an administrative order to cease the violations. A mandatory compliance date, with automatic fines for each day after the compliance date, would be included in the order. In extreme cases, failure to comply with an administrative order in a reasonable time could lead to criminal proceedings, civil liabilities, or restrictions of building permits. In the case of the ponds, excessively high pond levels would increase the risk of a levee failure.

# 2.0 CURRENT EFFLUENT DISPOSAL CAPACITY

The City disposes of secondary treated effluent in two ways: by beneficial irrigation of City-owned land, and by discharging flow to the San Joaquin River. The amount of water which can be applied to the irrigation area is dictated by agronomic conditions and required farming operations. There are several constraints in disposing of the treated effluent to the river.

Per the City's current National Pollution Discharge Elimination System (NPDES) permit, discharges to the river are only allowed from October through May. The permit also requires that a minimum dilution of 20:1 (river flow to effluent flow) be maintained during the river discharge period. The volume of effluent that can be discharged is also affected by effluent quality. Algae blooms occur in the effluent storage reservoirs in October and November. The algae generates high suspended solids concentrations that typically exceed discharge limits. As a consequence, discharges to the river in these months are normally not possible.

Excess flows that cannot be discharged to the river or used for irrigation must be stored. The NPDES permit and the State Division of Dam Safety permit contain maximum operating levels for the storage reservoirs.

The estimate of current effluent disposal capacity is based on the following assumptions:

- River flows are at the lowest 10th percentile, based on river flow data from 1996 to the present. Previous studies (the Ranch Utilization Study and the March 2005 Wastewater Treatment CIP Study) used flow data from 1985 to 1994 to establish a frequency distribution of flows. However, the flow management practices of the San Joaquin River and the Merced River (which is a major tributary to the San Joaquin) have changed since 1996. See Section 4 for a more detailed discussion of the river management changes. As a result of the new river management practices, the previous river flow data from before 1996 are not an accurate predictor for future flow

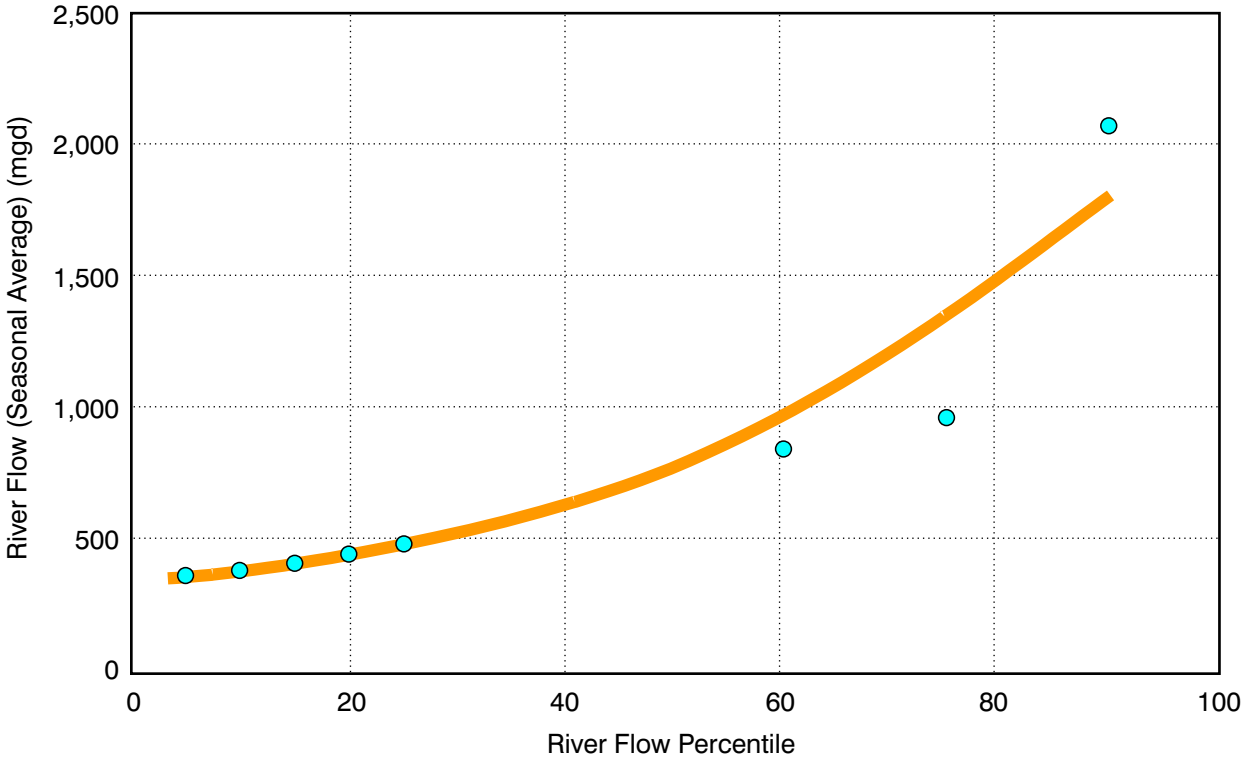
conditions. Accordingly, river flow data (at Patterson, Main Street Bridge) from 1996 to 2005 were used for this study. Although the data are limited, they provide a rough basis for predicting future flows. Average seasonal (October through May) river flows under various return frequency assumptions are shown in Figure 1.

- The City will continue operation without the 20 percent contingency used to set the river discharge flow to achieve the 20:1 dilution permit requirement. This procedure had been followed in previous years but was discontinued in the fall of 2005. Previously, City operators applied a 20 percent contingency (i.e., reduced allowable river discharges of effluent by 20 percent), because the permit wording was interpreted to mean that the 20:1 dilution requirement applied to instantaneous river flows. The City's discharge facilities cannot react fast enough to respond to instantaneous river flows fluctuations, so a contingency was applied by the City to account for deviations from the dilution target value. The City's recent interpretation is that the 20:1 dilution requirement applies to daily flow totals instead of instantaneous flows. On a daily flow basis, the effluent discharge system can control the river discharge flow close to the target dilution factor, thus eliminating the need to maintain a 20 percent contingency. This has been demonstrated successfully during the most recent year's discharge season.
- The land application rate for new land will be 6 feet/year (ft/yr), including rainfall. The City was able to safely irrigate in 2005 at the rate of 6 ft/year compared to a more typical rate of 5ft/yr, while meeting regulatory requirements.
- All of the City's 2,526 acres will be used for irrigation.
- Segregated cannery process water will have an average annual capacity requirement of 4 mgd (1,460 million gallons [MG] discharged over the period of July through September). Average annual segregated cannery wastewater flow in 2005 was 3.6 mgd.
- Current Waste Discharge Requirements (WDRs) which regulate the application of wastewater to land will remain in effect.

The current total domestic wastewater discharge capacity is estimated to be 24.2 mgd at the 10th percentile river flow. Effluent disposal capacity consists of the following parts (see Figure 2):

- Secondary effluent to land (for irrigation) = 8.1 mgd.
- Net losses from evaporation and rainfall = 5.9 mgd.
- Discharge to river with 20:1 dilution = 10.2 mgd.

It should be noted that the City has recently completed the design of a project to add dissolved air flotation (DAF) to remove algae in October and November. This would add an additional 3.0 mgd of disposal capacity during a 10th percentile year. With DAFs, the total domestic wastewater disposal capacity would be 27.2 mgd.




Notes:
1) Represents river flows since flow management practices changed (years 1996-2005)

**Figure 1**
**FREQUENCY-DISTRIBUTION PLOT FOR**
**SAN JOAQUIN RIVER FLOWS AT PATTERSON**
DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY
CITY OF MODESTO



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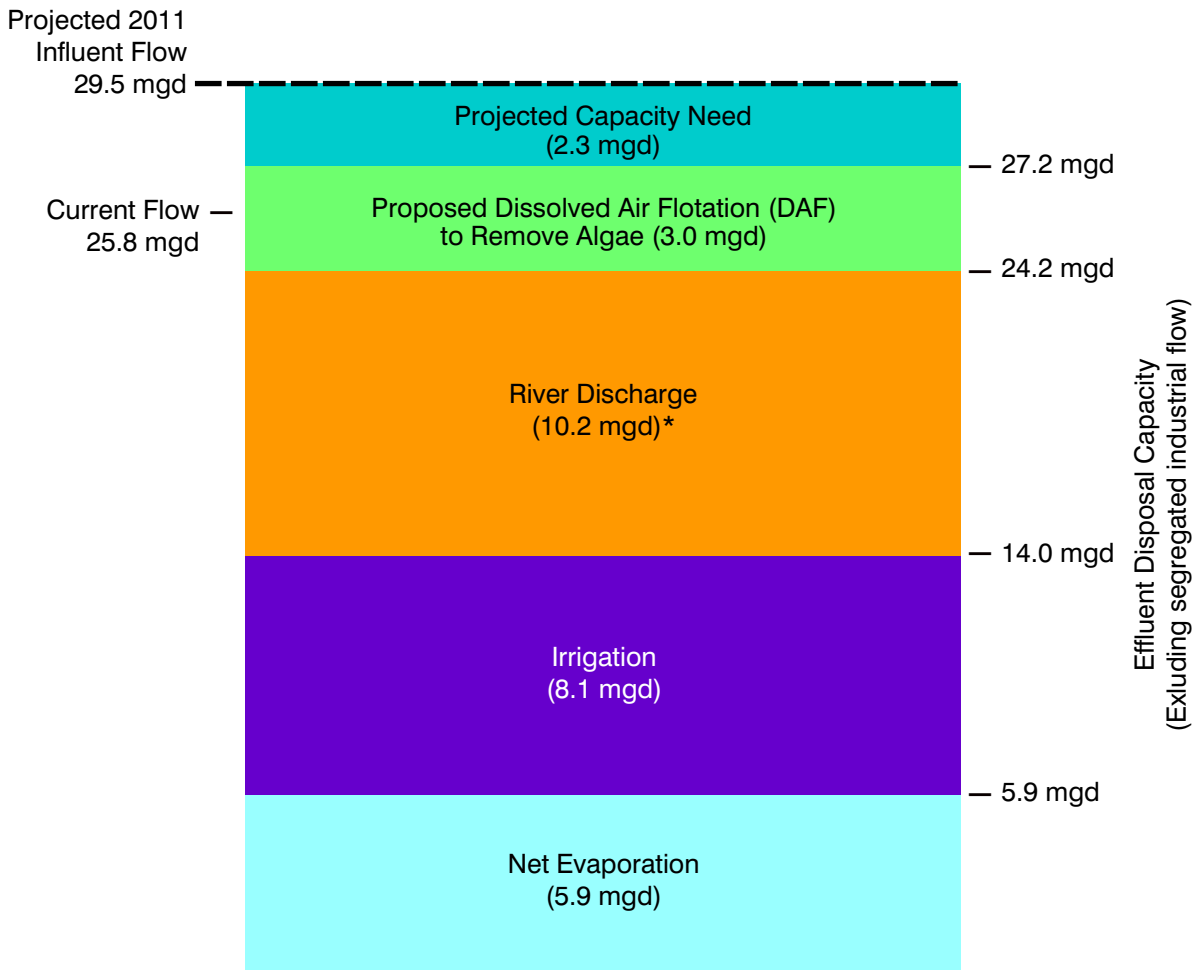


*Based on 10th percentile river flow conditions.

**Figure 2**
**AVAILABLE DOMESTIC EFFLUENT DISPOSAL CAPACITY**
DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY
CITY OF MODESTO



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## 3.0 EFFLUENT DISPOSAL CAPACITY NEEDS (2006 - 2011)

Based on the City's estimate of 290 gallons per day (gpd) per EDU, the projected increase in average dry weather flow (ADWF) from 12,728 EDUs is approximately 3.7 mgd. The current annual average domestic influent flow to the Jennings Road facility is 25.8 mgd. Adding the additional flow from the projected development results in a 2011 capacity requirement of 29.5 mgd, (25.8 mgd + 3.7 mgd). With the DAFs online, the additional effluent disposal capacity required would be 2.3 mgd (29.5 mgd - 27.2 mgd).

As stated previously, the effluent disposal system at Jennings Road is dependent upon river flow conditions and resultant ability to maintain a 20:1 dilution during the allowable discharge period. Consequently, effluent disposal requirements are highly dependent upon river flow assumptions. As noted herein, the capacity deficit assumes the 10th percentile river flow condition. Table 1 summarizes the effluent disposal capacity under varying river flow assumptions with and without the implementation of the DAF project. As indicated, there would be sufficient capacity in the near term should river flows exceed the 25th percentile and the DAF project is constructed. Without the DAFs, river flow would need to be between the 40th and 50th percentile. It should be noted that river flow data corresponding to current river flow control methodology are extremely limited.

## 4.0 SAN JOAQUIN RIVER FLOW CONTROLS

Various upstream flow controls and system operating methodologies based on hydrologic conditions impact the flow in the San Joaquin River. Friant Dam in Fresno County controls the San Joaquin River and most of the water from the resulting Millerton Lake is diverted southward to the Fresno area. The Merced River joins the San Joaquin River upstream of Patterson. Other tributaries that contribute to the flows at Patterson include the Mud and Salt Sloughs and minor agricultural drains. The San Joaquin Valley Project Area and Vicinity is shown in Figure 3.

Based on recent data and operating conditions, the Merced River contributes from 45 to 52 percent of the water that flows in the San Joaquin River at Patterson. The San Joaquin River, as measured by Friant Dam releases, contributes only 5 to 23 percent of the flow that reaches Patterson. The remaining contributions come from the sloughs and agricultural drains, as previously described.

The New Exchequer Dam in Merced County controls the Merced River. Most of the water from the Merced that would normally flow to the San Joaquin is diverted for agricultural and other uses. The pattern of the mean monthly Merced River losses of water due to diversions is illustrated in Appendix A.

As shown in Appendix A, in the drier year of 2003, there was less flow in the Merced River, however the diversions remained relatively the same as 2000. Therefore, it is evident that in dry years the remaining flow from Merced River that reaches the San Joaquin River at

**Table 1 Projected Effluent Disposal Capacity for Varying River Flow Assumptions**
**Domestic Wastewater Near Term Capacity Study**
**City of Modesto**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 5=2+3+4 | | 7=5+6 | | 9=7-8 | | 11=5-10 | 12=7-10 |
| River Flow Percentile | Allowable Effluent Discharge to River (without DAFs)[1] mgd | Secondary Effluent to Land mgd | Net Losses from Evaporation/ Rainfall mgd | Current Total Effluent Disposal Capacity Without DAFs | Additional Effluent Discharge Capacity from DAFs[2] mgd | Total Effluent Disposal Capacity with DAFs mgd | Current Influent Flow to Jennings Road mgd | Available Additional Capacity with DAF mgd | Required 2011 Capacity mgd | Effluent Disposal Capacity Need (without DAFs) mgd | Effluent Disposal Capacity Need (with DAFs) mgd |
| 10 | 10.2 | 8.1 | 5.9 | 24.2 | 3.0 | 27.2 | 25.8 | 1.4 | 29.5 | (5.3) | (2.3) |
| 25 | 12.6 | 8.1 | 5.9 | 26.6 | 3.4 | 30.0 | 25.8 | 4.2 | 29.5 | (2.9) | 0.5 |
| 50 | 21.2 | 8.1 | 5.9 | 35.2 | 4.5 | 39.7 | 25.8 | 13.9 | 29.5 | 5.7 | 10.2 |
| 60 | 23.3 | 8.1 | 5.9 | 37.3 | 4.8 | 42.1 | 25.8 | 16.3 | 29.5 | 7.8 | 12.6 |
| 75 | 26.8 | 8.1 | 5.9 | 40.8 | 5.1 | 45.9 | 25.8 | 20.1 | 29.5 | 11.3 | 16.4 |
| 90 | 62.2 | 8.1 | 5.9 | 76.2 | 5.7 | 81.9 | 25.8 | 56.5 | 29.5 | 46.7 | 52.8 |

Notes:

(1) Refer to Appendix B for derivation of allowable effluent discharges to river.

(2) Dissolved air flotation for algae removal.

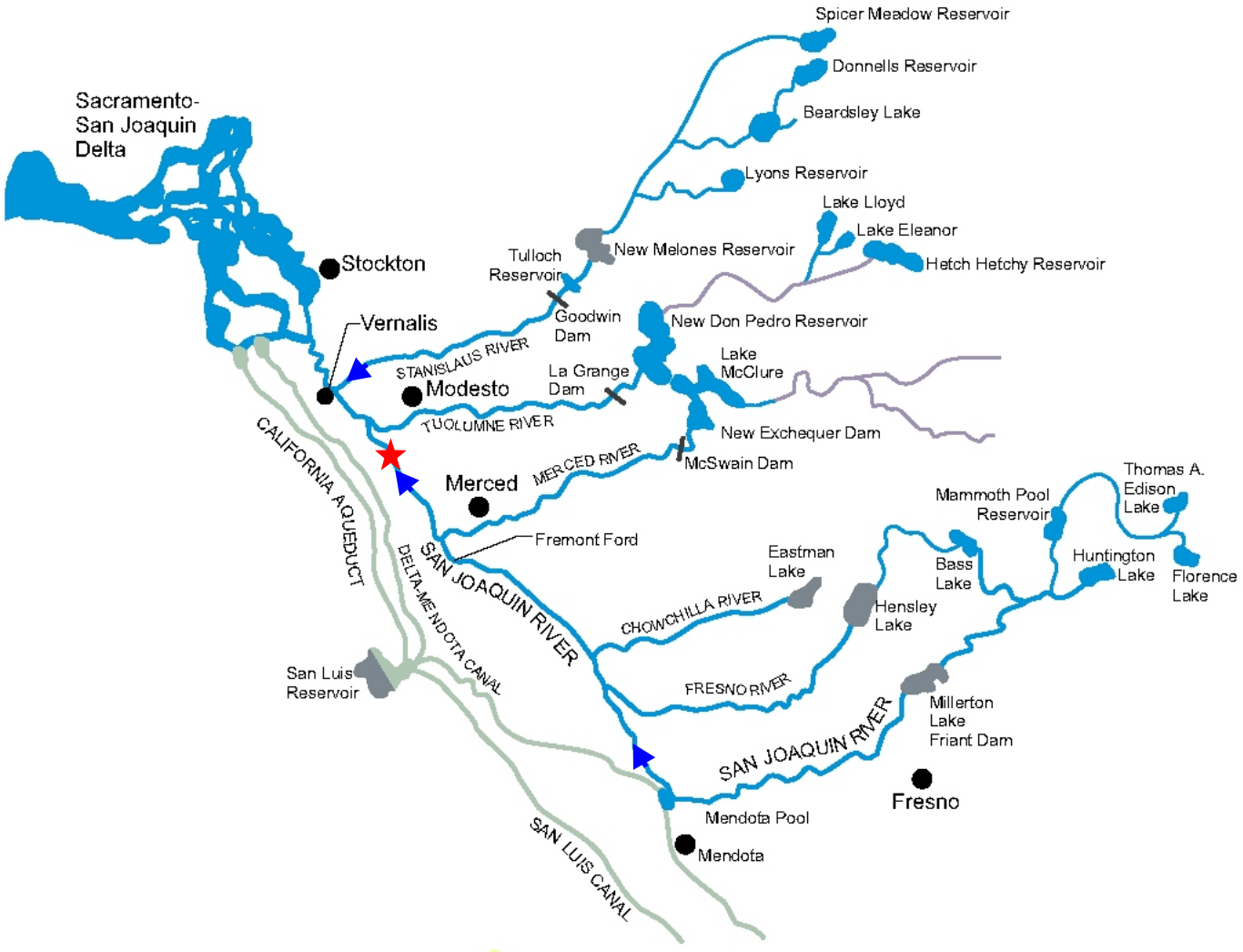


**Figure 3**
**MAP OF SAN JOAQUIN VALLEY**
**PROJECT AREA AND VICINITY**
DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY
CITY OF MODESTO



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Patterson will be lower. Furthermore, in 2003, the drier year, diversions over shadow the gains in flow from tributaries during the months of February, March, and December, as opposed to the opposite pattern seen in the year 2000. This translates to reduced stream flows reaching Patterson in those months.

Recently, river management practices changed as a result of environmental concerns. In the 1998, an agreement was reached with major stakeholders to provide a level of protection to the San Joaquin River to satisfy flow objectives contained in the State Water Resources Control Board (SWRCB) 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta. The stakeholders in the plan included California State agencies (CDWR, CDFG), Federal agencies (USBR, USFWS), San Joaquin River Group parties (SJRGA and other member agencies), Central Valley Project/State Water Project export interests, and environmental community groups. This agreement, called the San Joaquin River Agreement (SJRA), has had and will continue to have a significant impact on the flow of San Joaquin River and its tributaries. A key part of this agreement is the Vernalis Adaptive Management Plan (VAMP), which is designed to protect juvenile Chinook salmon migrating from the San Joaquin River through the Sacramento-San Joaquin Delta.

As a part of the VAMP, “pulse flows” to protect salmon runs are released in October and May. Although the magnitudes of the pulses change annually in response to hydrologic and biologic conditions, pulse flows have been observed at the lower San Joaquin River, including near Patterson, since 2000. The SJRA expires in year 2010, and it is unknown if the agreement will be renewed.

In conclusion, river flows are expected to be slightly higher than in the past due to the San Joaquin River Agreement, which includes a requirement for releasing pulse-flows during fall and spring for salmon spawning and smolt return. Most of the flow that reaches the San Joaquin at Patterson will continue to come from the Merced River. Flow releases to the Merced will likely continue to be operated with the priority to supply agricultural uses. In dry years, the City can expect less flow at Patterson as agricultural diversions receive higher priority. Even if a certain year has average or above average rainfall, and the preceding year or years had below average rainfall, the flow releases could be controlled to retain storage in upstream reservoirs. Under these conditions, a year with average rainfall could yield low river flows consistent with a dry year. A similar pattern occurred in the years 2000 to 2004 (see Appendix C) in which river flows were near the lowest 10th percentile although rainfall was not abnormally low. In addition, droughts have occurred in roughly every 10 to 15 years since 1913 (See Appendix D). Accordingly, it would be prudent to be conservative in predicting river flows, and the corresponding allowable effluent discharges to the river.

# 5.0 ALTERNATIVES FOR NEAR TERM CAPACITY INCREASES

Six alternatives for meeting projected 2011 domestic wastewater effluent disposal capacity needs of 2.3 mgd were considered. The alternatives, and their advantages and disadvantages, are summarized in Table 2. All alternatives assume that segregated cannery process water will have an average annual capacity requirement of 4 mgd (1,460 MG discharged over the period of July through September).

**Alternative 1 - Additional Land with DAF**

Alternative 1 entails the acquisition of a minimum of 477 acres of additional land to increase the capacity by 2.3 mgd through beneficial reuse. The additional land area would provide a dual purpose of not only providing for additional domestic disposal capacity, but also accommodating modest canning process flow BOD loadings in excess of current permitted conditions. An additional 3 mgd of capacity would be achieved by installation of DAFs to remove algae and restore the capability to discharge during October and November. The DAF project has already been designed and is being reviewed by the City. If implemented, the DAF project should be reviewed to verify that it would be consistent with long-term disposal recommendations contained in the Wastewater Master Plan - Phase 2. The disadvantage of this alternative is that it would include the re-opening of the existing WDRs. The re-opening of these requirements is anticipated to be contentious and time consuming.

**Alternative 2 - Tertiary Treatment/Year Round with DAF**

Alternative 2 consists of adding 2.3 mgd of tertiary treatment for year round discharge and construction of the DAF project for a total additional capacity of 5.3 mgd. The existing secondary treatment system and river discharge during October through May would continue consistent with current practices. The tertiary facilities would treat storage reservoir effluent to California Title 22 standards. New tertiary treatment units would consist of nitrification facilities, a coagulation/flocculation chamber, cloth disk filters or continuously back washed sand filters, and a new disinfection system. No additional land would be required under this alternative. The size of these facilities would be small enough to allow the installation of some skid-mounted equipment. This has the possible advantage of reduced implementation time. The corresponding disadvantage is that some facilities may not be easily incorporated into long-term system improvements. Revisions to the City's current NPDES permit would be necessary for year round discharges to the river. These revisions would be incorporated into the NPDES permit update currently underway.

**Alternative 3 - Increased River Flow**

Alternative 3 involves the acquisition of water rights and/or transfers to provide for increased flow in the San Joaquin River during low flow or drought conditions. The added augmentation in river flows would allow a corresponding increase in the volume of secondary effluent which can be discharged within the 20:1 dilution requirement. An

**Table 2 Alternatives to Provide Near Term Effluent Disposal Capacity**
**Domestic Wastewater Near Term Capacity Study**
**City of Modesto**

| Alternative | Description | Requirements | Pros | Cons |
|---|---|---|---|---|
| 1 | Additional land for disposal of secondary effluent | 477 acres of additional land<br>DAFs for algae removal | Land may be acquired in a relatively short time if there are willing sellers<br>Consistent with current NPDES permit<br>City has already completed CEQA for land acquisition<br>Provides additional land for cannery process flows | Will reopen the provisions of the existing WDRs.<br>May require lengthy land acquisition process if land owners are not willing to sell |
| 2 | Tertiary treatment - discharge to river year round | 2.3 mgd tertiary facility at Jennings Road<br>DAFs for algae removal<br>Additional Disinfection | Eliminates land acquisition issues<br>Eliminates need to re-open WDRs | Will require modifications to NPDES permit<br>Does not provide additional land for cannery process flows.<br>Integration into future facilities will be more costly. |
| 3 | Increased river flow | Purchase of water rights, DAFs for algae removal | No permit revisions required | Requires complex agreements<br>Will not produce land or treatment facility that could be used in future (other than DAFs). |
| 4 | Revise NPDES permit | No structural. | No construction cost. | Anti backsliding requires legal, consulting.<br>Regional Board indicated this approach would not be acceptable without additional treatment |
| 5 | DAF only | DAF for algae removal | Low cost<br>No permit revisions required | Increased exposure to risk of exceeding capacity |
| 6 | No Project | | No Cost | Highest exposure to risk of exceeding capacity |

additional 51,000 acre-feet of river flow augmentation would be required during the discharge period of October through May, assuming the DAFs are constructed, and the river flows are at their lowest 10th percentile. River flow augmentation requirements would vary depending on hydrologic conditions. No augmentation would be required if average discharge season river flow exceeds 720 cubic feet per second (cfs) or 465 mgd. This is slightly less than the 25th percentile flow condition. If feasible, this alternative has the advantage of not requiring an amendment to the existing WDRs or NPDES permit.

Preliminary inquiries indicate that although complex, water transactions such as that which would be required for this alternative do occur on the San Joaquin River system. Reportedly, these arrangements have been made in the past at a cost in the range of $60 to $100 per acre-foot. Indications are that the current cost may be as high as $100 to $200 per acre-foot. Detailed evaluations and associated negotiations will be required to verify availability, cost, and conditions associated with acquisition of required water rights and transfers. For the purpose of this analysis, it has been assumed that a total of 102,000 acre-feet (51,000 acre-feet for 2 years) would be purchased over the period of 2006 to 2011.

**Alternative 4 - Revise Permit Requirements**

Alternative 4 would seek to revise current NPDES permit requirements to allow less than a 20:1 dilution and/or eliminate the time constraints associated with river discharge. The time to prepare studies to demonstrate that the City is not impacting the river would be excessive. In addition, downstream water purveyors may block any changes unless the effluent was treated to tertiary standards. Regional Board staff has indicated they and other agencies would oppose any change to the existing permit for the discharge of secondary effluent. It is not considered feasible to implement this alternative.

**Alternative 5 - DAF Only**

With this alternative, the City would construct DAF facilities, but no other capacity improvements. Accordingly, the City would be exposed to a capacity deficit in 2011 of 2.3 mgd for a 10th percentile river flow. The projected capacity deficit would be zero at the 25th percentile river flow. Thus, under this alternative, the City's risk of exceeding its effluent disposal capacity would be 25 percent for any year at the end of the five-year interim period.

**Alternative 6 - No Project**

As the name implies, this alternative would not provide any new facilities to increase domestic effluent disposal capacity in the near term. River flows would need to be between the 40th and 50th percentile to provide for adequate capacity for the projected 2011 wastewater flow.

# 6.0 EVALUATION OF ALTERNATIVES

Table 3 is an evaluation of all alternatives based on considerations other than costs. Alternative 1 (additional land plus DAFs), Alternative 2 (tertiary treatment - year round discharge plus DAFs), and Alternative 3 (increased river flows plus DAFs) are considered viable. For Alternative 5 (DAF only), it was assumed that a 25 percent risk of exceeding capacity by 2011 would be unacceptable and therefore this alternative was dropped from further consideration. For Alternative 6 - No Project, the 2011 domestic capacity need would be 5.3 mgd at a 10th percentile river flow and 2.9 mgd at a 25th percentile. The "break even point" is between the 40th and 50th river flow percentile. In other words, if the City does nothing, there is roughly a 50 percent chance that the capacity of the effluent disposal system would be exceeded by 2011. Due to the high risk, this alternative was dropped from further consideration. Conceptual level cost estimates for the three viable alternatives are presented in Table 4.

Because the expected capacity needs are near term (i.e., 5 years), the time required to implement each alternative is a major factor. Based on discussions with RWQCB staff, the implementation of Alternative 1 (land plus DAF) is problematic due to the need to re-open the WDRs and the time required to do so given the City's projected needs. Alternative 2 (tertiary year round plus DAF) would require an estimated 1 to 3 years, depending primarily on the time to design and construct needed facilities. Regional Board staff anticipate less issues associated with a revision to the NPDES permit to allow year round discharge of tertiary effluent than they do with revising the WDRs. Alternative 3 (increased river flows) is estimated to require from 1 to 2 years to prepare agreements and negotiate/approve terms.

# 7.0 RISK ANALYSIS

An analysis was performed to assess the City's risk of selecting a river flow percentile higher than the lowest 10th percentile for the interim capacity design condition. A 10th percentile river flow means that there would be a 90 percent chance that river flows will be at that flow or higher. Or, conversely, the City would have a 10 percent risk of exceeding the disposal capacity for a 10th percentile river flow. Choosing a 25-percentile river flow means there would be a 25 percent risk of exceeding capacity, and so on. Selecting a higher river flow percentile would reduce the interim capacity needs and the corresponding costs, but would also increase the risk of violating the WDRs and the NPDES permit and the Division of Dam Safety operation permit. As discussed previously in Section 1, violations would lead to fines. If the violations are persistent, an administrative order could be issued to cease the violations, with stipulated penalties for each day that actual compliance is late. Excessive pond levels could jeopardize the integrity of the pond levees. As shown in the previously referenced Appendix C, five out of the last ten years the San Joaquin River had flows within the 10th to 30th percentile ranges. As discussed in Section 4, this pattern is the result of how the upstream water resource facilities are controlled. River flow may not mirror rainfall patterns, because a

**Table 3 Evaluation of Alternatives**
**Domestic Wastewater Near Term Capacity Study**
**City of Modesto**

| Alternative | Description | Cost | Permitting Requirements | Time to Implement | Risk of Exceeding Capacity after Implementation | Ease of Implementation | Key Benefit |
|---|---|---|---|---|---|---|---|
| 1 | Land + DAF | High | New WDR | 6-12 mos. For land, 1-2 years for DAF | Low (10%) | Difficult due to WDR revision | Provides land for industrial process flows |
| 2 | Tertiary treatment year round + DAF | Moderate | New NPDES | 1-3 years, including permit revisions | Low (10%) | Moderately difficult due to permitting | Does not require land acquisition or modifications to WDRs |
| 3 | Increased river flow + DAF | High | Water rights agreements required | 1-2 years | Low (10%) | Moderately difficult due to complex agreements | Revisions to WDR and NPDES permits not required |
| 4 | Revise NPDES permit | Unknown | New NPDES permit, EIR | Over 5 years | Low (10%) | Very Difficult - resistancy by downstream water users and regulators | No capital expenditure |
| 5 | DAF only | Low | None | 1-2 years for DAF | Moderate (25%) | Easy | Permit revisions not required.<br>No cost except for DAF |
| 6 | No Project | Possible Fines | None | N/A | Moderate to High (50%) | Easy | No cost (but at high risk) |

**Table 4 Cost Comparison of Viable Alternatives - 10th Percentile River Flow, Average Rainfall**
**Domestic Wastewater Near Term Capacity Study**
**City of Modesto**

| Alternative | Description | Item | Unit Costs | Estimated Costs - $M[4] |
|---|---|---|---|---|
| 1 | Additional land for disposal of secondary effluent, add DAFs | 477 acres | $34,000[1] per acre | 16.2 |
| | | DAFs for algae removal | Lump sum[2][3] | 10.4 |
| | | **Total** | | **$26.6** |
| 2 | Tertiary Treatment - Discharge to river year round | 2.3 mgd tertiary facility | $2.0 M per mgd of capacity[3] | 4.6 |
| | | 2.3 mgd nitrification | $1.0 M[3] per mgd of capacity | 2.3 |
| | | Disinfection facilities | $1.0 M[3] per mgd of capacity | 2.3 |
| | | DAFs for algae removal | Lump sum[2][3] | 10.4 |
| | | **Total** | | **$19.6** |
| 3 | Increased River Flow | DAFs for algae removal | Lump sum[2][3] | 10.4 |
| | | Water rights agreements for 102,000 acre-feet | $150/ac-ft | 15.3 |
| | | **Total** | | **$25.7** |

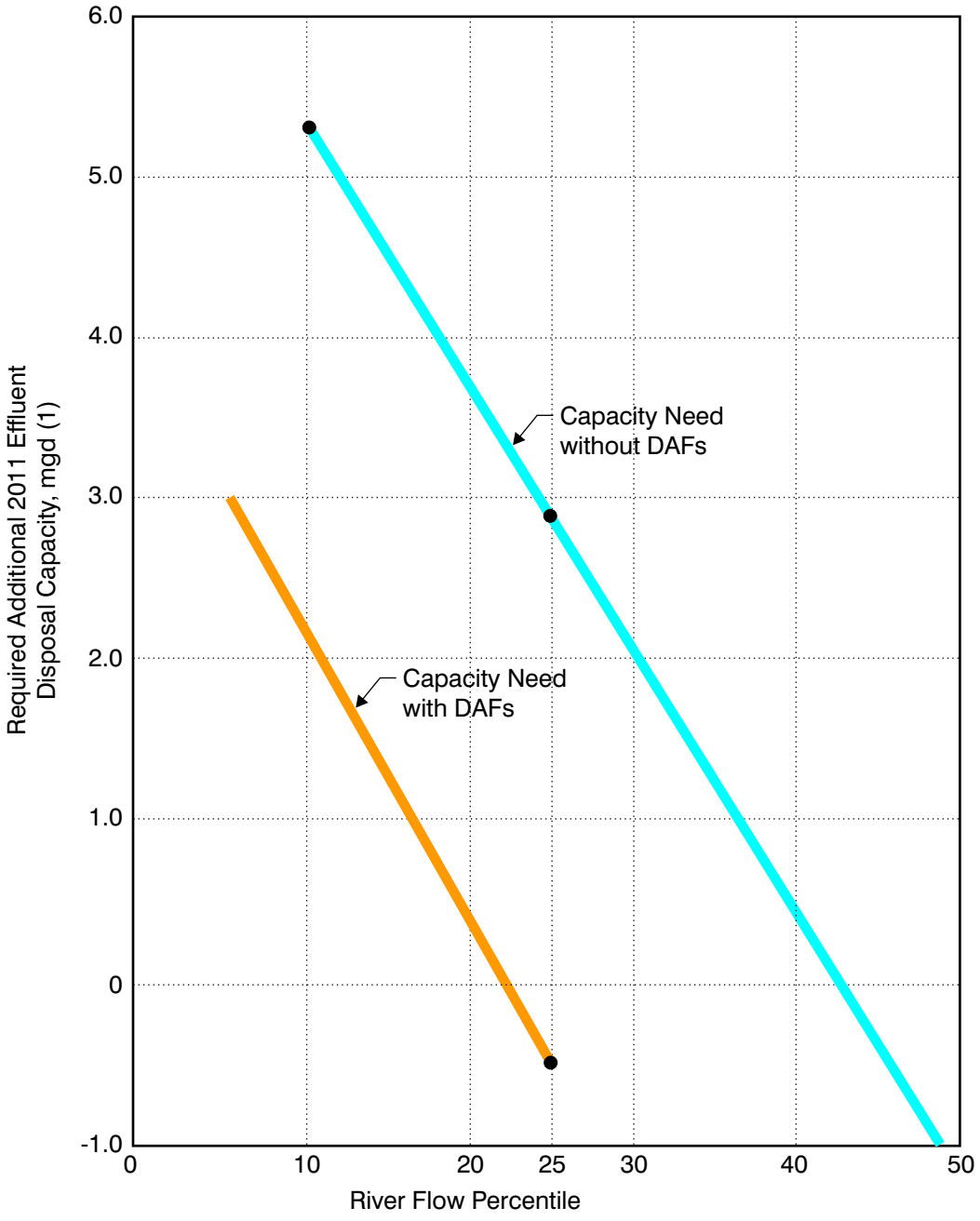
Notes:
(1) See Appendix E for basis of land cost estimate.
(2) Per Engineer's estimate.
(3) Includes contingencies and allowances for engineering, legal, and administrative costs.
(4) Conceptual level costs.

disproportional amount of water may be stored to accommodate agricultural uses. The limited data beyond the 30th percentile indicate a steeper curve. This pattern suggests that during unusually wet years the upstream facilities are operated to release water to prevent overfilling the reservoirs.

Figure 4 shows the additional capacity needed in 2011 in relationship to river flow percentile, with and without construction of DAFs. The flow data indicate that the "break even" point when no additional capacity would be needed to accommodate the increased flow is between the 20th and 25th percentile if the DAF facility is constructed and the 40th and 50th percentile without the DAF.

## 8.0 SUMMARY OF FINDINGS

- Total effluent disposal capacity is significantly impacted by San Joaquin River flows resulting from hydrologic conditions and the control of upstream water resources.
- Data available from which to develop a projection for future San Joaquin River flow conditions is very limited due to recent changes in control strategies for upstream water resources.
- Based on the 10th percentile river flow conditions and annual industrial process water contributions from the cannery segregation line of 1,460 MG (4.0 mgd annual average), the current available domestic wastewater disposal capacity is 24.2 mgd.
- Current (2005) average annual domestic wastewater flow is 25.8 mgd.
- Implementation of the DAF project, already designed, will increase domestic disposal capacity to 27.2 mgd.
- A plan to address overall long-term wastewater capacity issues will not be implemented for 4 to 5 years.
- It is estimated that approximately 12,728 EDUs will be added to the service area through the year 2011. Those units will increase domestic wastewater flow by 3.7 mgd, or from 25.8 to 29.5 mgd.
- Assuming the DAF project is implemented and the 10th percentile river flow condition, anticipated near-term residential and commercial growth will result in a capacity shortfall of 2.3 mgd by 2011.
- Near-term capacity shortfalls after the implementation of the DAF project would not occur if river flows were to remain at or above the 25th percentile condition.
- The following three alternatives and associated conceptual level capital costs are considered viable to meet interim domestic wastewater disposal needs through 2011 (as indicated in Table 5).




(1) See Table 1

**Figure 4**
**CAPACITY NEED VERSUS RIVER FLOW ASSUMPTION**
DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY
CITY OF MODESTO



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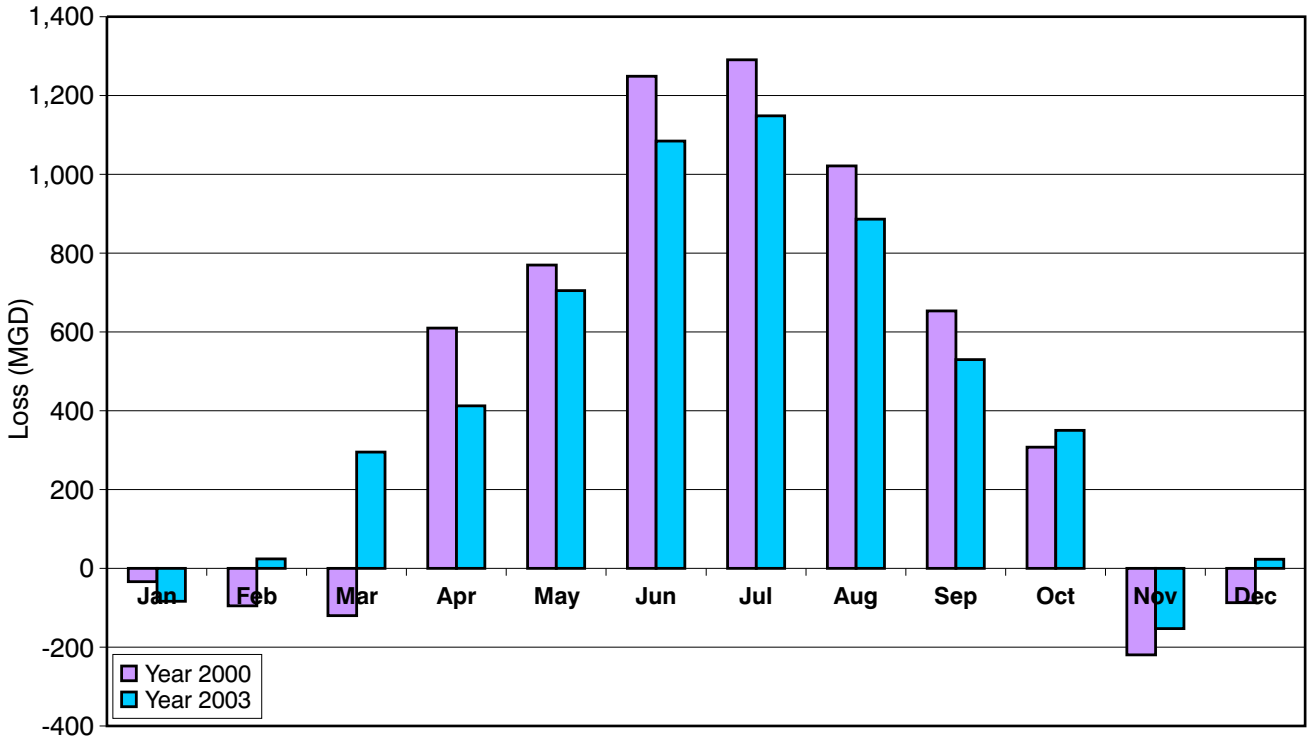
| Table 5 Conceptual Capital Costs of Disposal Alternatives<br>Domestic Wastewater Near Term Capacity Study<br>City of Modesto | | |
|---|---|---|
| **Alternative** | **Cost ($M)[1]** | **Cost per Non-Vested EDU[2]** |
| 1. Additional Land | 26.6 | $5,320 |
| 2. Tertiary Treatment - Year Round | 19.6 | $3,920 |
| 3. Increased River Flow | 25.7 | $5,140 |

Notes:
(1) For 10th percentile river flow assumption.
(2) Based on 5,000 non-vested EDUs for interim period. Each alternative has advantages and disadvantages, as well as obstacles to implement in a timely manner.

# 9.0 RECOMMENDATIONS

- Establish 10th percentile flows as the baseline condition for design of facilities and to minimize risks of exceeding WDR/NPDES permit requirements.
- Construct the DAF project as soon as practicable. Review design concepts to verify consistency with long-term tertiary treatment options.
- Review all aspects of the operation of the existing disposal facilities to identify and correct any inefficiencies.
- Proceed with the implementation of Title 22 (tertiary) treatment for year round discharge to meet near term capacity needs.

# APPENDIX A - MERCED RIVER LOSSES




**Appendix A**
**MERCED RIVER LOSSES**
DOMESTIC WASTEWATER INTERIM CAPACITY STUDY
CITY OF MODESTO

mo206f8-6887.cdr

# APPENDIX B - ESTIMATED ALLOWABLE EFFLUENT DISCHARGES TO RIVER

Table B1 - Estimated Allowable Effluent Discharge to River without DAFs for Algae Control

Percentiles based on 1996-2005 river data

| Month | 5% | | 10% | | 25% | | 50% | | 60% | | 75% | | 90% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG |
| 1 | 368 | 11,418 | 397 | 12,311 | 429 | 13,305 | 541 | 16,766 | 616 | 19,086 | 1,017 | 31,537 | 1,193 | 36,998 |
| 2 | 405 | 11,338 | 417 | 11,675 | 603 | 16,876 | 1,125 | 31,486 | 1,147 | 32,122 | 1,349 | 37,776 | 3,607 | 100,990 |
| 3 | 464 | 14,391 | 493 | 15,280 | 582 | 18,046 | 1,004 | 31,127 | 1,125 | 34,860 | 1,152 | 35,716 | 2,988 | 92,618 |
| 4 | 410 | 12,290 | 437 | 13,114 | 559 | 16,774 | 1,083 | 32,485 | 1,125 | 33,735 | 1,161 | 34,817 | 2,825 | 84,764 |
| 5 | 335 | 10,390 | 337 | 10,435 | 425 | 13,181 | 819 | 25,401 | 1,017 | 31,542 | 1,125 | 34,860 | 3,762 | 116,609 |
| 6 | - | - | - | - | - | - | | - | | - | | - | | - |
| 7 | - | - | - | - | - | - | | - | | - | | - | | - |
| 8 | - | - | - | - | - | - | | - | | - | | - | | - |
| 9 | - | - | - | - | - | - | | - | | - | | - | | - |
| 10 | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | |
| 12 | 354 | 10,988 | 371 | 11,512 | 453 | 14,033 | 566 | 17,545 | 599 | 18,569 | 667 | 20,691 | 801 | 24,825 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Flow during discharge period, mgd | 389 | | 409 | | 509 | | 856 | | 938 | | 1,079 | | 2,529 | |
| Total River Flow Volume during Discharge Period, MG | | 70,815 | | 74,327 | | 92,216 | | 154,811 | | 169,912 | | 195,397 | | 456,804 |
| Allowable Effluent Discharge Volume, MG (at 20:1 dilution) | | 3,541 | | 3,716 | | 4,611 | | 7,741 | | 8,496 | | 9,770 | | 22,840 |
| Allowable Effluent Discharge, mgd - during disharge season (1) | | 19.5 | | 20.4 | | 25.4 | | 42.6 | | 46.7 | | 53.7 | | 125.6 |
| Allowable Effluent discharge, mgd - distributed over entire year | | 9.7 | | 10.2 | | 12.6 | | 21.2 | | 23.3 | | 26.8 | | 62.6 |
| | | | | | | | | | | | | | | |
| Irrigation (existing 2,526 acres) | | 8.1 | | 8.1 | | 8.1 | | | | | | | | |
| Net Evaporation/Percolation | | 5.9 | | 5.9 | | 5.9 | | | | | | | | |
| Algae Removal | | - | | - | | - | | | | | | | | |
| Total Allowable Disposal Capacity, mgd (without DAFs) | | 23.7 | | 24.2 | | 26.6 | | | | | | | | |

Legend/Notes
mgd - million gallons per day
MG - million gallons
(1) Distributed over 6 months

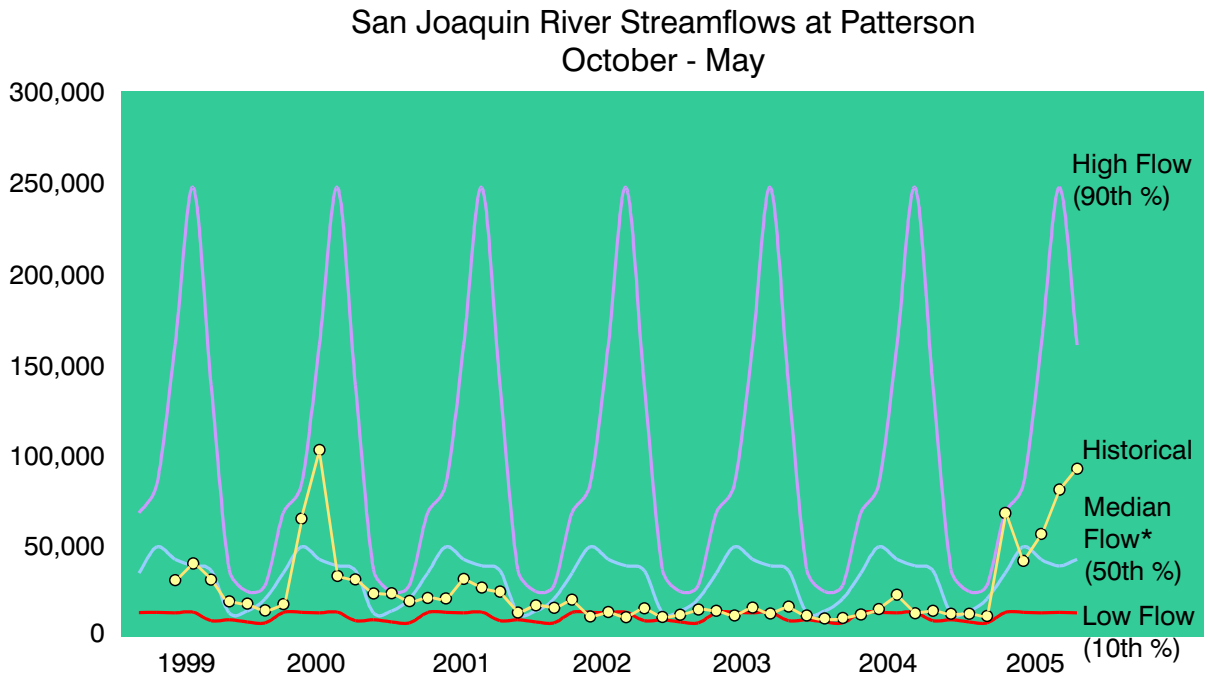
Table B2 - Estimated Allowable Effluent Discharge to River with DAFs for Algae Control

Percentiles based on 1996-2005 river data

| Month | 5% | | 10% | | 25% | | 50% | | 60% | | 75% | | 90% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG | Flow, mgd | Vol, MG |
| 1 | 368 | 11,418 | 397 | 12,311 | 429 | 13,305 | 541 | 16,766 | 616 | 19,086 | 1,017 | 31,537 | 1,193 | 36,998 |
| 2 | 405 | 11,338 | 417 | 11,675 | 603 | 16,876 | 1,125 | 31,486 | 1,147 | 32,122 | 1,349 | 37,776 | 3,607 | 100,990 |
| 3 | 464 | 14,391 | 493 | 15,280 | 582 | 18,046 | 1,004 | 31,127 | 1,125 | 34,860 | 1,152 | 35,716 | 2,988 | 92,618 |
| 4 | 410 | 12,290 | 437 | 13,114 | 559 | 16,774 | 1,083 | 32,485 | 1,125 | 33,735 | 1,161 | 34,817 | 2,825 | 84,764 |
| 5 | 335 | 10,390 | 337 | 10,435 | 425 | 13,181 | 819 | 25,401 | 1,017 | 31,542 | 1,125 | 34,860 | 3,762 | 116,609 |
| 6 | - | - | - | - | - | - | | - | | - | | - | | - |
| 7 | - | - | - | - | - | - | | - | | - | | - | | - |
| 8 | - | - | - | - | - | - | | - | | - | | - | | - |
| 9 | - | - | - | - | - | - | | - | | - | | - | | - |
| 10 | 362 | 11,231 | 373 | 11,563 | 394 | 12,199 | 530 | 16,439 | 580 | 17,985 | 641 | 19,872 | 721 | 22,349 |
| 11 | 331 | 9,935 | 348 | 10,440 | 411 | 12,320 | 545 | 16,345 | 577 | 17,300 | 588 | 17,631 | 658 | 19,752 |
| 12 | 354 | 10,988 | 371 | 11,512 | 453 | 14,033 | 566 | 17,545 | 599 | 18,569 | 667 | 20,691 | 801 | 24,825 |
| Average Flow during discharge period, mgd | 379 | | 397 | | 482 | | 777 | | 848 | | 962 | | 2,069 | |
| Total River Flow Volume during Discharge Period, MG | | 91,981 | | 96,330 | | 116,735 | | 187,595 | | 205,197 | | 232,901 | | 498,905 |
| Allowable Effluent Discharge Volume, MG (at 20:1 dilution) | | 4,599 | | 4,816 | | 5,837 | | 9,380 | | 10,260 | | 11,645 | | 24,945 |
| Allowable Effluent Discharge, mgd - during disharge season (1) | | 19.0 | | 19.9 | | 24.1 | | 38.7 | | 42.3 | | 48.0 | | 102.9 |
| Allowable Effluent Discharge, mgd - distributed over entire year | | 12.6 | | 13.2 | | 16.0 | | 25.7 | | 28.1 | | 31.9 | | 68.3 |
| Allowable Effluent Discharge w/out DAF (from Table A-1) | | 9.7 | | 10.2 | | 12.6 | | 21.2 | | 23.3 | | 26.8 | | 62.6 |
| Additional Discharge Capacity from DAF's | | 2.9 | | 3.0 | | 3.4 | | 4.5 | | 4.8 | | 5.1 | | 5.7 |
| Irrigation (existing 2,526 acres) | | 8.1 | | 8.1 | | 8.1 | | 8.1 | | | | | | |
| Net Evaporation/Percolation | | 5.9 | | 5.9 | | 5.9 | | 5.9 | | | | | | |
| Algae Removal | | 2.9 | | 3.0 | | 3.4 | | 4.5 | | | | | | |
| Total Allowable Disposal Capacity with DAF | | 26.6 | | 27.2 | | 30.0 | | 39.7 | | | | | | |
| Current (2005) Influent Flow, mgd | | 27.0 | | 27.0 | | 27.0 | | 27.0 | | | | | | |
| Required Disposal Capacity for Interim Period | | 30.1 | | 30.1 | | 30.1 | | 30.1 | | | | | | |
| Capacity Deficit | | 3.50 | | 2.90 | | 0.11 | | (9.60) | | | | | | |

Legend/Notes
mgd - million gallons per day
MG - million gallons
(1) Distributed over 8 months

# APPENDIX C - SAN JOAQUIN RIVER FLOWS - 1999 TO 2005

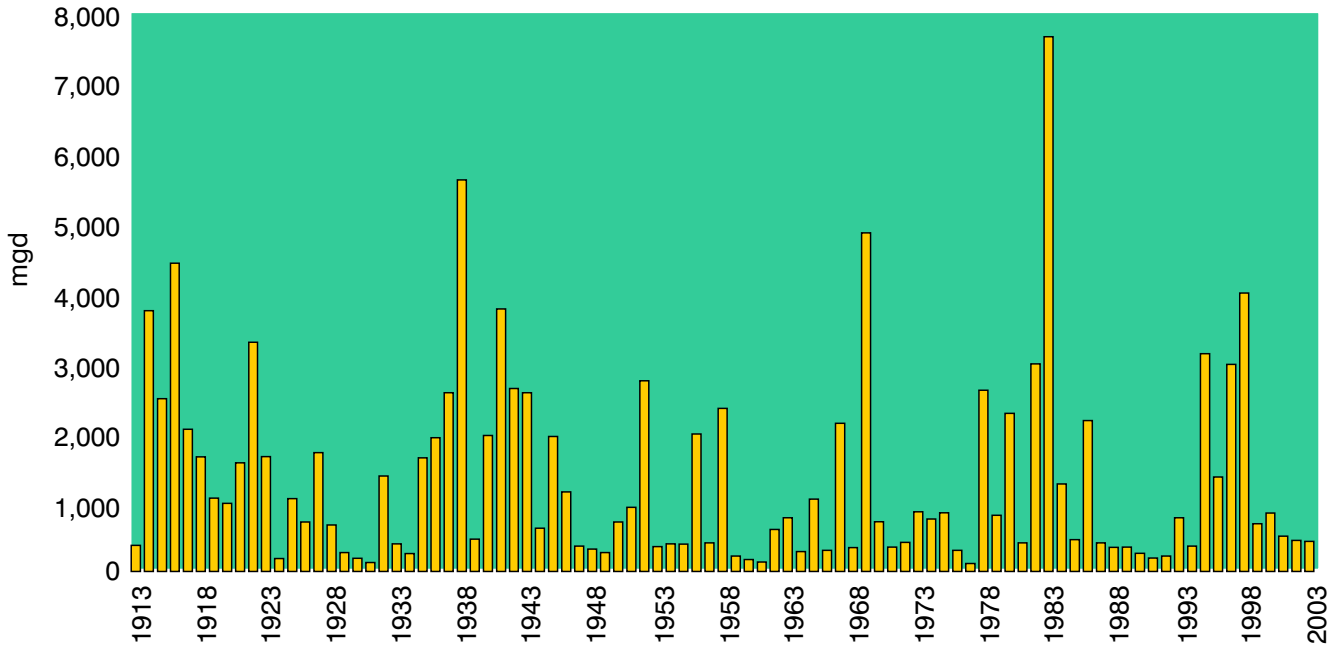



*San Joaquin River at Newman

**Appendix C**
**SAN JOAQUIN RIVER FLOWS 1999-2005**
DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY
CITY OF MODESTO

mo206f5-6887.cdr

# APPENDIX D - AVERAGE STREAMFLOWS OF SAN JOAQUIN RIVER AT NEWMAN




**Appendix D**
**AVERAGE STREAMFLOWS OF**
**SAN JOAQUIN RIVER AT NEWMAN**
DOMESTIC WASTEWATER NEAR TERM CAPACITY STUDY
CITY OF MODESTO

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# APPENDIX E - LAND COST ESTIMATE

**Table E-1 Land Cost Estimate**
**Domestic Wastewater Near Term Capacity Study**
**City of Modesto**

| | Cost Per Acre |
|---|---|
| Land | |
| Estimated purchase price in 2005[1] | $25,000 |
| Escalation for 2006 - 3% | 750 |
| Acquisition Cost - 3% | 750 |
| Allowance for parcel size, roads, buffers, etc. - 10% | 2,500 |
| **Subtotal - Land** | **$29,000** |
| Improvements | |
| Allowance for clearing, grading, fencing, irrigation, piping. | 2,000 |
| Conveyance[2] | 3,000 |
| **Subtotal - Improvements** | **$5,000** |
| **Total Estimated Cost per Acre** | **$34,000** |

Notes:

(1) Per telephone conversation with Shane Donlon Associates, area realtor.

(2) Estimate based on the following

| | |
|---|---|
| Conveyance Piping: 36" Ø, 5,000 lf x $150/lf | $750,000 |
| Conveyance Pumping: | $500,000 |
| | $1,250,000 |

$1,250,000 ÷ 477 acres = $2,621/ac; use $3,000