CITY OF NEWMAN

Wastewater Treatment and Disposal Master Plan

October 2008

Prepared for
City of Newman

Prepared by
ECO:LOGIC Engineering

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ENGINEERS · CONSULTANTS

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Executive Summary

The City of Newman (City) Wastewater Treatment and Disposal Master Plan (Master Plan) is intended to provide guidance to the City on the existing wastewater treatment plant (WWTP) and options for necessary future expansion and improvements to accommodate City growth and regulatory requirements, respectively. This Master Plan is a continuation of work completed for the Capacity Analysis Study of the existing WWTP and negotiations with the Central Valley Regional Water Quality Control Board (Regional Board). One significant result of discussions with the Regional Board included agreement with the City's proposed course of action for reduction of salinity in the WWTP effluent. This compliance strategy includes the implementation of a new surface water supply (discussed in the companion City of Newman Water Master Plan) and other salinity source control measures. This Wastewater Treatment and Disposal Master Plan is a compilation of historical system performance data, projected wastewater flows from new City residences and businesses, applicable existing and expected State and Federal regulations, and cost projections for various treatment and disposal alternatives. Specific objectives of the Master Plan include:

- To evaluate the treatment and disposal capacity of the existing WWTP.
- To identify capital improvements needed to correct any identified existing deficiencies.
- To provide guidance on potential regulatory issues.
- To identify potential options for wastewater facilities needed to serve planned City growth.
- To relate this Master Plan to the City's companion Water Master Plan and Wastewater Collection System Master Plan.

ES.1 OVERVIEW

The City of Newman is located in the western portion of the Central Valley, at the southern border of Stanislaus County, near Merced County (Figure ES-1). The City of Newman WWTP receives wastewater from a residential population of approximately 10,000 and a commercial center concentrated within the City's historic downtown area. The City also treats wastewater generated from F&A Dairy (a raw milk processing facility), which discharges directly into the municipal sewer.

The existing WWTP is a series of ponds where necessary oxygen for treatment is provided by both mechanical aerators and surface reaeration from the atmosphere. Treated wastewater (termed "effluent") is stored during the wet season and reclaimed as irrigation water on City-owned agricultural lands during the dry season. Emerging concerns related to the operation and expansion of the existing WWTP include:

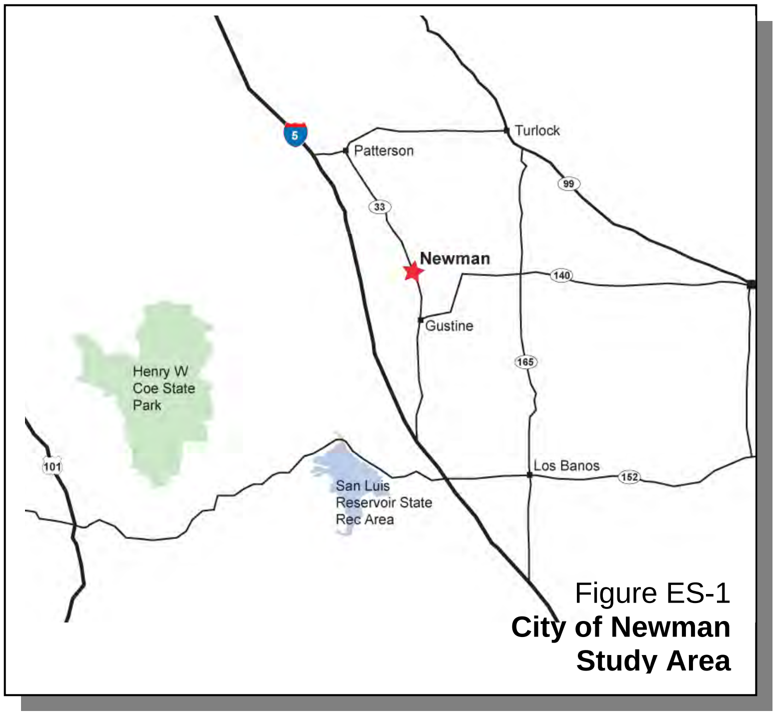


Figure ES-1
City of Newman
Study Area

- The City's General Plan addresses community growth up to a population of approximately 45,400. The forecast wastewater flow from this level of development is 4.8 million gallons per day (Mgal/d). Current wastewater flow is approximately 1.1 Mgal/d. The permitted equivalent capacity of the existing WWTP is 1.4 Mgal/d.

- The City's effluent has higher salinity than other irrigation water used in the vicinity. Therefore, the City's effluent reclamation practice has the potential to cause salinity degradation of underlying groundwater. The major source of salinity in the City's effluent is the City's potable water supply. This Master Plan coupled with the companion Water Master Plan provides a plan for a potable water supply improvement project to address this concern.

- The City's wastewater treatment ponds are unlined and in direct contact with shallow groundwater. Due to this contact, there is concern that salts, nitrates, pathogens, pesticides, and/or metals may be causing groundwater contamination. Although a wastewater treatment pond in direct contact with groundwater has the potential to contaminate that groundwater, it has generally been observed that contamination does not occur (Design Manual (for) Municipal Wastewater Stabilization Ponds (EPA-625/1-83-015)). The reason widespread contamination does not occur is that wastewater treatment ponds tend to "seal" themselves to reduce leakage of wastewater to groundwater and wastewater which does leak out is generally well treated by the sludge, soil, and associated microbes. The City currently is studying whether its treatment pond system acts in a similar manner. Also in need of study is whether unacceptable nitrogen degradation is occurring in the effluent reclamation areas. Even if other compounds appear not to contaminate groundwater, effluent salinity is still an issue for the WWTP.

- The City's potable water shift from groundwater to a high quality, more expensive surface water may put the City in a position to offset potable water with reclaimed effluent for some to all urban landscape irrigation water in new development areas. This is common practice in Southern California and is becoming more common in areas of Northern California where potable water is becoming more expensive and/or difficult to reliably obtain.

- Once the potable water supply improvement project is complete, effluent salinity concentrations should be acceptable to the Regional Board. The remaining concern includes determining whether nitrogen degradation of groundwater is occurring under the reclamation area due to the pond effluent. Pond treatment (as compared to nitrification/ denitrification activated sludge) is generally not considered a reliable method for removing nitrogen from wastewater.
- The City's effluent reclamation areas are on lands with naturally high groundwater levels, which also tend to be areas of naturally high salinity. To control shallow groundwater levels and soil salinity so as to allow agriculture to occur, much of the land immediately east of the City has been "reclaimed" by 1) the addition of subsurface shallow groundwater drainage pipes that drain to the San Joaquin River, and 2) flushing the historically accumulated salinity via application of surface water and/or groundwater to the soil. Although effluent reclamation on soils needing subsurface drainage is not prohibited, it is not encouraged if alternative effluent reclamation lands are feasible.

In light of the above concerns and the fact that a definitive assessment of degradation will take several years, this Master Plan addresses the long-term potential wastewater treatment needs by bracketing the two extremes of options. This approach gives the City a plan which can easily be adjusted based on the results of groundwater monitoring and degradation analysis. The actual path the City pursues will be dictated by the results of the groundwater monitoring and the Regional Board's input as well as policy decisions of the City Council on what type of resource it views the City's wastewater. The two extremes of options are:

1. If the existing ponds are shown to not have an impact on local groundwater (either directly near the ponds or beneath the agricultural fields due to reclamation), the existing, unlined treatment ponds will continue to be used for existing customers. The WWTP will be expanded with similar treatment for new development.
2. If the existing unlined ponds show some degree of impact to local groundwater (either directly or through effluent reclamation), wastewater from new development will be treated in a more mechanical treatment process (such as activated sludge) and the existing users will be phased out of the existing ponds and into mechanical treatment over time.

The two options identified above are the extremes. It is possible that alternatives between these two options exist.

ES.2 EXISTING TREATMENT AND DISPOSAL ALTERNATIVES

The existing WWTP has a permitted capacity of 1.69 Mgal/d maximum dry weather monthly flow (MDWMF) based on the current Waste Discharge Requirements (WDRs, i.e., "the permit") issued by the Regional Board. This corresponds to an average sanitary flow of 1.44 Mgal/d and this permitted capacity will accommodate the existing residents and growth within the City limits. If the existing pond system is not causing acute pollution of the groundwater and the potable water supply improvement project is implemented to reduce effluent salinity, it appears that the existing unlined treatment ponds should be able to be used in the near-term future. The City's ability to continue to use the existing unlined treatment ponds (up to the permitted capacity) on a long-term basis will be determined based on the results of the on-going groundwater monitoring program. If the ponds are causing unacceptable degradation of the groundwater, then the City would need to plan a different treatment method to serve existing City residents (as well as new residents) for the long-term future.

However, in order to continue using the existing ponds (in either the near-term or the long-term), treatment improvements are necessary. The existing pond system is currently being loaded with organics above its reliable capacity. The existing aeration system in the ponds would not provide the oxygen needed to treat the organic load under peak flow and load conditions. This Master Plan identifies three alternatives to assure that the system will operate reliably and comply with the current WDRs up to the permitted flow. The three alternatives include:

- Create a third aeration basin (AB No. 3) by baffling approximately five acres of the existing 50-acre Oxidation Pond and splitting the influent load across all aerated ponds (AB Nos. 1, 2, and 3). This alternative would require a flow diversion structure after the existing headworks and the addition of mechanical aeration in AB No. 3 and the Oxidation Pond. The total capital cost is estimated at $3.8 million for existing flow conditions, with an additional $200,000 needed at permitted flow conditions.
- Pretreat F&A Dairy wastewater to municipal wastewater organic strength and provide means to recirculate flow from the Oxidation Pond or the new storage basin into AB No. 1. F&A Dairy's high strength wastewater represents over half the organic load entering the WWTP and has significant variability in strength compared to municipal wastewater. The total capital cost for permitted flow conditions is estimated at $4.2 to $4.6 million. These costs include the pretreatment of F&A Dairy wastewater, estimated at approximately $2.0 million.
- Decommission existing AB No. 1 and replace it with two new, lined, mechanically aerated basins (AB No. 1A and No. 1B). This alternative also includes recirculation of flow from the Oxidation Pond or the new storage basin into the new AB No. 1A & 1B. The total capital cost for permitted flow conditions is estimated at $6.2 million.

The first alternative appears to offer the most flexibility, least capital cost (though higher operation and maintenance cost), and least investment in infrastructure. Least investment in infrastructure is an important consideration should significant groundwater degradation be found from on-going studies, which require the existing users to phase out of the existing WWTP and into mechanical treatment in the long-term.

With construction of the previously designed supplemental storage basin, the existing WWTP will be able to store effluent and 1-in-100 year precipitation events. However, since this basin will be built on existing reclamation area, an additional approximately 100 acres of effluent reclamation area will be needed. The cost of this additional land will depend on the specific area identified, but will likely be on the order of $2 million, including land, effluent conveyance to the land, and on-site improvements. The City should begin the process of securing future disposal land as soon as practical.

ES.3 FUTURE TREATMENT AND DISPOSAL ALTERNATIVES

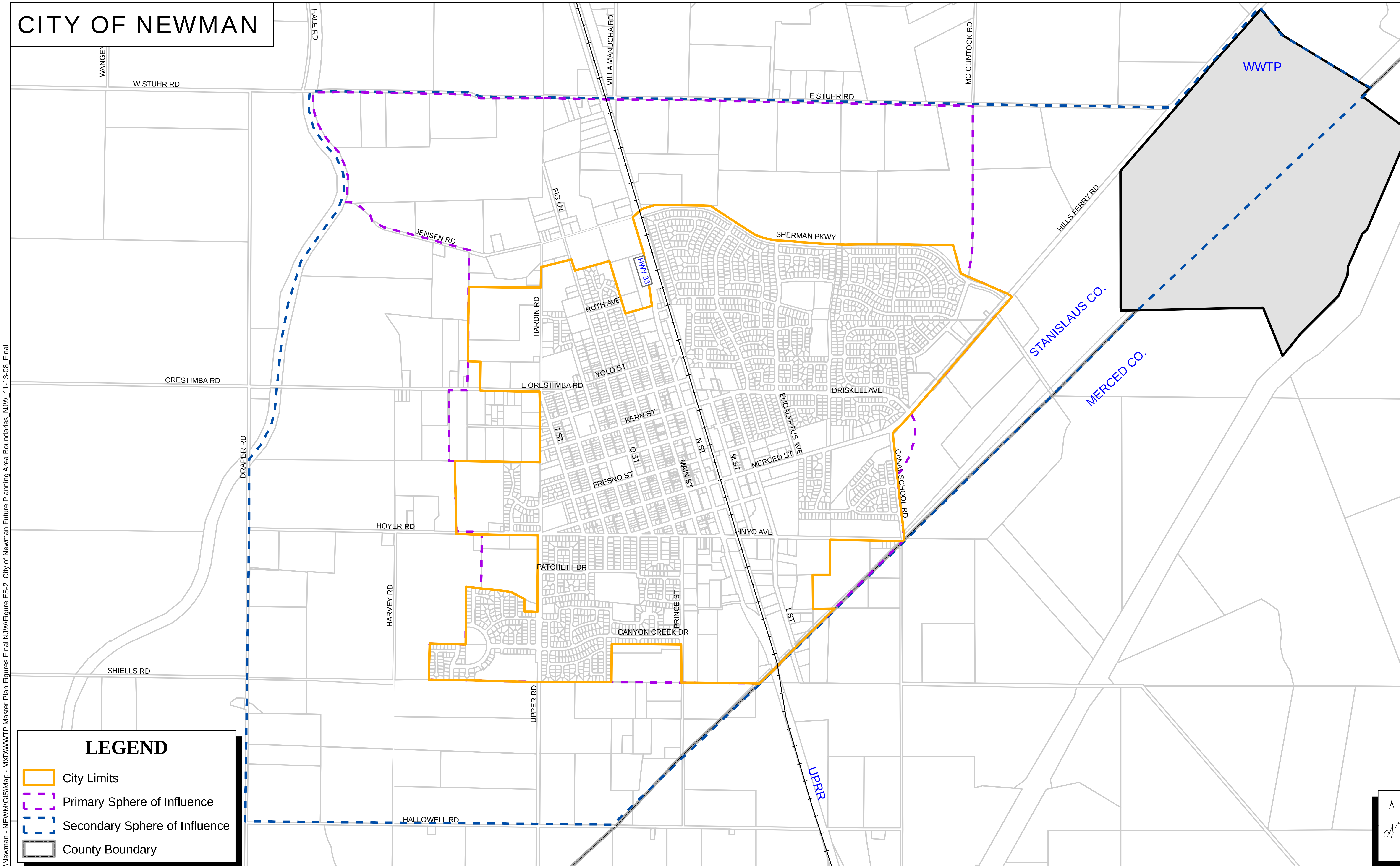
Once the potable water supply improvement project is completed, effluent salinity concentrations should be acceptable to the Regional Board. As mentioned above, the remaining concerns to be addressed include the potential for groundwater degradation due to the unlined ponds and nitrogen degradation due to the existing reclamation practices. In addition, the other major concern will be creating WWTP capacity to accommodate City growth beyond the existing City limits. Additional treatment, storage, and disposal will be needed to accommodate the Primary and Secondary Spheres of Influence (SOIs) identified in the City's General Plan (Figure ES-2). These WWTP components presumably will be funded by new development.

ES.3.1 FUTURE TREATMENT ALTERNATIVES

A fundamental aspect of any future WWTP expansion is that disposal governs treatment. The level of treatment required is dictated by where and how the effluent will be disposed. If more flexibility is needed or desired, or if degradation potential exists, then a higher level of treatment is required. The level of treatment required and other considerations for various effluent disposal methods are described in Table ES-1. As shown, for most disposal options besides current practices, tertiary treatment is required. A more detailed flowchart of the specific treatment processes needed for different disposal options is provided in Figure ES-3. Of particular importance is that all treatment methods, except for pond treatment, allow the process to be upgraded as necessary to include nitrogen removal, conventional or membrane filtration, and/or disinfection. The disadvantage of this flexibility is that there is an additional capital and operational cost associated with mechanical treatment. Technological advantages continue to improve nitrogen removal with pond treatment, but reliable removal is still uncertain with ponds.

Table ES-1
Level of Treatment Required and Considerations for Effluent Disposal Methods

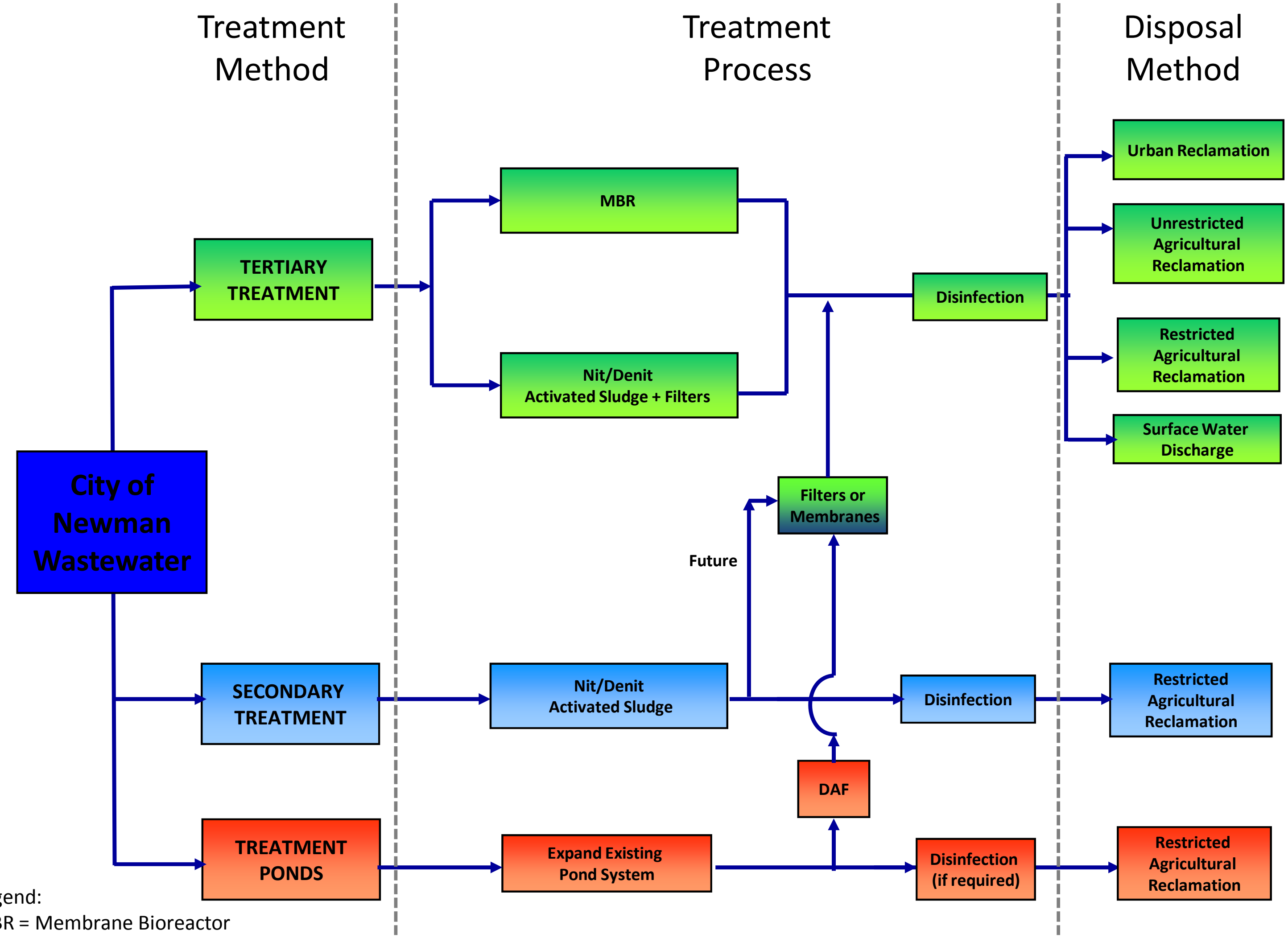
Effluent Disposal Method	Level of Treatment	Additional Considerations
Urban Reclamation (e.g., Irrigation of parks, schools, greenbelts, parkways, commercial landscaping, front yards, and/or back yards)	Tertiary	❐ Significant costs for distribution ❐ Community input/perception ❐ Needs to be incorporated early into the General Planning process ❐ Reduces potable water demands and, therefore, potable water supply capital and annual costs
Unrestricted Agricultural Reclamation (e.g., food crops)	Tertiary	❐ City typically buys the land to assure the long-term viability of this method
Restricted Agricultural Reclamation (e.g, fodder crops; current practice)	Secondary (or equivalent secondary)	❐ Disinfection needed unless all stormwater is contained on-site



M:\Newman - NEWMIGIS\Map - MXD\WWTP Master Plan Figures Final NJW\Figure ES-2 City of Newman Future Planning Area Boundaries NJW 11-13-08 Final

ECO:LOGIC Engineering
City of Newman Wastewater Treatment and Disposal Master Plan

Figure ES-2
City of Newman Future Planning Area Boundaries



Legend:
MBR = Membrane Bioreactor
Nit/Denit = Nitrification/Denitrification
DAF = Dissolved Air Floatation

Figure ES-3
Level of Treatment Required for Various Disposal Option

Regardless of the outcome of any degradation analyses relative to the existing ponds, it is unlikely that additional unlined treatment ponds will be allowed for growth beyond the permitted capacity of the existing treatment ponds. Unlined treatment ponds are generally no longer considered Best Practical Treatment and Control (BPTC) technology because of their potential for groundwater degradation, even if (when wastewater salinity is not an issue) no significant degradation may actually be occurring in many situations, as reported by EPA. Therefore, the City should plan for an alternative treatment process to serve City growth beyond the permitted capacity of the existing WWTP. The three main treatment alternatives that exist for future users include:

- **Lined Treatment Ponds –** Lined treatment ponds (Figure ES-4) may be an acceptable long-term alternative for new development if the City can demonstrate that agricultural reclamation of the resulting effluent is not causing excessive nitrogen application rates to the crops, resulting in unacceptable nitrogen degradation of groundwater. However, even if groundwater degradation is not occurring, the City should evaluate the risks verses benefits of continuing to expand the pond system. Pond treatment does not offer reliable nitrogen removal at this time without going to the added expense of dissolved air flotation (DAF) and a separate nitrification/denitrification step (Figure ES-3). The potential need for these steps verses the cost (and cost effectiveness) of nitrification/denitrification activated sludge need to be considered by the City. These and other factors are discussed further below. If groundwater degradation due to nitrogen is occurring under the reclamation fields, then the City would need to plan to provide treatment via a nitrification / denitrification secondary or tertiary treatment process. Upgrading treatment for existing residents would need to be negotiated with the Regional Board. For new growth (and possibly existing residents), some effluent disinfection prior to irrigation of the fodder crops appears likely to be necessary when the current WDRs are renewed based on current Regional Board policy. However, that policy is in conflict with other Regional Board policies being implemented at this time. Therefore, the proper course of action for the City at this time is to plan for disinfection, but not implement it until mandated by the Regional Board.

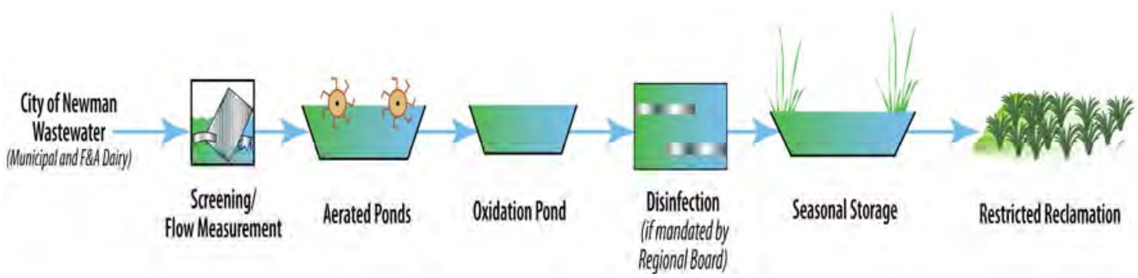


Figure ES-4
City of Newman Existing WWTP - Example of Lined Treatment Ponds

- **Secondary Treatment –** If it is determined that groundwater degradation is occurring in the reclamation fields due to nitrogen in the effluent, a nitrification / denitrification secondary treatment process (Figure ES-5) would be required at least for new growth. The Regional Board should give existing residents time to upgrade their treatment process, if needed. Secondary treatment, alone, does not significantly expand the disposal options available to the City. Secondary treatment would facilitate upgrading the WWTP in the future to a higher level of treatment, if regulations and/or disposal methods dictate. Because the capital and annual costs of secondary treatment are not significantly different from lined, unaerated treatment ponds and requires a fraction of the land for treatment, the City should pursue secondary treatment if it does not want to embark on more extensive groundwater degradation studies or take the risk that groundwater degradation would cause a shift in treatment processes in the future. It is also possible that a nitrification / denitrification secondary treatment process could handle either all the City's wastewater or only a portion, if only a partial reduction in nitrogen is necessary to protect groundwater quality and still satisfy crop nitrogen needs.

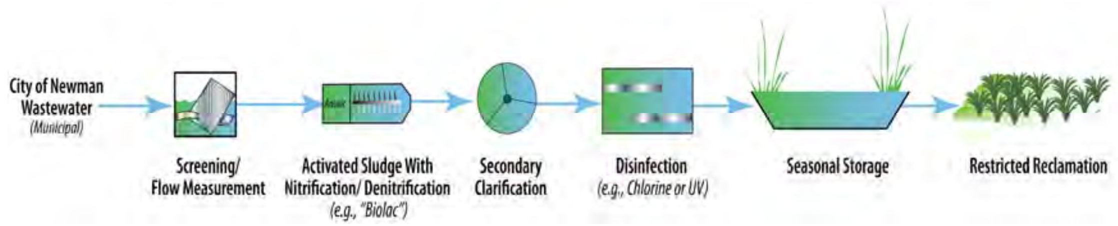


Figure ES-5
Example Secondary Treatment Process

- **Tertiary Treatment –** If the City prefers to 1) have the most flexibility in terms of effluent disposal options, and 2) reduce potable water supply costs, then tertiary treatment should be planned for new development – either for near-term new development or as a future treatment option. For wastewater effluent to be used for unrestricted reclamation, tertiary level treatment and effluent disinfection are required (as shown in Figure ES-3). Tertiary treatment (Figure ES-6) includes a biological treatment process followed by filtration or membrane filtration. Disinfection can be either through the use of chlorine or ultraviolet light (UV) disinfection. Wastewater treated to tertiary standards (as defined by Title 22 of the California Code of Regulations) can be reclaimed in an urban or agricultural setting. Tertiary treatment would give the City the ability to reclaim water in an urban setting, which would either reduce the capital and annual costs of the new surface water supply system (if it is sized to allow reclamation to meet some to all urban irrigation use demands), or reduce the input of poor quality groundwater into the potable water supply system when urban irrigation demands are greatest.

  Tertiary treatment could be accomplished through a secondary treatment process followed by filtration or through a combined process, such as a membrane bioreactor (MBR). Membrane bioreactors combine the biological treatment step of nitrification/denitrification activated sludge with membrane filtration to produce a high quality effluent. For either of these treatment options, treatment is further followed by UV disinfection. The same amount of acreage is needed for storage and disposal. However, the City would have the added flexibility of reclaiming the water on discrete parcels (such as urban landscaping, parks, greenbelts, commercial landscaping, etc), the ability to use the water on different types of crops, and may be able to enter into a long-term lease instead of a land purchase with an area farmer.

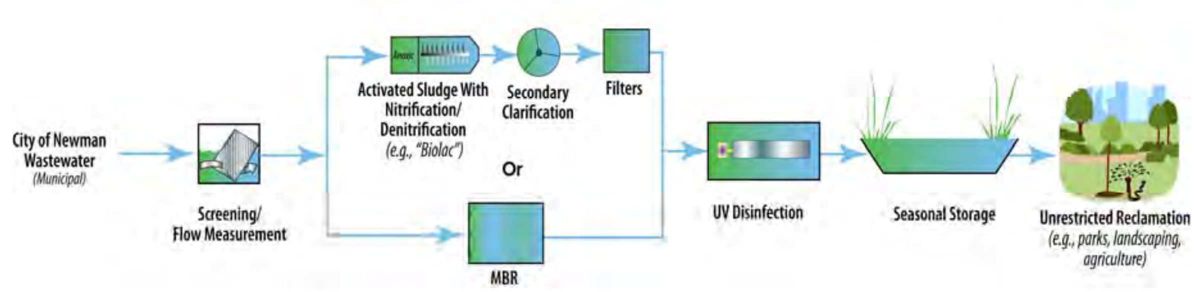


Figure ES-6
Example Tertiary Treatment Process

A summary of each level of treatment, advantages, disadvantages, and relative cost is summarized in Table ES-2.

ES-3.2 INDUSTRIAL PRETREATMENT

In addition to future treatment of residential wastewater, the future treatment of F&A Dairy wastewater also needs to be considered. The higher strength food process wastewater from F&A Dairy represents over half the total organic load currently entering the WWTP. Pond systems are generally well suited for food processing wastewater due to the fact that the systems can tolerate large swings in organic load on a daily, weekly, or monthly basis. Analysis of the existing WWTP capacity (described above) assumes that F&A Dairy flows and loads remain the same. Given this assumption and with the existing system improvements completed, the current WWTP should be able to accommodate the current flow and load from F&A Dairy. However, recent analysis of F&A Dairy load indicates that it may be more equitable to base monthly charges on COD (chemical oxygen demand) load, rather than the current method of BOD_5 (5-day biochemical oxygen demand) load.

When considering future treatment, it is assumed that F&A Dairy will not increase production and, therefore, the flow and load contribution will not change. However, if the flow and/or load of the dairy does go above current levels, pretreatment of the wastewater to municipal strength will be required, even if no improvements to the wastewater treatment process are required. Also, the size and associated capital cost as well as the operation and maintenance cost of activated sludge treatment processes are greatly affected by the influent organic loading. Therefore, if activated sludge secondary or tertiary treatment is used for future growth, it will be most cost effective only to treat municipal wastewater with this process. If F&A Dairy increases its loading to the City's WWTP or if results of the groundwater assessment indicate that the existing users (including F&A) are required to phase out of the existing ponds into secondary or tertiary treatment, it will be more cost effective to provide a separate pretreatment process at F&A Dairy to reduce the amount of organic load to municipal strength. This pretreatment process would likely be a high rate anaerobic process, which is much more suited to handle high organic strength wastewater.

Table ES-2
City of Newman Treatment Options for New Users Summary

	Lined Treatment Ponds	Secondary Treatment	Tertiary Treatment
Description	Ponds with synthetic lining to prevent leakage to groundwater; Addition of mechanical aeration, **OR** Large ponds for passive, atmospheric re-aeration	"Biolac" nitrification/denitrification activated sludge treatment process with chlorine disinfection	"Biolac" biological treatment process with conventional filters (disk filtration) and UV disinfection, **OR** Membrane bioreactor with UV disinfection
Disposal	Restricted agricultural reclamation (unless treatment is upgraded with at least DAF, filtration, and disinfection. A post DAF nitrogen removal process may be necessary)	Restricted agricultural reclamation (unless upgraded with filtration and enhanced disinfection)	❒ Urban reclamation ❒ Unrestricted agricultural reclamation ❒ Restricted agricultural reclamation ❒ Limited surface water discharge may be possible to reduce storage costs in wet winters
Advantages	❒ Familiar treatment and operation process ❒ Addition of aerators reduces size of treatment ponds ❒ Lowest O&M cost	❒ Upgradeable treatment system ❒ Consistent with current disposal practices ❒ BPTC with respect to nitrogen and salinity ❒ All treatment could occur on existing wastewater treatment plant site	❒ Highest level of treatment ❒ Modular treatment system (MBR) ❒ Opportunities for multiple disposal options ❒ BPTC with respect to nitrogen and salinity ❒ All treatment could occur on existing wastewater treatment plant site
Disadvantages	❒ Restricted disposal option ❒ Additional land needed for treatment ❒ Lining of unaerated ponds is very expensive due to large size of ponds ❒ May be inconsistent with long-term growth plans of City ❒ Upgradeable, but only at a significantly higher overall cost than other options	❒ Restricted disposal option ❒ More costly than aerated ponds ❒ Separation of industrial flows is likely cost effective	❒ Provides higher level of treatment than currently needed ❒ Highest capital cost ❒ Highest O&M cost ❒ Separation of industrial flows is likely cost effective
Capital Cost TREATMENT ONLY (2 Mgal/d; April 2008$)	$21.2 (aerated) to $49.1 million (unaerated)	$38.7 million	$45.0 (Biolac & Filters) to $55.1 million (MBR)
Additional O&M Cost (2010$)	$0 (unaerated) to $270,000 (aerated)	$500,000	$640,000 (Biolac & Filters) to $710,000 (MBR)

ES-3.3 STORAGE AND DISPOSAL

Future storage needs are independent of the treatment and reclamation disposal method used. Storage must be designed to accommodate the wastewater generated during the wet season as well as 1-in-100 year precipitation. For the Primary SOI, approximately 33 acres beyond the existing WWTP are needed. At full buildout of the Secondary SOI, approximately 150 total acres are needed (117 additional acres). Reclamation disposal land depends on the amount of urban reclamation used. If only restricted agricultural reclamation is employed, 208 acres of land is needed for the Primary SOI and an additional 570 acres is needed for the Secondary SOI. A schematic of the land area that will be required for storage and restricted reclamation at full buildout of the Secondary SOI is shown in Figure ES-7. The areas identified in Figure ES-7 are not intended to be the exact parcels, but instead to demonstrate the amount of land area needed.

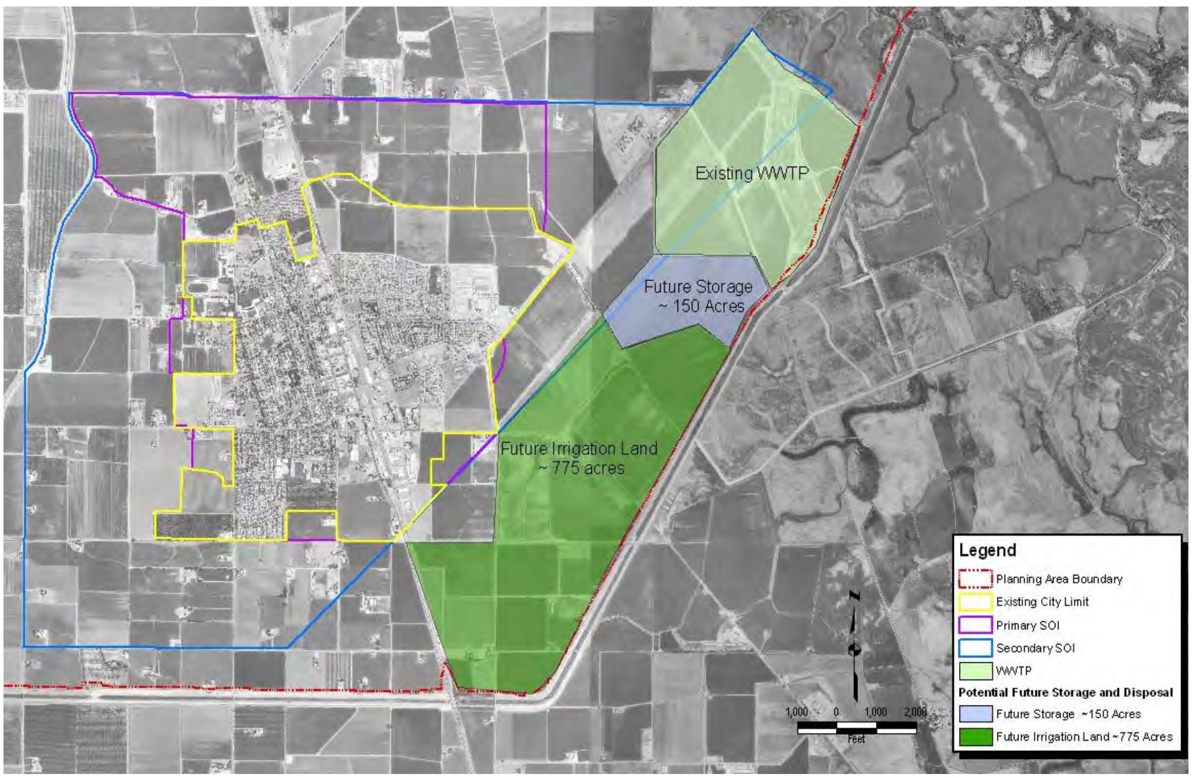


Figure ES-7
City of Newman Future Storage and Disposal Land Requirements – Full Buildout of Secondary SOI

ES-4 RECOMMENDED PLAN

In light of the above regulatory concerns, treatment and disposal options, and unknowns related to the potential for groundwater degradation, it is recommended that the City follow a plan that allows for the most flexibility in the future. The City of Newman has a unique, one-time opportunity to create a plan that is both consistent with regulations and also conserves resources. Growth within the existing City Limits can be accommodated in the existing WWTP with some near-term, and possibly long-term, upgrades. Lands to the north (Primary SOI), west, and south (Secondary SOI) of the City that wish to annex to the City will need to fund construction infrastructure (including water and wastewater utilities) to serve these annexations. As discussed in the companion Wastewater Collection System Master Plan, these areas will need new trunk sewers to accommodate future wastewater flow to the WWTP. This “separate” collection system creates a distinction between new and existing users. There is a logical separation of new users to a new treatment process compared to the existing users who have already put a significant investment into their existing WWTP. F&A Dairy’s wastewater is also limited to flowing to the existing pond system, which is better able to accommodate the high and variable strength wastewater than activated sludge or an MBR. This flexibility of separation of the new and existing users exists in very few Cities. In addition, if a higher level of treatment is selected for new growth, there is a nexus between that higher cost and the beneficiaries of the infrastructure being created. With a higher level of treatment being funded by the annexed areas, these areas can be required to be plumbed to use tertiary effluent on parks, school yards, commercial landscaping, etc., including consideration of residential front yard irrigation in all years, and back yard irrigation in drought years when the City’s surface water allocation from the California Aqueduct may be reduced. It is prohibitively expensive to retrofit the existing City with urban reclamation “purple pipes” to allow the level of reclamation and water supply security possible for the annexed areas.

Based on the foregoing concepts, developed to provide existing and new City residents the most cost-effective and secure water supply and wastewater treatment and disposal system, the following major actions are recommendations as part of this Master Plan:

- **Plan for diversifying effluent disposal options in the future.** Continued expansion of the City’s pond system to serve future growth is based on the ability of the City to acquire large parcels of land suitable for treatment and disposal ponds and restricted reclamation and, more importantly, the demonstration that the existing WWTP does not degrade groundwater either from the unlined ponds and/or from the reclamation practices. It is essentially impossible to predict if either of these concerns will surface in the future. Other communities that use secondary or tertiary treatment processes instead of pond treatment have the distinct advantage of being able to construct add-on processes to remove nitrogen, turbidity, pathogens, and even trace pollutants that allow the effluent to be disposed or reclaimed for other uses. For this reason, it is recommended that new development 1) treat its wastewater to a higher level, and 2) provide alternative means of effluent disposal.

- **Acquire more disposal land.** Concurrent with planning for diversified effluent disposal options, it is also prudent planning to secure suitable disposal land (ideally near the WWTP). This land can be used on either an interim basis and/or for long-term future disposal needs and will allow the WWTP to expand as needed to accommodate growth, regardless of the treatment and disposal methods pursued on a long-term basis.

- **Assume new development in the Primary and Secondary SOIs would be required to treat their wastewater tertiary standards.** As noted above, diversifying effluent disposal options requires a higher level of wastewater treatment. Current BPTC is a lined wastewater treatment process that removes total effluent nitrogen to less than 10 milligrams per liter, unless the effluent discharger specifically demonstrates that the level of treatment is not needed to prevent degradation of underlying groundwater. The burden of proof rests with the City for new growth beyond the 1.44 Mgal/d (average sanitary flow basis) permitted capacity of the existing facility. Coupling BPTC with the need to diversify effluent disposal results in the recommendation that annexations to the City fund tertiary level treatment providing pathogen-free effluent that can be applied in an unrestricted manner to agricultural crops and urban landscaping. While there are several types of treatment processes that produce tertiary quality effluent, fiscal planning around a new membrane bioreactor (MBR) facility is recommended. MBRs have comparable costs to conventional tertiary systems and many of the new WWTPs built in California today are MBRs.

- **Plan future City parks, schoolyards, landscape medians, greenbelts, etc. for irrigation with tertiary effluent.** This recommendation implements diversifying effluent disposal and takes steps to either reduce the size and cost of the new potable water supply and/or maintain the quality of that water supply by reducing the need to operate existing potable water wells (with poor quality water) during maximum potable water demand days driven by landscape irrigation water needs. As discussed previously, this plan can only be implemented to any great extent in new development areas because of the high cost to retrofit existing developed areas with dual "purple pipe" systems needed for effluent reclamation. The City may wish also to consider effluent reclamation in residential front yards, and possibly in back yards during severe drought when the City's allocation of California Aqueduct Water may be reduced. With modern, reliable tertiary wastewater treatment facilities, front and back yard effluent irrigation is becoming increasingly common in prestigious communities. The "perception problem" is diminishing and since this practice would only be occurring in new areas, the people buying the home would be accepting the use as evidenced by the fact that they bought the home. This is a very different perspective than a forced retrofit where existing people have no choice.

- Under this plan, the layout of the new water, wastewater, and reclaimed water (i.e., effluent) pipes in the annexed areas would be consistent with California Department of Public Health "Title 22" requirements. This includes use of "purple pipe" to designate non-potable uses, addition of backflow preventers from the City's potable water lines, separate water lines to bathrooms/ drinking fountains, and selection of certain types of sprinkler heads to minimize overspray in public areas. Many communities have amended their city design standards to include the Title 22 provisions, even before reclaimed water is available. The new UC Merced campus is an example of such planning where the irrigation system is designed to switch over to reclaimed water when sufficient wastewater is generated by the students. Since it is very expensive to retrofit existing areas, it is recommended that city design standards be modified so that the City has options for how new urban landscaping could be watered in the future.

- **Develop a revenue program that equably funds wastewater treatment and disposal for both existing and new users.** Funding these initiatives will impact both the City's monthly wastewater rates (for capital projects related to achieving the permitted capacity of the existing WWTP and new operational costs benefiting existing users) and wastewater capital fees (for capital projects benefiting City growth, including expansion of the WWTP beyond the current permitted capacity). A detailed revenue program is needed to determine funding of the items discussed above. Depending on the outcome of the groundwater monitoring, input from the Regional Board, and evaluation of the ability to off-set potable water demands, the City may desire to construct a new tertiary WWTP for new development and recycle that water on new urban and agricultural areas. Since funding major facility upgrades through monthly sewer rates is expensive and difficult to implement equitably across all users, it is recommended to base capital fees for development of the Primary and Secondary SOIs on the costs for constructing a new tertiary MBR treatment facility. A new MBR facility with a capacity of 1.0 Mgal/d and accommodations for future growth is estimated to cost $33 million (for treatment only) in 2008 dollars. Capital fees based on this amount would be adjusted each year to an inflation index tied to the construction industry. At this point, the plan recommends only <u>collecting</u> fees associated with the tertiary WWTP as a means to minimize risk to the City. If the various unknowns related to treatment and disposal practices can be resolved with some surety, then a portion of the collected money could be refunded to parties who funded the construction of the actual facilities.

Chapter 1

Introduction

The City of Newman (City) Wastewater Treatment and Disposal Master Plan (Master Plan) is intended to provide guidance to the City on the existing wastewater treatment plant (WWTP) and options for necessary future expansion and improvements to accommodate City growth and regulatory requirements, respectively. This Master Plan is a continuation of work completed for the Capacity Analysis Study of the existing WWTP and negotiations with the Central Valley Regional Water Quality Control Board (Regional Board). One significant result of discussions with the Regional Board included agreement with the City’s proposed course of action for reduction of salinity in the WWTP effluent. This compliance strategy includes the implementation of a new surface water supply (discussed in the companion City of Newman Water Master Plan) and other salinity source control measures. This Wastewater Treatment and Disposal Master Plan is a compilation of historical system performance data, projected wastewater flows from new City residences and businesses, applicable existing and expected State and Federal regulations, and cost projections for various treatment and disposal alternatives. Specific objectives of the Master Plan include:

- To evaluate the treatment and disposal capacity of the existing WWTP.
- To identify capital improvements needed to correct any identified existing deficiencies.
- To provide guidance on potential regulatory issues.
- To identify potential options for wastewater facilities needed to serve planned City growth.
- To relate this Master Plan to the City’s companion Water Master Plan and Wastewater Collection System Master Plan.

The existing WWTP is a series of ponds where necessary oxygen for treatment is provided by mechanical aerators and surface reaeration from the atmosphere. Treated effluent is stored seasonally during the wet season and reclaimed as irrigation water on City-owned agricultural land during the dry season. The WWTP is regulated under a Waste Discharge Requirements (WDRs) issued by the Regional Board. The system is very resilient to periodic high loads from the food processing industry within town, F&A Dairy. To the extent the facility can comply with new regulatory mandates, the City should continue to operate this system due to its simplicity and low capital, operation, and maintenance costs. Emerging concerns related to the operation and expansion of the existing WWTP include:

- The City's General Plan addresses community growth up to a population of approximately 45,400. The forecast wastewater flow from this level of development is 4.8 Mgal/d (millions of gallons per day). Current wastewater flow is approximately 1.1 Mgal/d. The permitted equivalent capacity of the existing WWTP is 1.44 Mgal/d.

- The City's effluent has higher salinity than other irrigation water used in the vicinity. Therefore, the City's effluent reclamation practice has the potential to cause salinity degradation of underlying groundwater. The major source of salinity in the City's effluent is the potable water supply. This Master Plan coupled with the companion Water Master Plan provides a plan for a potable water supply improvement project to address this concern.

- The City's wastewater treatment ponds are unlined and are in direct contact with shallow groundwater. Due to this contact, there is concern that salts, nitrates, pathogens, pesticides, and/or metals may be causing groundwater contamination. Although a wastewater treatment pond in direct contact with groundwater has the potential to contaminate that groundwater, it has generally been observed that contamination does not occur (<u>Design Manual (for) Municipal Wastewater Stabilization Ponds</u> (EPA-625/1-83-015)). The reason widespread contamination does not occur is that wastewater treatment ponds tend to "seal" themselves to reduce leakage of wastewater to groundwater and that wastewater which does leak out is generally well treated by the sludge, soil, and associated microbes. The City currently is studying whether the Newman pond system acts in a similar manner. Even if other compounds appear not to contaminate groundwater, effluent salinity is still an issue for the WWTP. Also in need of study is whether unacceptable nitrogen degradation is occurring in the effluent reclamation areas. Even if other compounds appear not to contaminate groundwater, effluent salinity is still an issue for the WWTP.

- The City's effluent reclamation areas are on lands with naturally high groundwater levels, which also tend to be areas of naturally high salinity. To control shallow groundwater levels and soil salinity so as to allow agriculture to occur, much of the land immediately east of the City has been "reclaimed" by 1) the addition of subsurface shallow groundwater drainage pipes that drain to the San Joaquin River, and 2) flushing the historically accumulated salinity via application of surface water and/or groundwater to the soil. Although effluent reclamation on soils needing subsurface drainage is not prohibited, it is not encouraged if alternative effluent reclamation lands are feasible.

- The City's potable water shift from groundwater to a high quality, more expensive surface water may put the City in a position to offset potable water with reclaimed effluent for some to all urban landscape irrigation water in new development areas. This is common practice in Southern California and is becoming more common in areas of Northern California where potable water is becoming more expensive and/or difficult to reliably obtain.

- Once the potable water supply improvement project is complete, effluent salinity concentrations should be acceptable to the Regional Board. The remaining concern includes determining whether nitrogen degradation of groundwater is occurring under the reclamation area due to the pond effluent. Pond treatment (as compared to nitrification/ denitrification activated sludge) is generally not considered a reliable method for removing nitrogen from wastewater.

In light of the above concerns and the fact that a definitive assessment of degradation will take several years, this Master Plan addresses the long-term potential wastewater treatment needs by bracketing the two extremes of options. This approach gives the City a plan which can easily be adjusted based on the results of groundwater monitoring and degradation analysis. The actual path the City pursues will be dictated by the results of the groundwater monitoring and the Regional Board's input as well as policy decisions of the City Council on what type of resource it views the City's wastewater. The two extremes of options are:

1. If the existing ponds are shown to not have an impact on local groundwater (either directly near the ponds or beneath the agricultural fields due to reclamation), the existing, unlined treatment ponds will continue to be used for existing customers. The WWTP will be expanded with similar treatment for new development.
2. If the existing unlined ponds show some degree of impact to local groundwater (either directly or through effluent reclamation), wastewater from new development will be treated in a more mechanical treatment process (such as activated sludge) and the existing users will be phased out of the existing ponds and into mechanical treatment over time.

The two options identified above are the extremes. It is possible that alternatives between these two options exist.

Chapter 2

Existing and Future Flows and Loads

The purpose of this chapter is to summarize historical data and projected flows and loads for the City of Newman (City) Wastewater Treatment Plant (WWTP). This chapter establishes current (2007) equivalent design loading criteria. These flow and organic loading criteria are then used as a basis for projecting future wastewater loading conditions.

This chapter is organized into two major sections:

- Historical Wastewater Flows and Loads
- Projected Wastewater Flows and Loads

2.1 HISTORICAL WASTEWATER FLOWS AND LOADS

The City of Newman WWTP receives wastewater from a residential population of approximately 10,000 and a commercial center concentrated within its historic downtown. The City also treats wastewater generated from F&A Dairy, a raw milk processing plant, which discharges directly into the municipal sewer.

To determine historical flows and loads, daily influent flow and bi-weekly biochemical oxygen demand (BOD_5), were obtained from plant records from January 2003 to August 2007. F&A Dairy effluent flow and BOD_5 was obtained for January 2005 to December 2006. Historical WWTP influent BOD_5 indicated unaccounted for BOD_5. Therefore, some special testing was performed in August and September of 2007 to further clarify the appropriate design BOD_5 loads.

2.1.1 HISTORICAL FLOW CONDITIONS

In assessing the wastewater treatment capacity of pond systems, such as at the City's, several wastewater flow and loading characteristics are important to distinguish. Important flow conditions for this analysis are described in Table 2-1.

Average monthly influent flow, average sanitary flow (ASF), and maximum dry weather monthly flow (MDWMF) at the Newman WWTP for January 2003 through August 2007 are shown in Figure 2-1. Average monthly influent flow during this period ranged from 0.93 to 1.40 million gallons per day (Mgal/d).

The peak hour flow is the measured maximum flow at the WWTP plant. The current peak hour flow of 3.0 Mgal/d was measured in February 2005 during a rainfall storm event. Historical flow information is summarized in Table 2-2.

Table 2-1
City of Newman WWTP Flow Components [a]

Flow Component	Current Flow (Mgal/d) [b]	Description
Average Dry Weather Flow (ADWF)	1.17	ADWF represents the flow for system regulations by the Regional Water Quality Control Board (RWQCB), and for system capacity assessments by the City. Currently, the City's ADWF is regulated by the maximum month flow during dry season (often interpreted as the months of May through September). ADWF can be regulated as the 5-month average flow during this period.
Average Sanitary Flow (ASF)	1.10	ASF represents the base sanitary flow generated from residences, businesses, and industry. Often this flow corresponds to the ADWF that occurs in the summer months, unless surrounding agricultural irrigation causes significant infiltration and inflow (I&I) during summer months. In Newman, there is no significant summer I&I, therefore the ASF is roughly equivalent to the ADWF.
Maximum Dry Weather Monthly Flow (MDWMF)	1.44	MDWMF is used to determine flow compliance under the current Waste Discharge Requirements (WDR's) Permit issued by the RWQCB. Though unstated in the City's current WDRs (Order No, 98-163), RWQCB often interprets the dry weather period of the year to be from May through September. Based on this interpretation, MDWMF is expected to occur in May under heavy late spring rain conditions as a result of residual I&I from the preceding rainy season.
Peak Hour Flow (PHF)	3.00	Peak hour flow is the flow that the pond system headworks has to handle to convey the wastewater to the aeration basins/ponds. Some flow equalization will occur in the aeration basins/ponds, thereby reducing the critical peak flows and loads on the rest of the wastewater treatment system.

[a] Flow calculated based on WWTP influent data 2003 - 2007
[b] Mgal/d = million gallons per day

Based on the flow interpretations described in Table 2-1 and the City's I &I model (derived from the City's historical I&I and rainfall data), the ASF limit on the existing WWTP under the existing WDR is 1.44 Mgal/d. The current ASF is estimated to be 1.1 mgd. Thus, the existing WDRs allow 0.34 Mgal of community growth as long as any deficiencies in wastewater treatment capacity, effluent storage volume, and effluent reclamation area are corrected.

2.1.2 HISTORICAL LOADING CONDITIONS

The organic loading capacity of the Newman WWTP is measured as 5-day biochemical oxygen demand (BOD_5). BOD_5 is the accumulated oxygen required over a five day period by naturally occurring bacteria to consume the wastewater organics arriving at the WWTP each day. Influent BOD_5 for the City is measured from flow proportional samples taken weekly. BOD_5 flow composite data is also collected from the discharge of the City's largest industry, F&A Dairy. Influent BOD_5 loading, in pounds per day (lbs/d), for the last four years is provided in Figure 2-2. Average and four-sample (two month) rolling averages are also provided to determine the variation in organic loading throughout the year. The average influent BOD_5 load is about 8,300 lbs/d, with two month rolling averages from approximately 4,500 to 12,700 lbs/d.

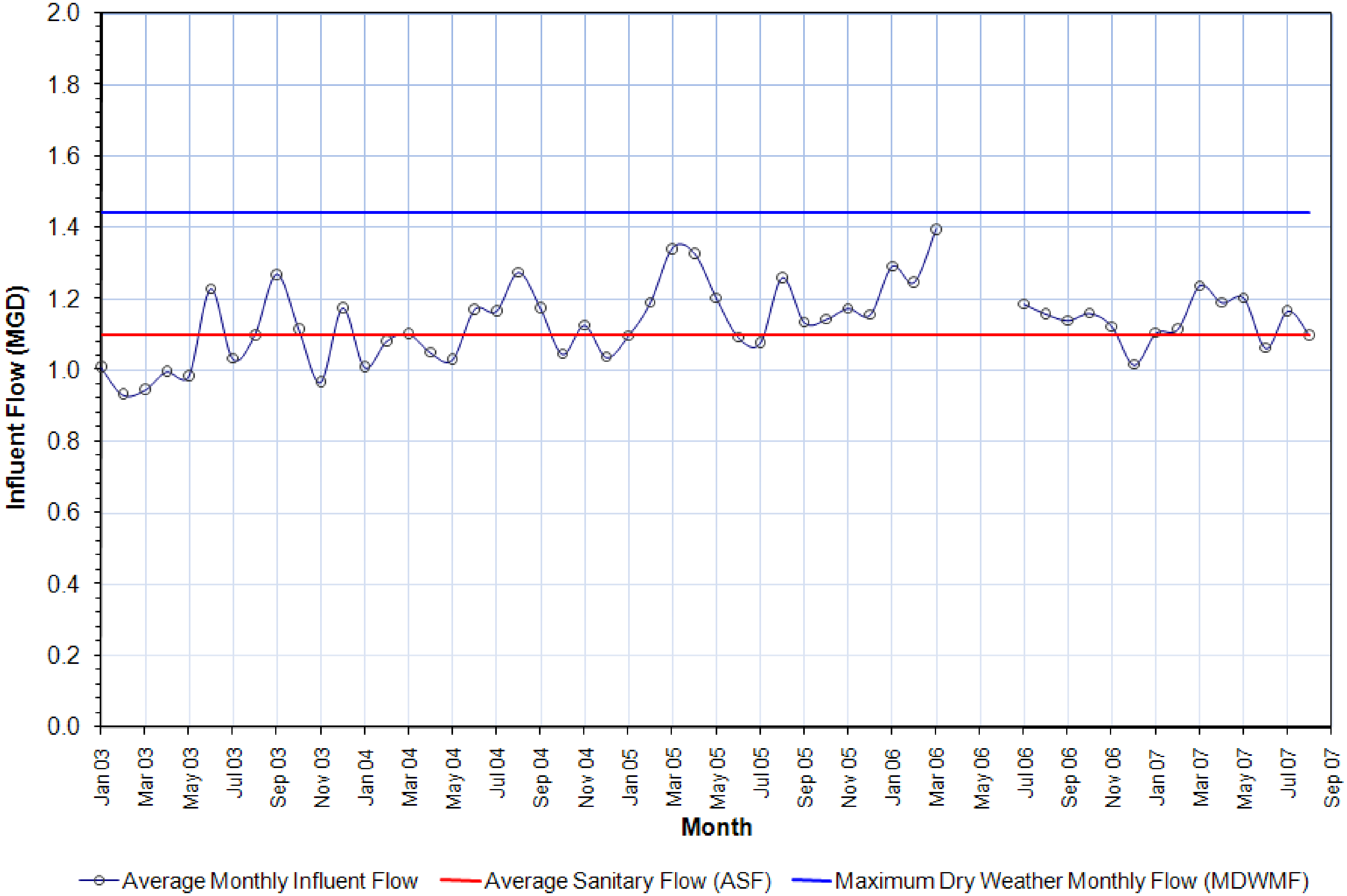


Figure 2-1
Average Monthly Influent Flow, ASF, and MDWMF at the City of Newman WWTP

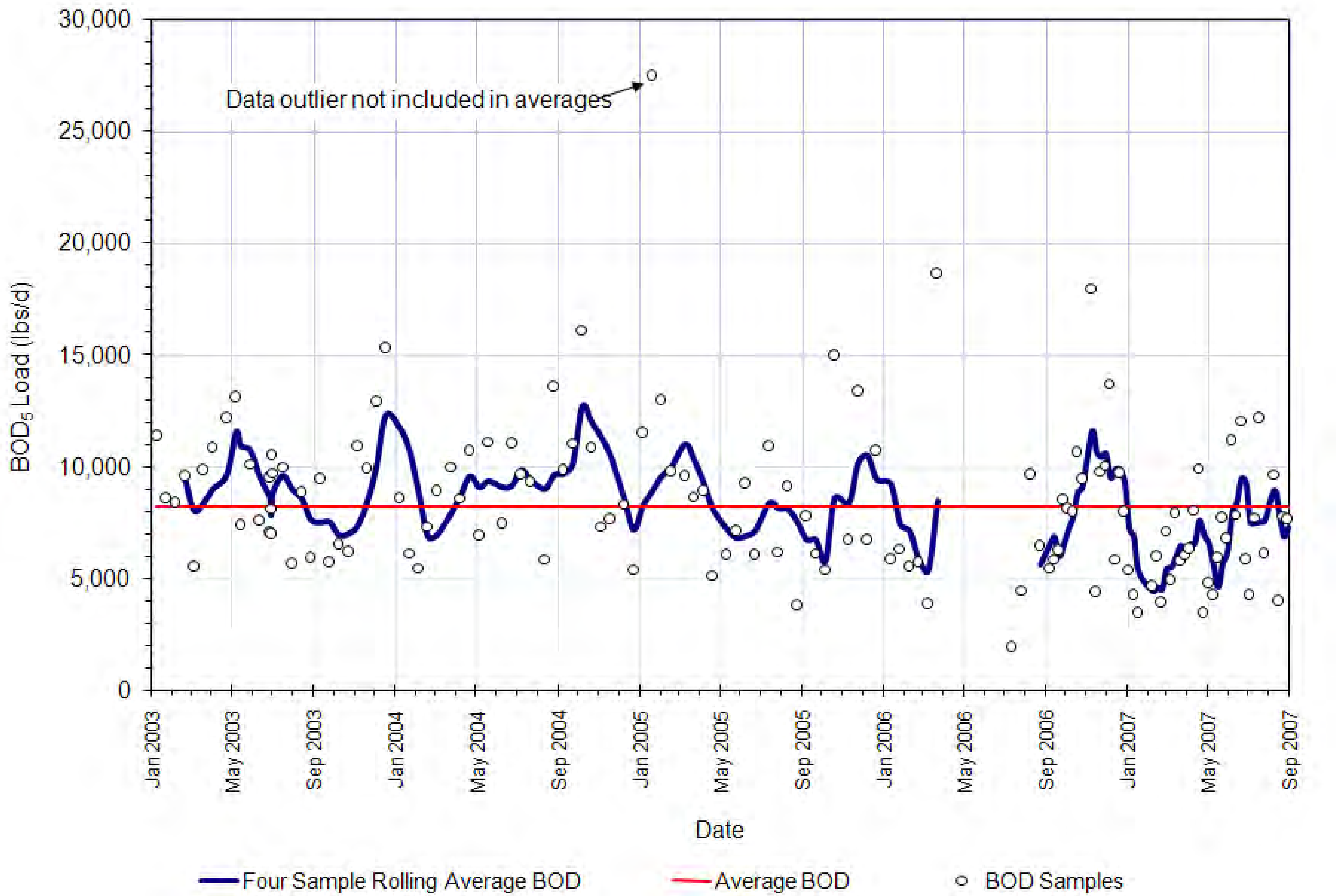


Figure 2-2
City of Newman Historical Influent BOD_5 Loading

A comparison of the existing plant design criteria and the current conditions for flows and loads is displayed in Table 2-2.

Table 2-2
City of Newman WWTP Design and Existing Flows and Loads

Constituent [a]	Existing Plant Design Criteria	Existing Conditions [b]
Flow (Mgal/d)		
Average Dry Weather Flow (ADWF)	1.14	1.17
Average Sanitary Flow (ASF)	--	1.10
Maximum Dry Weather Monthly Flow (MDWMF)	--	1.44
Peak Flow (PF)	1.71	1.40
Peak Hour Flow (PHF)	--	3.00
Constituent (lbs/d)		
Average BOD_5	9,430	8,300
Maximum BOD_5	--	18,000

[a] Mgal/d = million gallons per day; lbs/d = pounds per day.
[b] Constituents loading values determined from bi-weekly data from January 2003 to August 2007.

2.1.3 INDUSTRIAL WASTEWATER CONTRIBUTION

The City WWTP also treats wastewater generated by the industries in the City. Of particular importance is that the F&A Dairy (with an historical average BOD_5 load of about 5,200 lbs/d) represents over half of the influent organic loading to the WWTP. Based on historical data, the average monthly BOD_5 concentration of F&A Dairy discharge is about 1,800 milligrams per liter (mg/l). However, due to the variability in F&A Dairy discharge (ranging from 310 mg/l to 7,700 mg/l during 2005 to 2006) a conservative value of 2000 mg/l is used for analyses in this Master Plan. F&A Dairy is a significant contribution to the influent organic load at the WWTP and much of the variation in influent organic load (Figure 2-2) is likely attributable to this industry. Peak monthly loading from municipal wastewater typically varies about 20 to 30 percent above average. As a result of industrial contributions, the peak monthly loading for the four year period shown in Figure 2-2 varied up to 200 percent above the average and values of 50 to 60 percent above average were not uncommon.

2.1.4 ORGANIC LOADING SPECIAL TESTING

Prior analysis of WWTP influent and F&A Dairy effluent BOD_5 indicated that there was a significant discrepancy in the BOD_5 observed at the WWTP and the load that would be anticipated based on typical residential wastewater strength (Table 2-3). This variance is important since BOD load affects WWTP costs in both the capital cost of the treatment facilities and in the cost to maintain and operate those treatment facilities.

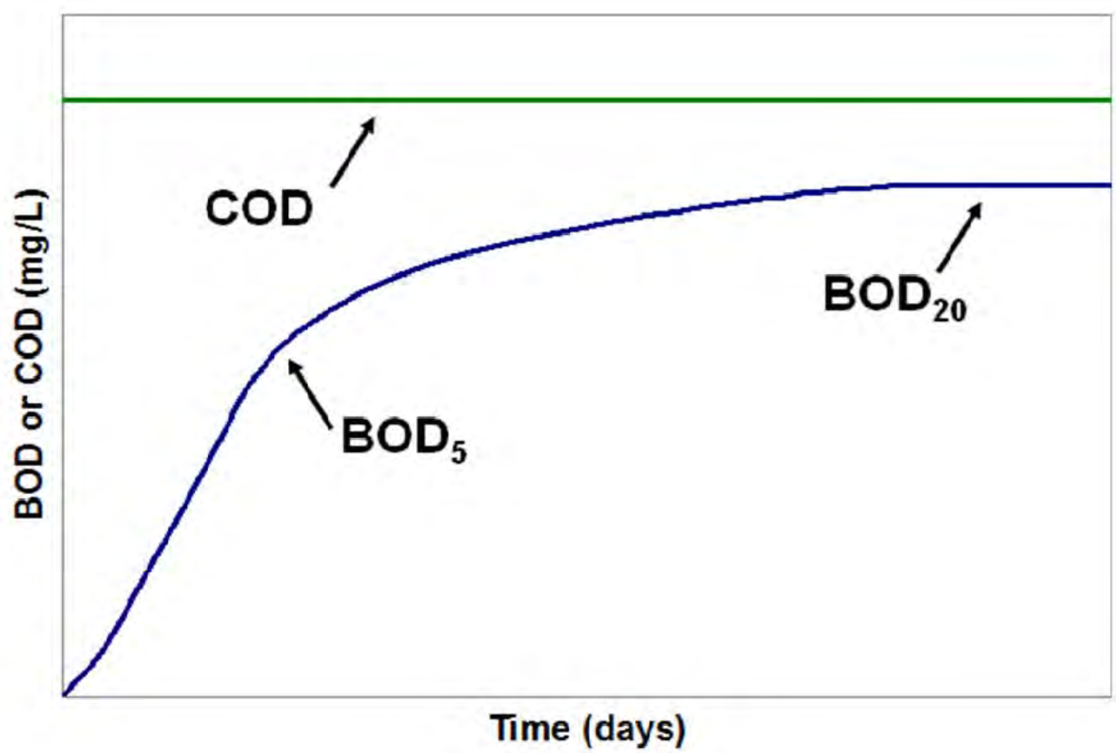
Table 2-3
City of Newman Anticipated BOD_5 Load

	Biochemical Oxygen Demand (BOD_5) in pounds per day (lbs/d)
F&A Dairy BOD_5	5,200
Estimated BOD_5 for 10,000 people	1,800
Total Anticipated BOD_5 Load	**7,000**
Current Average WWTP BOD_5 Load	8,300
Difference (Unaccounted for BOD_5)	**1,300**

Special testing was conducted on August 22nd and September 12th, 2007 to determine the source of this "mystery" BOD. Wastewater samples were collected from three locations: F&A Dairy effluent, a manhole in the City prior to F&A Dairy discharge, and the influent to the WWTP. Samples were analyzed for 5-day biochemical oxygen demand (BOD_5), 20-day biochemical oxygen demand (BOD_{20}), chemical oxygen demand (COD), and total organic carbon (TOC). The 5-day BOD test provides a measure of the readily biodegradable organics in the wastewater. The 20-day BOD test provides a measure of the ultimate biodegradable organics and the COD is an actual measure of organic demand (Figure 2-3). Sampling (two samples) of City wastewater prior to F&A Dairy discharge indicated that the municipal wastewater for the City of Newman has an average BOD_5 concentration of approximately 255 mg/l. Municipal BOD_5 is generally between 250 and 300 mg/l when I&I is low. Therefore, the City's municipal wastewater appears to be to be typical. Conclusions from the special testing are described in detail in Appendix A and summarized below.

Special testing conclusions include:

- The organic loading of F&A Dairy effluent is highly variable. Samples collected on the two special testing days were 1,610 lbs/d and 4,460 lbs/d and have been measured as high as 7,250 lbs/d (March 2006).
- F&A Dairy wastewater is not readily biodegradable.
- F&A Dairy BOD_5 results are probably low at times due to microbial inhibition due to disinfectants and/or inadequate seed in the BOD test bottle.
- F&A Dairy and City residential wastewaters synergistically become very biodegradable wastewater in the collection system.
- Unaccounted for BOD may be a result of transformations in the collection system pipes leading to the WWTP.
- Some organics remain in the collection system and are degraded by organisms in the collection system, which produce more readily biodegradable wastes. These show up at the WWTP and increase in the influent BOD_5.
- BOD_5 (alone) is not a good indicator of overall organic oxygen demand.



Note:
BOD_5 = 5-day Biochemical Oxygen Demand
BOD_{20} = 20-day Biochemical Oxygen Demand
COD = Chemical Oxygen Demand

Figure 2-3
General Relationship Between BOD_5, BOD_{20}, and COD

Based on the special testing results, a summary of the current and permitted future influent flow and loading conditions is provided in Table 2-4.

Table 2-4
City of Newman WWTP Current and Permitted Influent Flows and Load

	Average Sanitary Flow (Mgal/d) [a]	BOD_5 (mg/l) [a],[b]	BOD_5 (lbs/d) [a]
Existing Conditions			
Municipal	0.92	300	2,300
F & A Dairy	0.18	2,000	3,000
Total at WWTP	**1.1**	**580**	**5,300**
Permitted Conditions			
Municipal	1.26	300	3,200
F & A Dairy	0.18	2,000	3,000
Total at WWTP	**1.44**	**514**	**6,200**

[a] Mgal/d = million gallons per day; mg/l = milligrams per liter; lbs/d = pounds per day
[b] Municipal BOD_5 is based on historical data and typical composition of untreated domestic wastewater of 110mg/l – 350mg/l (Metcalf & Eddy 4th Edition)

2.2 PROJECTED WASTEWATER FLOW AND LOADS

The *City of Newman 2030 General Plan* (General Plan) (Design, Community & Environment, April 2007) establish three areas for future development. These areas include: infill within the existing city limit (i.e., Buildout of existing City Limits), the Primary Sphere of Influence (SOI), and the Secondary Sphere of Influence (SOI) (Figure 2-4). The General Plan established land use designations for planned future developments, including residential densities and commercial and industrial acreages. Land use designations are shown in Figure 2-5.

2.2.1 PROJECTED CITY GROWTH

The General Plan assesses delineated land use areas referred to as the Sphere of Influence (SOI), which are larger than the proposed City limits. The SOI includes land over which the City does not have complete jurisdiction. However, the City has the option to annex the land and develop it in the future. The SOI is divided into two areas: the Primary SOI and the Secondary SOI. The Primary SOI depicts areas that are anticipated to be developed within ten years after the adoption of the General Plan. The Secondary SOI includes lands that are anticipated to be developed through 2030.

The General Plan provides land use designations for each of the development area, including residential densities (expressed in equivalent dwelling units, or EDUs), commercial, industrial and public area acreage, as shown in Figure 2-5. The total residential EDUs and acreage for the land use designations for each of the development area are summarized in Table 2-6. The population projections have been estimated based on 3.4 people per equivalent dwelling unit, as stated in the General Plan.

2.2.2 PROJECTED FUTURE WASTEWATER FLOW & LOADS

Projected influent flow and loads were developed based on the per capita and EDU information provided in the General Plan as described above. Wastewater unit flows used to develop total flows for the various land use types are shown in Table 2-5.

Table 2-5
City of Newman
Recommended Planning Wastewater Unit Flows

Land Use Designations	Future Land Use Unit Flow [a]
Residential [b]	63 gpdpc
Commercial	1,500 gpd/ac
Industrial	1,650 gpd/ac
Public / Quasi Public	1,200 gpd/ac

[a] gpdpc = gallons per day per capita; gpd/ac = gallons per day per acre.
[b] Unit generation values for residential are based on residential densities as defined in the General Plan and an occupancy rate of 3.4 persons/EDU.

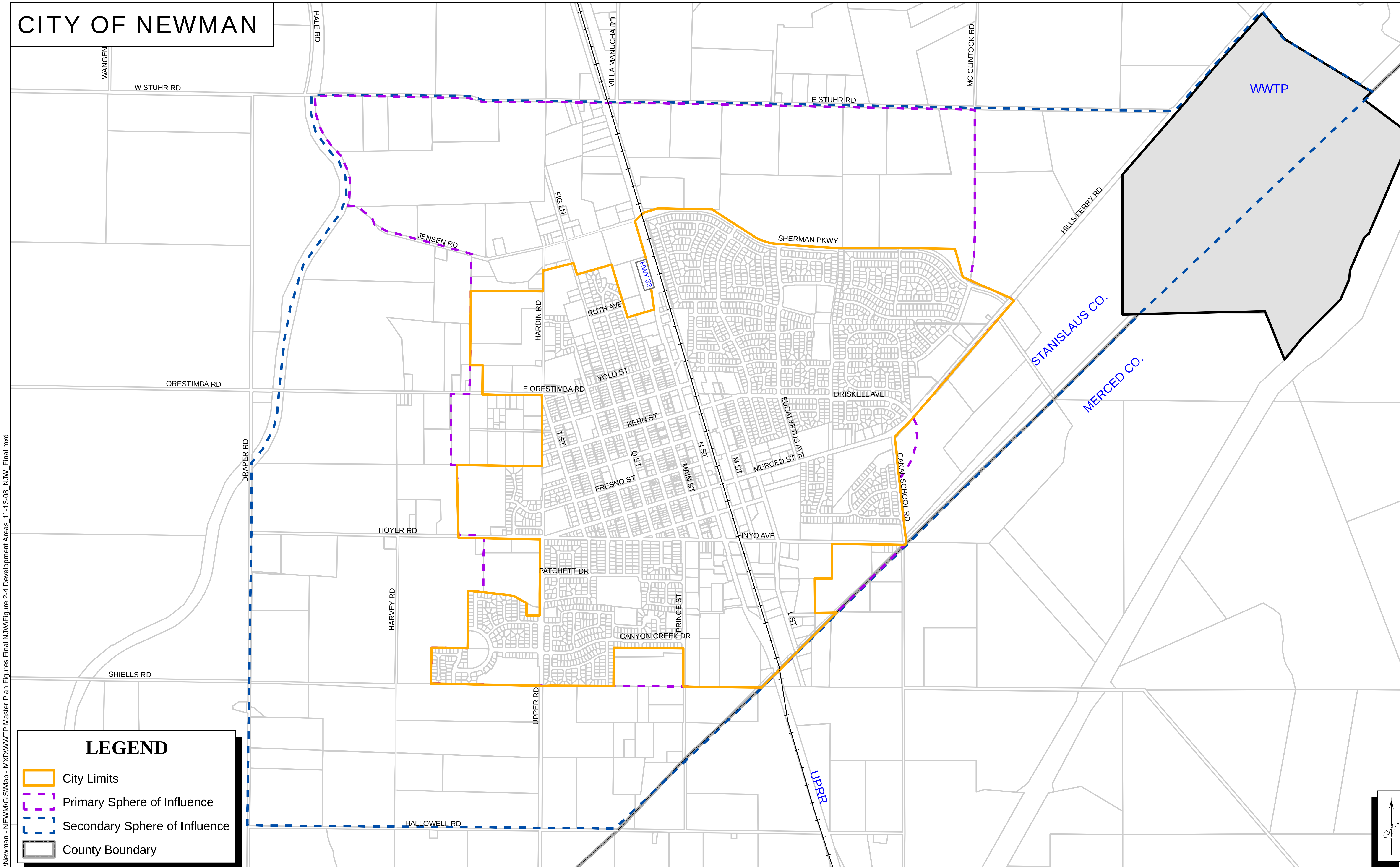


Figure 2-4
City of Newman Development Areas

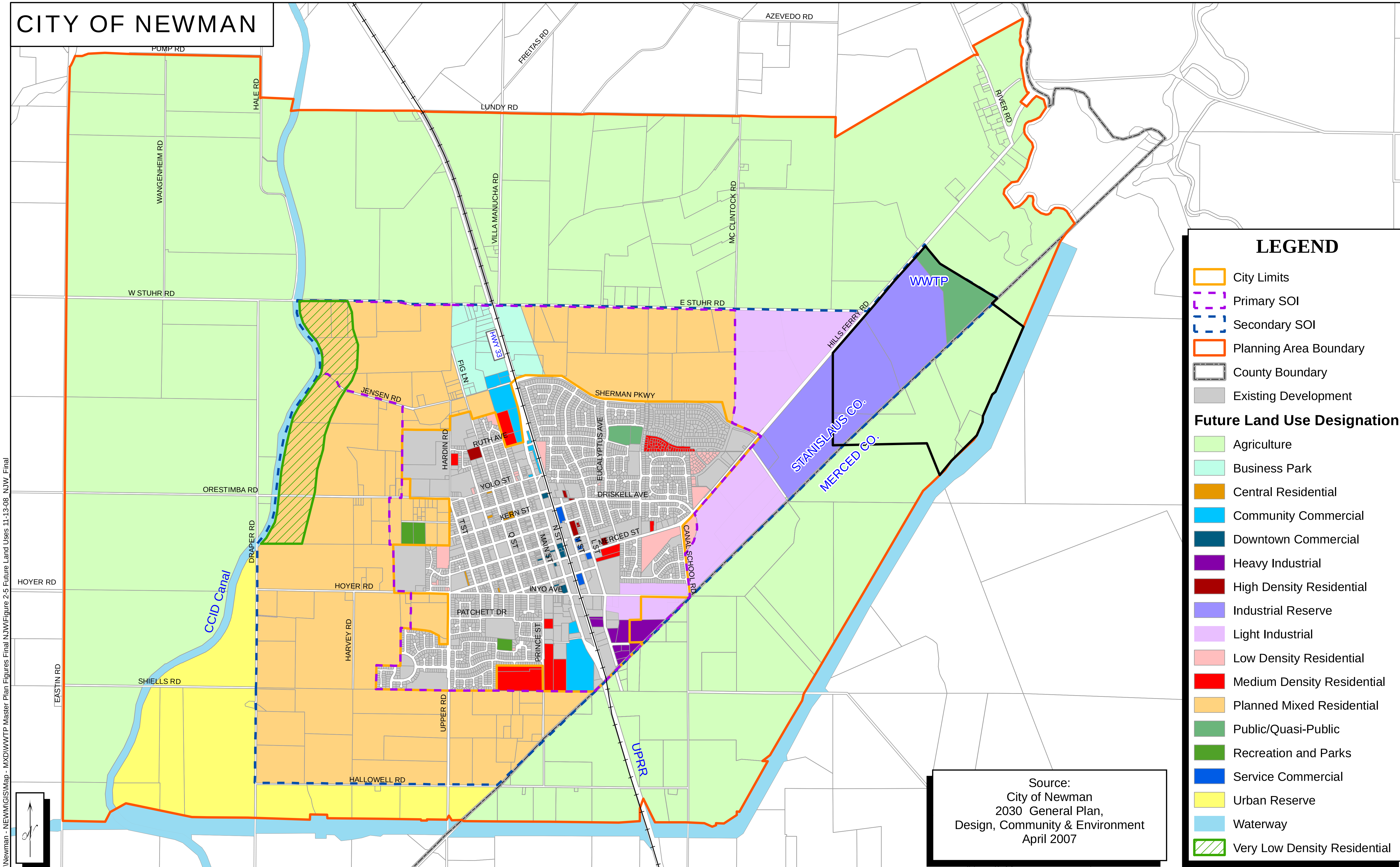


Figure 2-5
Future Land Uses

A summary of the existing and projected flows for each development area by land use type is provided in Table 2-6. Within the current City Limits, the additional residential developments, commercial facilities, and industrial facilities are estimated to produce an additional average flow of approximately 0.3 Mgal/d. Combining this flow with the current ASF of 1.1 Mgal/d will result in a flow of 1.4 Mgal/d for build-out of the existing City Limits. For the Primary SOI, the additional development will produce a total average flow of 2.3 Mgal/d. At build-out of the entire development area the total average influent flow is projected to be 4.8 Mgal/d.

Projected influent loading conditions were also determined based on historical loads and the following assumptions:

1. The City of Newman municipal wastewater BOD_5 concentration will remain at typical strength, approximately 300 mg/l.

2. F&A Dairy will not experience significant growth and will, therefore, continue to contribute an average of 0.18 Mgal/d to the total flow of the City, with a BOD_5 concentration of 2,000 mg/l. Or, any additional flow produced by F&A Dairy will be pre-treated to municipal strength.

A summary of the projected flows and loads for each future development area is also provided in Table 2-6.

Table 2-6

City of Newman Estimated Flows and Load for each Land Use Designation

	Existing [(a), (h)]	**Additional within Existing City Limit**	**Additional within Primary SOI**	**Additional within Secondary SOI**	**Cumulative Total at Buildout**
Population [(b)]	10,140	1,972	11,118	22,168	45,398
Residential [(c)] (EDUs)	2,805	580	3,270	6,520	13,175
Commercial [(d)] (acres)	37	35	116	--	188
Industrial [(e)] (acres)	57	41	25	660	783
Public/Quasi-Public [(f)] (acres)	102	10	--	47	159
Flow, gallons per day (gpd)					
Residential	0.64	0.12	0.70	1.40	2.86
Commercial	0.06	0.05	0.17	--	0.28
Industrial	0.09	0.07	0.04	1.09	1.29
Public/Quasi-Public	0.12	0.01	--	0.06	0.19
F& A Dairy [(g)]	0.18	--	--	--	0.18
Total ASF, (Mgal/d), rounded	**1.1**	**0.3**	**0.9**	**2.5**	**4.8**
Biochemical Oxygen Demand (BOD_5) Load, lbs/day					
Average BOD_5 [(h)]	2,279	641	2,291	6,360	11,600
F& A Dairy [(g)]	3,019	--	--	--	3,019
Total Average BOD_5 Load, lbs/day	5,298	641	2,291	6,360	14,590

(a) Existing population and units information obtained from the City of Newman and City of Newman Public Review 2030 General Plan EIR (October 2006).

(b) Projected population at 3.4 people/EDU (City of Newman 2030 General Plan).

(c) Projected units represent the potential number of units that could be added through build-out. Source: City of Newman 2030 General Plan (April 2007), Public Review Newman 2030 General Plan EIR (October 2006), Geographical Information System (GIS) database provided by DC&E.

(d) Includes Business Park, General Commercial, Downtown Commercial, and Office uses.

(e) Additional industrial acres within the Secondary SOI includes 310 acres of Industrial Reserve.

(f) Includes Schools and Public Buildings areas.

(g) Assumes F&A Dairy industrial wastewater will continue to contribute an average 0.181 Mgal/d to the total wastewater flow and BOD_5 concentration of 2,000 mg/l.

(h) Existing and projected flows and BOD_5 loads are calculated values based on special testing done in August and September 2007.

Chapter 3

Existing Wastewater Treatment and Disposal Facilities

This chapter describes the existing treatment and disposal facilities at the City of Newman Wastewater Treatment Plant (WWTP).

3.1 EXISTING TREATMENT AND DISPOSAL FACILITIES

The City of Newman (City) WWTP is located approximately one mile northeast of the City, west of the San Joaquin River and southeast of Hills Ferry Road. The Stanislaus County and Merced County line runs through the WWTP and disposal fields. The WWTP was originally constructed in 1908 and has undergone several expansions, modifications, and/or improvements since.

The City WWTP uses an aerated pond system to treat all wastewater generated within the City, including municipal wastewater and wastewater generated from the F&A dairy, which discharges into the municipal sewer. The treated effluent is stored in the winter and used to irrigate alfalfa, pasture grass, and sudan in the summer on City owned agricultural lands. A layout of the treatment plant site is provided in Figure 3-1.

The WWTP consists of a headworks, two aeration basins, an oxidation pond, a recirculation channel, and a recirculation pump station. Disposal facilities include a storage basin and reclamation fields. Treatment wastewater is reclaimed on overland flow terraces and by flood irrigation on agricultural fields. Tailwater from the fields is collected in a tailwater pond and returned to the storage basin.

Combined municipal and industrial wastewater flows by gravity from the City and enters the headworks through an 18-inch and a 21-inch pipeline. The existing headworks consists of a manual bar screen and a Parshall flume. Influent wastewater passes through the bar screen which removes particles larger than two inches. After the bar screen, the influent flow is measured by a 9-inch Parshall flume before entering a junction box that diverts flow to the first aeration basin for treatment.

Aeration pond systems are designed to oxidize organic material in the wastewater by providing oxygen to microbiological organisms through three means: 1) transfer of oxygen across the pond surface, 2) production of oxygen by algal photosynthesis, and/or 3) oxygenation supplemented by mechanical aeration equipment. In the case of Newman, all of these means of oxygenation are employed. Ponds using mechanical aeration equipment (aerators) are called “aerated ponds,”

CITY OF NEWMAN

M:\Newman - NEWM\GIS\Map - MXD\WWTP Master Plan\WWTP Master Plan Figures Final NJW\Figure 3-1 Existing Wastewater Treatment and Disposal Facilities Site Layout 11-13-08_NJW.mxd

ECO:LOGIC Engineering
City of Newman Wastewater Treatement and Disposal Master Plan

Figure 3-1
Existing Wastewater Treatment and Disposal Facilities Site Layout

while ponds without mechanical aerators are called “facultative ponds”. The first two ponds (Aeration Basin (AB) No. 1 and AB No. 2) are equipped with mechanical aeration to provide oxygen for wastewater treatment.

After passing through the aerated treatment ponds, effluent is conveyed to a facultative pond, the Oxidation Pond. To assist in providing more oxygen to the treatment process, higher dissolved oxygen water is recirculated from the Oxidation Pond via a recirculation channel to the head of AB No. 2.

From the Oxidation Pond, effluent is transferred to the irrigation storage reservoir via the transfer pump station. During the wet season, the Oxidation Pond also provides some storage. Effluent is pumped from the storage reservoir and reclaimed during the dry season (generally April through October) by flood irrigation of the City-owned disposal fields. Effluent is also pumped from the Oxidation Pond to be reclaimed on the overland flow terraces by spray irrigation.

The reclamation fields include 58 acres of pasture grass overland flow terraces and a total of 239 acres of agricultural fields. The agricultural fields consist of the Front 66 (66 acres), the Front 55 (55 acres), the Back 66 (66 acres) and the Back 52 (52 acres). These fields grow alfalfa, oats, and sudan. Excess tailwater from the fields is collected in a tailwater pond of approximately 1 acre and returned to the storage reservoir.

Existing design criteria for the City of Newman WWTP are provided in Table 3-1.

Table 3-1
City of Newman WWTP Existing Design Criteria [(a)]

Item	Design Value
Design Flows and Loads	
Average Day Weather Flow (ADWF), MGD	1.14
Peak Flow (PF), mgd	1.71
Design Constituent Loadings	
BOD_5, lbs/d	9,430
TSS, lbs/d	4,290
Ammonia, lbs/d	590
Parshall Flume	
Throat Width, in	9
Discharge Head at AAF, in	8.3
Discharge Head at PF, in	10.9
Bar Screen	
Channel Width, ft	4
Bar Spacing, in	1.5
Bar Width, in	3/8
Bar Depth, in	2.0

Item	Design Value
Aeration Basin No. 1	
Area, ac	2.7
Water Depth, ft	8.0
Volume, MG	7.0
Aeration Blower & Diffuser System[C]	
Blower Type	Regenerative
Number of Blowers	9
Horsepower, ea	10
Diffuser Type	Membrane Porous Pipe
Aeration Basin No. 2	
Area, ac	5.0
Water Depth, ft	5.5 - 9.0
Volume, MG	9.0 - 14.7
Surface Mechanical Aerators (Splash Type)	
Number	3
Horsepower, ea	40
Aeration Blower & Diffuser System	
Blower Type	Regenerative
Number of Blowers	1
Horsepower, ea	11.5
Diffuser Type	Membrane Porous Pipe
Oxidation Pond	
Area, ac	50
Water Depth (min to max), ft	5.5 - 9.0
Volume (min to max), MG	90 – 147
Maximum Organic Loading, lbs/d/ac	30 to 50 (winter to summer)
Recirculation Pumps	
Number	2
Capacity, ea, gpm	3,000
TDH, ft	4.0
Horsepower, ea	7.5
Overland Flow Pumps	
Number	2
Capacity, ea, gpm	50
TDH, ft	150
Horsepower, ea	25
Overland Flow System	
Area, ac	58
Slope Grade, %	2.5 - 5.5
Storage Reservoir No. 1	
Maximum Surface Area, ac	29
Maximum Water Depth, ft	12
Maximum Volume, MG	95

Item	Design Value
Irrigation System	
Area, ac	239
Crops	Alfalfa, Winter Oats, Sudan, Pasture Grass
Irrigation Pumping System	
Pump Type	Mixed Flow
Number	2
Capacity, ea, gpm	1,000
TDH, ft	19
Horsepower, ea	10
Tailwater Return System	
Reservoir Depth, ft	5.0
Maximum Volume, MG	1.6
Pumps	
Type	Mixed Flow
Number	2
Capacity, ea, gpm	700
TDH, ft	21
Horsepower, ea	7.5
Tailwater Return System B	
Pumps	
Type	Mixed Flow
Number	2
Horsepower, ea	5
Transfer Pump Station	
Pump Type	Mixed Flow
Number	2
Capacity, ea, gpm	1,000
TDH, ft	36
Horsepower, ea	10

(a) Based on TM No. 2 – Existing Wastewater Facilities, Carollo Engineers (August 2003)
(b) MGD = million gallons per day; MG = million gallons; gpm = gallons per minute; lbs/d/ac=pounds per day per acre.
(c) According to plant staff, 3 additional blowers were added after 2003.

3.2 NEAR-TERM TREATMENT AND DISPOSAL FACILITIES

The City has designed and is planning on constructing a new storage basin for supplemental storage on an existing irrigation field, the Back 52. The new storage basin will occupy approximately 39 acres of the existing 52 acres of crop land and will have depth of 12 feet with a capacity of 135 million gallons. This supplemental basin will hold effluent in wetter years. Since this storage basin will be constructed on existing irrigation disposal land, additional land will be needed in the future.

Chapter 4

Regulatory Review and Permit Compliance

The City of Newman (City) Wastewater Treatment Plant (WWTP) is regulated under Waste Discharge Requirements (WDRs) Order No. 98-163, which is issued and enforced by the California Regional Water Quality Control Board (Regional Board). WDRs describe wastewater treatment, effluent disposal requirements (water quality, disposal method, and disposal location) and allowable wastewater flow. Typically, WDRs are updated approximately every 5 to 15 years, unless more frequent updates are requested by the discharger (e.g., to increase permitted flow capacity). One of the purposes of this updating process is to keep the WDRs up to date with Regional Board regulations, which are constantly evolving. Consequently, specific permit requirements are unknown until the permit is adopted.

The City's WWTP currently is permitted to discharge 1.69 million gallons per day (Mgal/d) Maximum Dry Weather Monthly Flow (MDWMF) of "equivalent secondary" treated effluent to the City's effluent reclamation facilities, which consist of agricultural fields and seasonally used effluent storage ponds. This 1.69 Mgal/d MDWMF limit corresponds to an average sanitary flow (ASF) limit of approximately 1.44 Mgal/d. The City's WDRs were last updated in 1998.

Under the current WDRs, concerns to either the City or the Regional Board include facility capacity, the ability of the facility to operate during 100-year wet season conditions, effluent quality, and the potential for groundwater degradation. Regional Board concerns regarding effluent quality include:

- The possibility of wastewater pathogens traveling offsite via groundwater or surface waters,
- Wastewater salinity impacting groundwater quality,
- Naturally occurring metals, specifically arsenic, iron, and manganese, being mobilized in the groundwater by WWTP operations, and
- Wastewater nitrogen and nitrate impacting groundwater quality.

The City's current regulatory compliance strategy and permitting issues related to capacity and groundwater degradation are summarized in this chapter along with a discussion of probable future regulations related to potential future disposal options. The remainder of this chapter is organized into the following major sections:

- Summary of Current Regulatory Assessment
- Future Regulatory Permit Compliance Issues

4.1 SUMMARY OF CURRENT REGULATORY ASSESSMENT

As mentioned above, WDRs are typically updated every 5 to 10 years unless the City requires additional capacity for new development. WDRs can also be updated if the operation of the facility is determined to cause environmental degradation and does not to satisfy what the State considers "best practicable treatment and control" (BPTC). An assessment of whether the facility needs to implement BPTC typically involves comparing local groundwater water quality data to State water quality objectives. If degradation exists, the Board generally directs the discharger to propose BPTC mitigation measures and a compliance schedule for implementing those measures.

In correspondence to the Regional Board in late 2005 and 2006, several BPTC policy-related questions and interpretations of local groundwater quality data were addressed. On March 14th, 2006, the City submitted a letter to the Regional Board which provided information on system performance and local groundwater quality, summarized the City's wastewater and water planning activities, identified regulatory issues of concern, and provided a plan for compliance, particularly with regards to salinity (Appendix B). This letter and a subsequent meeting with the Regional Board on June 15th, 2006 identified the major wastewater issue as high effluent salinity. Other potential issues included the possibility of groundwater degradation due to the unlined storage ponds and the facility's ability to accommodate permitted flows under 100-year wet season conditions. With regards to groundwater degradation and salinity, the following permit issues and approaches were discussed:

1. Impacts from the WWTP on local groundwater quality are difficult to assess because the area has naturally high saline groundwater and no down-gradient monitoring well exists. The City and Regional Board agreed to construct a new monitoring well down-gradient of the Oxidation Pond and collect data to determine if specific impacts from the pond system could be determined. As additional groundwater data are compiled, the City and the Regional Board will re-evaluate whether the WWTP is causing degradation.
2. The Regional Board is concerned about wastewater salinity impacts to local groundwater. The City plans to change the potable water supply from saline groundwater to California Aqueduct surface water to reduce effluent salinity from the current value of about 3,500 microsiemens per centimeter (µS/cm) to about 2,000 µS/cm. The costs of purchasing raw surface water, constructing a new surface water treatment plant, and modifying the existing groundwater well-based water distribution system are significant and will be financed principally by increases to monthly water/wastewater rates. Preliminary estimates show that rates may increase by over $50 per month for typical single family homes. Such a magnitude of increase will likely limit the City's ability to fund other improvements to the WWTP in the next several years. The Regional Board recognized the dual benefit of focusing available funds on improving the potable water supply and encouraged the City to pursue this course of action.

The following sections describe the overall wastewater facilities compliance plan that the City is pursuing. It is important to note that, since aspects of the plan are beyond City control, the plan may need to change as regulatory negotiations progress related to evolving Regional Board policies.

4.1.1 Salinity Issues

The basic issue related to salinity is that the water supply is very salty (about 1,700 μS/cm) by drinking water standards and has a lot of hardness, which results in the use of water softeners in town. As described in the companion *City of Newman Water Master Plan* (March 2008), the City is seriously pursing a potable water supply and treatment project to convert the City from bulk groundwater (1,700 μS/cm) to surface water (500 μS/cm average annual salinity). This project will reduce average potable water supply salinity (and therefore average wastewater salinity) by about 1,200 μS/cm.

Converting the water supply from groundwater to surface water should reduce influent wastewater salinity from the current 2,800 μS/cm concentration down to about 1,600 μS/cm. A 1,600 μS/cm influent wastewater salinity would evaporatively increase on an average annual concentration basis to about 2,000 μS/cm after pond treatment and storage, based on the 25 percent increase in salinity currently occurring from influent to storage. Effluent in this salinity range could leak from unlined ponds and not cause degradation based on all available data.

To reduce wastewater salinity to the extent feasible, another aspect of the City plan is public education to try to reduce the use of water softeners in the community once water softeners are no longer needed because of the relatively “soft” surface water supply. The public education effort will be complemented with a careful review of City ordinances regulating the salinity of commercial/industrial discharges to the sewer system. The City’s objective is to reduce the influent wastewater salinity to less than 1,600 μS/cm to the extent feasible over time, though with increased water conservation as the City grows, a long-term decrease in salinity may not be observed.

4.1.2 Potential Groundwater Degradation due to Ponds

The City’s existing wastewater treatment ponds are unlined and in direct contact with shallow groundwater. However, previous engineering estimates of pond leakage have indicated a permeability of approximately 3.4×10^{-7} centimeters per second (cm/sec), or equivalent to the ponds having an intact one foot thick clay liner. A wastewater treatment pond in direct contact with groundwater has the potential to release a wide range of wastewater contaminants to groundwater, but often does not as evidenced by the following assessment from EPA’s Design Manual (for) Municipal Wastewater Stabilization Ponds (EPA-625/1-83-015):

> *The five communities were selected for study and the age of the systems ranged from 3 to 17 years.*
>
> *Field permeability tests indicated that the additional sealing from the sludge blanket was insignificant in locations where impermeable soils were used in the construction process. In the case of more permeable soils, it appeared that the sludge blanket reduced the permeability of the bottom soils from an initial level of 10^{-4} or 10^{-5} cm/sec to the order of 10^{-6} cm/sec. At all five systems evaluated, the stabilization pond was in contact with the local groundwater table. The buildup of sludge on the bottom of a pond appears to*

> *improve the quality of the seepage water leaving the pond. Sludge accumulation apparently increases the cation exchange capacity of the bottom of the pond.*
>
> *Groundwater samples obtained from monitoring wells did not show any appreciable increases in nitrogen, phosphorus, or fecal coliform over the background levels after 17 years of operation. The seepage from the ponds did show an increase in soluble salts over background levels.*

The reason widespread contamination does not occur is that wastewater treatment ponds tend to “seal” themselves to reduce leakage of wastewater to groundwater, and that wastewater which does leak out is generally well treated by the sludge, soil, and associated microbes. Regardless of the above information, the City is studying whether its ponds are causing any site-specific groundwater degradation. To complete a site-specific study requires establishing background groundwater quality concentrations and installing monitoring wells hydraulically down-gradient from the treatment ponds to measure pond impacts on shallow groundwater quality relative to the background concentrations. Four main concerns related to groundwater are:

1. <u>Salinity:</u> If influent salinity is reduced to roughly 1,600 μS/cm by switching to a surface water potable water supply, it is highly unlikely that the treatment ponds will be degrading groundwater with salinity. Once the conversion to surface water is made, it may take several years for the effect of the change to be detectable in monitoring wells because of slow horizontal flow rates in area shallow groundwater, and the long-term integrating effect of monitoring well screens more than a few feet long.

2. <u>Nitrogen</u>: The current “best guess” is that background total nitrogen concentrations are at or below the 10 milligrams per liter (mg/l) water quality objective (WQO). Therefore, the down-gradient wells will probably need to have total nitrogen concentrations not exceeding 10 mg/l on a long-term average basis for the ponds to remain in service. Nitrogen is not expected to be a problem in this particular situation, but this assumption needs to be confirmed by down-gradient monitoring well results.

3. <u>Pathogens:</u> Meaningful pathogen testing is a complex issue. Coliform bacteria are too large to move far in fine-grained, poorly drained soils, even if those soils are saturated. The presence of coliform bacteria in any down-gradient wells will most likely be an indicator that the well was contaminated during construction, has a faulty sanitary seal (a common problem with shallow monitoring wells in clay soils with shrink/swell potential), or was sampled without use of sterile techniques. It is possible that if groundwater is within a few feet of ground surface at the well site, coliform could migrate down from the ground surface at the well site, rather than horizontally from the treatment ponds. The actual indicator of potential virus movement from the treatment ponds into shallow groundwater is expected to be a virus of coliform. Unfortunately, if shallow groundwater is within a few feet of ground surface at the well site, then soil coliform and their virus naturally could be in the soil and groundwater immediately around the well site, and flow into the well during purging and sampling. Based on previous experience with similar sites over the last 20 years, coliform may be living in shallow groundwater on particles or on the surfaces of pipes and well casings, but not in the water. If coliform bacteria are present locally, then coliform virus will be present locally right in the monitoring well casing and sand pack. In this particular situation, it appears that neither coliform nor coliform virus testing, alone, will answer the question of whether virus

leakage from the ponds is occurring. It appears that coliform virus concentrations in the down-gradient treatment pond monitoring wells will have to be compared to coliform virus concentrations in wells constructed in similar soil and hydrogeologic conditions in the area. Additionally, the wells may need to be cleaned, super chlorinated, and gently purged immediately prior to each coliform virus sampling event to reduce the influence of well casing coliform and virus growths on groundwater monitoring results. The proper approach to resolve this complex matter is to carefully site, construct, and test the wells, first. If there are no coliform virus present, then there is no pathogen leakage problem from these ponds. If coliform virus are present, the City needs to take the additional coliform virus monitoring steps identified above before concluding whether the ponds do (or do not) have a detectable potential pathogen leakage problem.

4. Iron, Manganese, and Arsenic: Mobilization of soil iron, manganese, and/or arsenic is believed to be a potential problem with the ponds. Two reasons for this potential are:

   - The Oxidation Pond is large and effectively cuts off all atmospheric molecular oxygen transfer to the underlying groundwater. Without atmospheric molecular oxygen transfer, even a relatively small organic load to the underlying groundwater has the potential to reduce the reduction/oxidation potential (i.e., redox potential) of the groundwater environment. A low redox can mobilize naturally occurring soil iron, manganese, and/or arsenic into groundwater.

   - Though leakage from the Oxidation Pond is quite low (estimated to be 2.1 feet/year), this leakage water is believed to contain more biochemical oxygen demand than molecular oxygen. Thus, a reduction of redox potential in groundwater underlying the Oxidation Pond is likely.

Whether a serious iron, manganese, and/or arsenic problem exists can only be determined via monitoring down-gradient shallow groundwater quality and comparing those results to background concentrations.

To determine the degradation potential of the ponds with regard to the above concerns, a down-gradient indicator monitoring well was installed in early 2008. It is presumed that if testing from this well shows that the “de facto lined” treatment ponds are not degrading or polluting groundwater, then the ponds will remain in service. If only salinity is a problem, then the ponds will remain in service if the new surface water potable water supply is obtained. Groundwater degradation from nitrogen, pathogens, or iron/manganese/arsenic probably necessitates either lining the treatment ponds or replacing the ponds with a mechanical treatment process at some point at significant expense. The cost of replacing the current treatment ponds (which does not address potential salinity degradation caused by the reclamation area) would almost certainly preclude the potable water supply improvement project on a near-term basis because implementing both projects would result in a monthly fee increase of roughly $80 to $100, or more, depending on final construction and operational costs. Such a fee increase is not believed to be viable with the City’s electorate. Consequently, the most cost effective, feasible plan appears to be to implement the water supply improvement project to reduce wastewater salinity and to address the treatment pond problem, if necessary, when financially feasible.

If there is pollution from the current treatment ponds, there is some rational technical basis for deferring pond replacement until financially feasible. That basis is that background shallow groundwater salinity is roughly 3,000 μS/cm, or more, which is not suitable for potable water supply use (without extensive treatment or dilution). Therefore, the ponds, even if polluting in some regard contrary to the EPA’s general findings, should not be directly polluting a potable water supply. However, this groundwater does flow into other water resources used as potable water supplies. Within this flow path the groundwater is treated and diluted by natural processes such that pollution of an actual potable water supply is believed to be unlikely. In this case, it may be feasible to allow the ponds to remain in current service (but not expanded service) until existing dischargers can realistically fund the pond replacement project or alternative mitigation measure.

4.1.3 POTENTIAL GROUNDWATER DEGRADATION DUE TO RECLAMATION

With effluent salinity currently at about 3,500 μS/cm and background shallow groundwater salinity about 3,000 μS/cm, or more, it may seem that salinity groundwater degradation in the reclamation area is unlikely, particularly if the potable water supply is improved to reduce effluent salinity to about 2,000 μS/cm. Unfortunately, agronomic irrigation (including effluent reclamation) evapotranspiratively concentrates salt in the irrigation water, potentially by a factor of up to about 3 to 4 depending on crop, irrigation method, rainfall, and averaging period. Effluent typically has a greater salinity than other irrigation water supplies. Therefore, agronomic irrigation with effluent typically results in greater salinity degradation of underlying shallow groundwater than would occur with use of other irrigation water supplies. Salinity degradation resulting from effluent reclamation runs contrary to State Board Resolution No. 68-16, which was adopted in 1968. However, the California legislature superseded this resolution relative to salinity degradation from water reclamation projects by adopting California Water Code (CWC) Section 13523.5. This law facilitated the legislature’s desire to encourage wastewater reclamation as stated in CWC Sections 13510, 13511, 13512, etc. The legislature appears to be saying in CWC Section 13523.5 that the need to reclaim wastewater is a higher priority than the salinity degradation that may result from wastewater reclamation at this time.

The City’s effluent reclamation areas are on lands with naturally high groundwater levels, which also tend to be areas of naturally high salinity (because of the historical evaporation and evapotranspiration from these lands, such as is still occurring to the east in the alkali areas along the San Joaquin River). To control shallow groundwater levels and associated soil salinity so as to allow agriculture to occur, much of the land immediately east of the City has been “reclaimed” by 1) addition of subsurface shallow groundwater drainage pipes that drain to the San Joaquin River, and 2) flushing the historically accumulated salinity to the San Joaquin River via application of surface water and/or groundwater to the soil. No effort has been made to estimate the historical salinity of groundwater in the area (which is believed to be greater than 3,000 μS/cm), though this may become necessary as part of an anti-degradation analysis. Although effluent reclamation on soils needing subsurface drainage is not prohibited, it is not encouraged if alternative effluent reclamation lands are feasible.

Based on the above, the City plans to continue effluent reclamation, but needs to involve the Regional Board in the development of that reclamation plan. The March 14th, 2006 letter to the Regional Board outlined the City's plan, which involved the following elements:

1. CWC Section 13523 states, "(a) Each regional board…shall… prescribe water reclamation requirements for water which is used… as reclaimed water." The City reclaims its wastewater and requested of the Regional Board that the current permit be revised to include "water reclamation requirements" (WRRs) as required by CWC Section 13523.

2. CWC Section 13523.5 states, "A regional board may not deny issuance of water reclamation requirements to a project which violates only a salinity standard in the basin plan." The City requested that the Groundwater Limitations in the requested WRR's reflect CWC Section 13523.5.

3. To avoid abuses under the foregoing, the City requested that the WRR's require a flow-weighted, average annual salinity for water applied to the effluent reclamation areas of no more than 2,000 μS/cm. This approach is 1) as protective as current laws related to agricultural use of groundwater, 2) passes the "reasonable man" test, and 3) is economically feasible. The basis behind this request included:

   - Bulk groundwater under the City (as evidenced by the City's current municipal water supply) has a long-term average salinity of about 1,700 μS/cm.

   - Bulk groundwater should become somewhat more saline to the east of the City as the historical alkali flats of the San Joaquin River are approached, and as suggested by DWR groundwater salinity maps for the area. Based on these state maps and the associated City data, a credible estimate for bulk groundwater salinity at the current WWTP site is about 2,000 μS/cm.

   - This 2,000 μS/cm groundwater could be used by local farmers for irrigation purposes without regulation.

   - Because of the evaporative salt concentrating effect of pond evaporation and tailwater return, a reclaimed water salinity limit of 2,000 μS/cm represents an equivalent influent wastewater average annual salinity limit of about 1,600 μS/cm. This is a 1,100 μS/cm increase over the 500 μS/cm presumed surface water supply. This increase is comparable to the current salinity increase and, therefore, should be achievable after the change in the potable water source.

4. The City's approach of using the quality of the bulk natural water resource for the area as the basis for establishing compliance appears to be in agreement with CWC Section 13551 and the California Supreme Court's recent construction of the legislature's intent in the case of City of Burbank v. State Board.

4.1.4 PERMIT ISSUES RELATED TO CAPACITY

The facility is extremely well operated and maintained compared to similar oxidation pond systems of this type. However, the existing facility does not provide the margin of safety generally expected by the WDRs. Specifically, the WDRs include two requirements that the facility is currently unable to meet:

1. "*The dissolved oxygen content in the upper zone (1 foot) of wastewater in ponds shall not be less than 1.0 mg/l*" – The requirement for 1.0 mg/l in all ponds is a common requirement in all treatment pond permits to ensure adequate treatment and minimal offsite odors. Currently, Aeration Basin No. 2, the Oxidation Pond, and storage pond consistently maintain dissolved oxygen levels well over the 1.0 mg/l requirement. Aeration Basin No. 1, however, appears to be organically overloaded and typically operates at a dissolved oxygen level of less than 0.5 mg/l. Because of the facility's remote location and prevailing winds the overloading has not been an odor issue for plant operations. This deficiency can be corrected with additional pond volume and mechanical aeration. Specific options to correct this issue are discussed in Chapter 5.
2. "*The treatment facilities shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return frequency*" – The system must be able to treat, store, and dispose of wastewater generated during 100-year precipitation wet seasons. Recent wet winters, including 2005-2006, have indicated that the system does not provide 100-year wet season protection. This deficiency will be addressed by constructing additional seasonal storage and disposal area to handle the additional flows. A new storage basin has been designed and is awaiting Regional Board approval prior to construction.

Deficiencies also exist in the current treatment pond system, which prevent realization of full permitted flow and loads. Improvements needed to reliably meet current and permitted flow and load conditions are identified in Chapter 5. The options described in Chapter 5 allow the facility to operate reliably to permitted capacity and comply with the current Waste Discharge Requirements (WDRs), while using the existing pond system and surrounding land to the extent feasible. Future conditions beyond the permitted capacity, as well as the disposal of the treated wastewater, are discussed Chapter 6.

4.1.5 ITEMS COMPLETED TO DATE

Regulatory permit compliance is an ongoing process. Some of the actions described above have been completed, others are in process, and others will occur as the planning process moves forward. Items which have been completed to date include:

- Salinity: Negotiations with the California Aqueduct water suppliers (Central California Irrigation District) have begun. The water treatment and distribution master plan has been completed.
- Potential Groundwater Degradation due to Ponds: One down-gradient monitoring well has been installed and monitoring begun.
- Storage and Disposal Capacity: The design of the supplemental storage basin has been completed and submitted to the Regional Board for approval via a Report of Waste Discharge.
- Planning: Wastewater Collection System Master Plan, Water Master Plan, and Wastewater Treatment and Disposal Master Plan have been completed.

4.2 FUTURE REGULATORY PERMIT COMPLIANCE ISSUES

Regulatory permit compliance issues identified in the sections above are ongoing issues that need to continually be addressed as the City continues to plan, design, and construct improvements and expansions of the wastewater treatment and disposal facilities. Additional specific issues related to future compliance are discussed in more detail below.

4.2.1 POTENTIAL GROUNDWATER DEGRADATION

As discussed above, the potential for groundwater degradation will continue to be monitored and comes from two sources: the unlined treatment ponds and the reclamation practices. Section 4.1 represents a reasonable assessment of the current state of the City's wastewater system with respect to State policies and concerns. The question of whether the City's unlined treatment ponds are following the EPA "model" of not causing degradation, except for salinity, is being studied by the City, and the results will impact some aspects of near-term City wastewater facilities planning. Also in need of study is whether unacceptable nitrogen degradation is occurring in the effluent reclamation areas. These questions cannot be answered at this time because needed studies have not been completed. The remainder of this report provides recommendations based on the knowledge that these questions will take several months to several years to adequately answer.

To address the effluent salinity issue the City has proposed to switch the City's potable water supply from groundwater to surface water. With the improved water supply, use of water softeners (which add salinity to the water) in town would no longer be appropriate and, therefore, may decrease via a public education program. In general, people who have opted to use water softeners are resistant to stopping that use even when water softening is no longer necessary. Thus, the success of this program is difficult to predict. Proposed Assembly Bill 2270 would allow cities to ban use of water softeners on existing and future connections to the City's sewer system. The fate of this bill is unknown at this time.

The City has also proposed to implement a salinity source control program. Elimination of any high salinity wastewater sources in town will also reduce effluent salinity. Water conservation is not a part of the solution to the City's problem because water conservation increases effluent salinity

When the water supply improvement project is completed, effluent salinity concentrations should be acceptable to the Regional Board. The remaining concern related to the ponds would be determining whether the unlined treatment ponds are causing degradation of area groundwater with nitrate, various elements (e.g., iron, manganese, arsenic, etc.), pesticides, detergents, or pathogens in violation of State Board Resolution No. 68-16 (the State's Anti-Degradation Policy). A definitive assessment of degradation will take several years. If significant degradation is occurring, then lining the ponds or decommissioning the ponds at some point in time almost certainly becomes necessary under Resolution No. 68-16. Existing City residents and businesses using the ponds would be given time to correct the deficiency. However, new

City growth would be expected to fund new facilities not having this problem, or any other known problem.

Considering the complexity of a definitive degradation assessment, and the willingness of the City to implement a major reduction in effluent salinity via changing the City's potable water supply, the City and Regional Board have reached an understanding on how to approach the issue of degradation relative to the existing treatment ponds and City growth up to the level allowed by the current wastewater permit (Order No. 98-163). That understanding is based on the Regional Board having serious concerns about unlined treatment ponds being in contact with groundwater regardless of the EPA report. Specifically, those concerns are based on there being no evidence that EPA's conclusions apply to the City's specific situation other than the observation that after decades of operation, the City's ponds have not caused any known water quality pollution problems. To provide at least some site-specific numerical data to address the possibility of there being an undetected, but acute, groundwater quality problem, the City and Regional Board have agreed to the location of an "indicator" shallow monitoring well to assess whether an acute groundwater pollution problem needing immediate attention may exist.

If the indicator well (and follow-up studies, if needed) confirms that the ponds are causing an acute groundwater quality problem (other than salinity), then the potable water supply improvement project to reduce effluent salinity will be postponed so that all available City finances (from existing development and new development) can be focused on correcting the acute pollution problem. Otherwise, the potable water supply improvement project will proceed to reduce effluent salinity; the City will continue to grow using the existing wastewater facility up to its permitted capacity (at least on an interim basis); and the City will either 1) begin the process of assessing whether significant degradation is, or is not occurring, which may allow the existing wastewater treatment plant to remain in service, or 2) agree to modify the existing wastewater treatment plant in such a manner that degradation is not a reasonable possibility (i.e., either line the treatment ponds, or replace them with a mechanical process, such as activated sludge). While the City has expressed the desire to avoid the possibility of degradation, the finances to take such a preemptory step do not exist at this time. However, this does not preclude the City from considering its future wastewater treatment options with this desire in mind.

4.2.2 EFFLUENT RECLAMATION

The Regional Board encourages reclamation (i.e., reuse) of wastewater, where practicable, and requires as part of a Report of Waste Discharge (RWD) an evaluation of reuse and land disposal options as alternative disposal methods. Use of effluent (also called recycled water) for reclamation purposes is governed by Title 22, Chapter 4, of the California Code of Regulations (Title 22). Title 22 defines four types of recycled water, determined by the treatment process and certain effluent requirements. The four categories of recycled water are:

- Undisinfected Secondary Recycled Water
- Disinfected Secondary-23 Recycled Water
- Disinfected Secondary-2.2 Recycled Water
- Disinfected Tertiary Recycled Water

A description of the type of treatment required and the type of irrigation allowed for each of these categories is described in more detail in Chapter 6. The first three categories of recycled water can be used for various types of "restricted reclamation" projects, such as the City's current effluent irrigation of alfalfa. The fourth category of recycled water is referred to as "unrestricted reclamation", which can be used to irrigate all urban landscaping and most food crops.

In accordance with State policies and objectives, the City reclaims "undisinfected secondary recycled water" generated by existing residents and businesses through irrigation of alfalfa and sudan grass. Effluent reclamation via irrigation results in effluent salts becoming more concentrated. This concentrating effect is caused by vegetation evapotranspirating a portion of the irrigation water to the atmosphere and leaving the water-associated salts behind in the soil. This salt concentrating effect occurs regardless of the source of the irrigation water: surface water, groundwater, or effluent. The difference between these sources are that:

- Effluent typically contains more salt than either surface water or groundwater, thus the same salt concentrating effect results in a higher concentration of salt in the soil when effluent is used; and,
- Salinity degradation resulting from effluent irrigation is regulated differently from salinity degradation resulting surface water or groundwater irrigation.

With the water supply improvement project, effluent salinity should be comparable to groundwater salinity. Thus, groundwater degradation from irrigation with either effluent or groundwater should be comparable, and therefore acceptable to the Regional Board. This will allow effluent reclamation to continue to be the City's primary effluent disposal method.

Nitrogen impacts on groundwater from agriculture are also a concern. With effluent reclamation, effluent nitrogen reduces or eliminates the need for fertilizer nitrogen application to grow the crop. The difference between effluent nitrogen and fertilizer nitrogen applied at the same rate to the same crop is how the resulting nitrogen degradation of underlying groundwater is regulated. The extend and acceptability of nitrogen degradation of groundwater underlying the current effluent reclamation areas needs to be determined. If unacceptable nitrogen degradation is occurring, this can be corrected by reducing the effluent nitrogen application rate to the crops. This reduction can be accomplished by either of the following approaches:

- Applying effluent to the crops at a lower hydraulic application rate which also reduces the nitrogen application rate. Supplemental low nitrogen water would be needed to make up for the lower effluent application rate to the crops. This approach reduces WWTP design, construction, and treatment plant operations costs, but increases land needs and reclamation area design, construction, and operations costs.
- Treating the wastewater in a nitrification/denitrification activated sludge process designed to reduce effluent nitrogen concentrations to below levels of concern to the Regional Board for disposal by effluent reclamation. This approach minimizes effluent reclamation land needs, but has the cost of designing, constructing, and operating a nitrification/denitrification activated sludge process.

Based on the realistic expectation that effluent reclamation will continue to be the City's primary effluent disposal method, the location and type of land used for effluent reclamation remains to be determined. As discussed in Chapter 6, consideration should given to expanding the effluent reclamation options in the future. Continued use of restricted reclamation will require additional agricultural land. Effluent disposal through unrestricted urban reclamation will require a higher level of treatment and the dual plumbing of new areas of the City.

For future reclamation land, the City will need to determine whether to require developers to provide the land needed for storage and disposal facilities, or require the developers to provide the City with money so that the City can buy the needed land. In general, there are two types of land in the greater-Newman area that could be used for expanded effluent storage and agricultural reclamation facilities. These lands include:

- Lands east of the City adjacent to the floodplain of the San Joaquin River in the general vicinity of the existing WWTP.
- Lands to the south, north, and west of the City.

A comparison these two land types is provided in Table 4-1.

Table 4-1
Comparison of Land Types for
City of Newman Wastewater Reclamation

	Land East of City	Land South, North, & West of City
Notes	Land expected to be impacted by shallow groundwater that is of relatively poor quality.	Land without shallow groundwater problems.
Advantages	Lower land costs.	Better soil.
	Lower conveyance costs (closer to WWTP).	Less land needed.
	Reduced possibility of effluent reclamation causing unacceptable degradation of shallow groundwater due to the naturally poor groundwater quality.	Easier effluent farming because there is less concern about balancing salt buildup against shallow groundwater levels.
		Effluent irrigation would occur at typical agronomic rates or greater, if increasing the leaching fraction to reduce effluent impacts on shallow groundwater quality is approved by the Regional Board.
Disadvantages	More land may be needed because the effluent application rates may need to be less than typical agronomic irrigation rates as a result of the shallow groundwater.	Higher land costs.
	Shallow groundwater may supply part of the crops' water needs. In such situations, "over irrigation" may cause the shallow groundwater to rise and hinder the crop and/or soil stability.	Higher conveyance costs from the WWTP to more remote sites.
	Lands are underlain with subsurface drains. Subsurface drains under effluent reclamation areas are undesirable.	Lower salinity in underlying groundwater puts a greater risk on effluent reclamation causing some degradation of groundwater quality.

Technical, financial, and regulatory trade-offs exist between these two types of land for effluent storage and reclamation. There is also the possibility of some effluent reclamation within the City, particularly in new community areas where parks, green belts, landscaping, open space, and/or agricultural preserves could be irrigated with effluent. Urban reclamation reduces effluent reclamation land needs at the WWTP, reduces irrigation demands on the potable water supply, and increases the amount of community development that can be served by a given amount of surface water. These benefits are discussed in more detail in Chapters 6 and 7.

Chapter 5

Existing Treatment Analysis and Improvement Options

The purpose of this chapter is to assess the existing treatment capacity of the City of Newman (City) Wastewater Treatment Plant (WWTP) and identify improvements needed to reliably meet current and permitted flow and load conditions. Future conditions beyond the permitted capacity as well as the disposal of the treated wastewater are discussed Chapter 6. A previous WWTP treatment capacity analysis (*WWTP Capacity Analysis Technical Memorandum,* ECO:LOGIC, 2006) indicated that deficiencies exist in the current treatment pond system based on a review of data available at that time. Based on that analysis, the City completed wastewater flow and strength studies to more accurately define the cause, nature, and extent of the deficiencies. This Master Plan expands on the previous Capacity Analysis by more thoroughly characterizing influent flows and loads and considering the effect of pretreatment alternatives on the existing treatment system. Deficiencies in the existing treatment ponds are discussed and improvement options are provided for the current influent conditions as well as the permitted capacity of the facility. The options described in this chapter will allow the facility to operate reliably to permitted capacity and comply with the current Waste Discharge Requirements (WDRs), while using the existing pond system and surrounding land to the extent feasible.

The remainder of this chapter is divided into the following sections:

- Assessment of Existing Treatment Facilities
- Improvement Options
- Summary

5.1 ASSESSMENT OF EXISTING TREATMENT FACILITIES

The existing WWTP treatment capacity was analyzed for two scenarios: 1) existing influent flow conditions (1.1 Mgal/d average sanitary flow (ASF)), and 2) permitted capacity (1.44 Mgal/d ASF). Based on the special testing described in Chapter 2, historical flows and loading data collected from F&A Dairy effluent, the City's municipal wastewater, and the combined waste stream at the WWTP, which includes F&A Dairy discharge, the following assumptions were made for this analysis:

1. The municipal wastewater BOD_5 concentration is 300 milligrams per liter (mg/l). This value reflects the uncertainty associated with the limited dataset available to estimate the municipal wastewater BOD_5 concentration (estimated at 255 mg/l) and the BOD_5 concentrating effect of water conservation by City residents.

2. F&A Dairy contributes an average of 0.18 Mgal/d to the total flow of the City, with an average BOD_5 concentration of 2,000 mg/l.

3. F&A Dairy industrial wastewater could be pretreated to match a municipal wastewater concentration of 300 mg/l.

A summary of the current and permitted future influent flow and loading conditions is provided in Table 5-1.

Table 5-1
City of Newman WWTP Current and Permitted Influent Flows and Load

	Average Sanitary Flow (Mgal/d) [a]	BOD_5 (mg/l) [a, b]	BOD_5 (lbs/d) [a]
Existing Conditions			
Municipal	0.92	300	2,300
F & A Dairy	0.18	2,000	3,000
Total at WWTP	**1.1**	**580**	**5,300**
Permitted Conditions			
Municipal	1.26	300	3,200
F & A Dairy	0.18	2,000	3,000
Total at WWTP	**1.44**	**514**	**6,200**

[a] Mgal/d = million gallons per day; mg/l = milligrams per liter; lbs/d = pounds per day
[b] Municipal BOD_5 is based on historical data and typical composition of untreated domestic wastewater of 110mg/l – 350mg/l (Metcalf & Eddy 4th Edition)

Wastewater pond systems are designed to oxidize organic material in the wastewater by aerobic and facultative microbiological metabolism using oxygen 1) transferred across the pond surface, 2) produced by algal photosynthesis, and/or 3) oxygenation supplemented by mechanical aeration equipment. In the case of Newman, all of these means of oxygenation are employed. The first two ponds (Aeration Basin (AB) No. 1 and AB No. 2) are equipped with mechanical aeration. The third pond in the City's treatment system is a facultative pond which is referred to as the Oxidation Pond. Ponds using mechanical aeration equipment (aerators) are called "aerated ponds" and are analyzed for wastewater treatment capacity using first order kinetics modeling. Ponds without mechanical aerators are called "facultative ponds" and are analyzed for wastewater treatment capacity using empirical design criteria. During times when high levels of photosynthesis are occurring (i.e. the afternoons of sunny days), the oxygen levels in the Oxidation Pond can be very high.

Aerated pond systems are designed to meet peak oxygen demands within each pond under design wastewater flow and load conditions. Oxygen demand in each pond is determined by the wastewater temperature, BOD_5 concentration, hydraulic residence time and hydraulic mixing in the pond. Hydraulic mixing in aerated pond is controlled by operation of the mechanical aeration equipment. A rough guide for hydraulic mixing is having 10 to 20 horsepower (hp) of mechanical aerator per million gallons of pond volume. The type and size of aerator used and pond geometry all impact the amount of aeration and mixing needed in aerated ponds. Facultative ponds are designed based on limiting the average BOD_5 load to the ponds surface area to no more than 30 pounds per acre per day (lbs/ac/d) under Central Valley climatic conditions.

To assess the treatment capacity based on aerobic treatment and compliance with the current WDRs, a first order kinetic model was utilized, incorporating established design criteria for aerated pond systems. The model was run at influent loading conditions for existing and permitted flows. The Newman WWTP treatment capacity was determined so that the organic loading on the oxidation pond does not exceed 30 lbs BOD_5/ac/d.

Winter wastewater temperatures used in the model were based on recorded winter temperatures of the influent in each basin and pond (15, 10, and 9 degrees Celsius, respectively). Cold winter temperatures are an appropriate temperature parameter for aerobic pond sizing and capacity analysis because biological activity is reduced at lower temperatures. Thus, treatment does not occur as rapidly and more treatment time is required. Summer temperatures used in the model were based on a typical temperature of 23 degrees Celsius. Summer temperatures are the appropriate temperature for sizing aerators because high summer temperatures cause the highest biological activity and greatest resulting oxygen demands.

5.1.1 AERATION BASIN NO. 1

Aeration Basin No. 1 (AB No. 1) has 2.7 acres of water surface area with a design depth of 8.0 feet and total volume of 7.0 million gallons (MG). However, this pond has significant sludge accumulation which is estimated to reduce the effective wastewater volume to about 4 MG. The current theoretical detention time is therefore estimated to be 3.1 days.

AB No. 1 uses an ASI small bubble diffuser system powered by a total of 90-hp of blowers. Modeling analysis of AB No. 1 indicates that under existing influent organic load conditions, the basin is overloaded. The oxygen estimated to be provided by the ASI aerators is only 49% of what is required to aerobically treat the existing BOD_5 load. Historical dissolved oxygen levels are typically below 0.5 mg/L and AB No.1 is malodorous (septic), though so far it has not triggered odor complaints from adjacent landowners. Besides organic load issues, the installed aerators may not be operating efficiently because of failures of the piping connections in the basins, which are difficult to maintain.

This submerged diffuser aeration system is not as efficient as desired in providing the required oxygen to maintain aerobic condition. The sludge buildup in the basin may have blocked some of the diffusers, resulting in cumulative inefficiency of the equipment, and the piping connections are difficult to maintain and often fail.

5.1.2 AERATION BASIN NO. 2

Aeration Basin No. 2 (AB No. 2) is a 5 acre pond with a minimum depth of 5.5 feet and maximum depth of 9.0 feet during wet season. The minimum volume of this pond is approximately 9 MG and the maximum volume is 14.7 MG. The detention time at minimum water levels is approximately 4 days. Oxygen in this pond is provided by a total of 120-hp of high speed splash type aerators and one 11.5 regenerative blower and membrane porous pipe grid system.

To assist in providing more oxygen to AB No. 2 and to reduce the incoming wastewater hydraulic residence time in the basin, high dissolved oxygen water from the oxidation pond is recirculated at approximately 1,000 gallons per minute (gpm) to the inlet of AB No. 2. With this operational strategy, the oxygen demand for aerobic treatment within this basin is met under the existing influent conditions. However, at permitted capacity AB No. 2 requires additional aerators.

5.1.3 OXIDATION POND

The Oxidation Pond is a 50 acre pond with a minimum depth of 5.5 feet and maximum depth of 9 feet. The greater depth is generally used during the wet season as an effluent storage feature. The minimum and maximum volumes of the Oxidation Pond are 90 and 147 MG, respectively. The effective volume for treatment is assumed to be 90 million gallons. There are currently no mechanical aerators in the Oxidation Pond and aeration is provided by oxygen transfer across the pond surface, aided by wind, and algal photosynthesis. Recirculation via a recirculation channel, which goes around the pond to AB No. 2, also provides additional oxygen.

Based on these oxygen transfer mechanics, under Central Valley climatic conditions, the maximum allowable BOD_5 loading capacity for this pond is 30 lbs/ac/d. Modeling analysis indicates that under the existing influent loading conditions the organic loading in the Oxidation Pond exceeds this amount during winter temperatures. Therefore, the Oxidation Pond is currently overloaded at times and may not ensure reliable treatment to meet the permit requirements.

5.2 IMPROVEMENT OPTIONS

As discussed above, based on the flows and loads presented in Table 5-1, the WWTP is currently above reliable capacity and the aeration system within the ponds may not meet the potential peak oxygen demands. This section summarizes options that will allow the aerated pond system to operate reliably and comply with the current WDRs, including the requirement to maintain 1.0 mg/l of dissolved oxygen in each treatment pond.

Aeration horsepower requirements for each pond have been determined assuming the use of paddlewheel style “brush” aerators for added mechanical aeration demands. These aerators have proven to be more reliable than other mechanical aerators and are preferred by City staff. These improvement options are based on AB No. 1 being cleaned (i.e. the accumulated sludge removed), and the existing ASI small bubble diffusers would be replaced with brush aerators. The existing splasher type aerators in AB No. 2 would remain in service.

For planning purposes, a minimum of 20-hp per aerator has been assumed for each option when additional mechanical aeration is required. The capital cost of a single 20-hp brush aerator is estimated at $40,000 (early 2008 pricing).

5.2.1 Option 1: New Aeration Basin (AB No. 3) and Influent Flow Split

Option 1 includes creating a third aeration basin (AB No. 3) by baffling approximately five acres of the existing 50 acre Oxidation Pond and splitting the influent load across all aerated ponds. The influent flow would be distributed 20% to AB No. 1, 20% to AB No. 2, and 60% to the new AB No. 3. A schematic of this option is shown in Figure 5-1. Effluent from AB No.1 would continue to flow to AB No.2. Effluent from AB No.2 would flow to the newly partitioned AB No. 3. The oxidation pond would receive effluent from AB No.3.

This option would require cleaning and removal of the sludge buildup in the five acres of the Oxidation Pond for AB No. 3 and creating a flow diversion structure with flow splitting capabilities directly after the existing headworks. At existing influent conditions and using brush aerators, 72-hp of aeration would be needed for the new AB No. 3 and 26-hp of aeration would be needed for the reduced size Oxidation Pond to accommodate the loading at winter temperatures. (Given the planning nature of these estimates, when determining the number of brush aerators needed, it is assumed that a 20-hp brush aerator would be sufficient when the aeration requirement is up to 29-hp. A more thorough analysis would be conducted during design to confirm this assumption.) This horsepower requirement corresponds to the equivalent of four 20-hp brush aerators in AB No. 3 and one 20-hp aerator in the Oxidation Pond. In addition, replacing the aeration equipment in AB No. 1 would require two 20-hp aerators. At permitted flow conditions, one additional 20-hp aerator would be needed in both AB No. 1 and the Oxidation Pond.

Planning level cost estimates for Option 1 are provided in Table 5-2. The total capital cost is estimated at $3.8 million and $4.0 million for existing and permitted flow conditions, respectively.

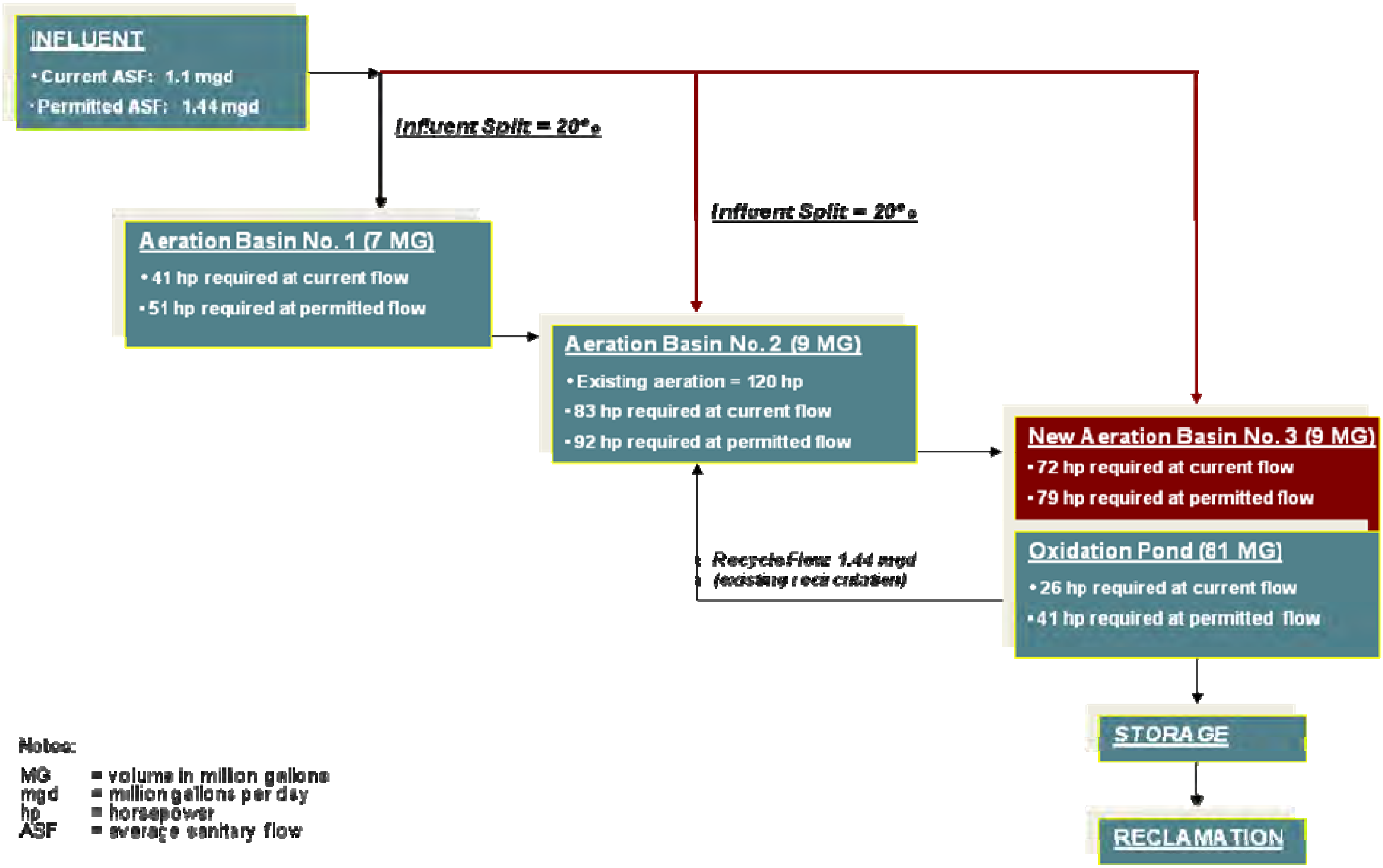


Figure 5-1
City of Newman WWTP
Option 1: New Aeration Basin (AB No.3) and Influent Flow Split

Table 5-2
City of Newman Planning Level Capital Cost Estimates for Option 1

	Current Conditions 1.1 Mgal/d [a]	Permitted Flow Conditions 1.44 Mgal/d [a]
Flow Split Box	$50,000	$50,000
Distribution Piping	$200,000	$200,000
Baffling of Oxidation Pond	$100,000	$100,000
Cleaning of New Aeration Basin No. 3	$460,000	$460,000
Aeration Equipment [b]		
Aeration Basin No. 1 (Replacement)	$80,000	$100,000
New Aeration Basin No. 3	$160,000	$180,000
Oxidation Pond	$60,000	$80,000
New Electrical Service		
Electrical Service Extension	$75,000	$75,000
Transformer	$150,000	$150,000
Conduits & Conductors	$40,000	$50,000
Switchgear	$200,000	$250,000
Allowance for Sitework & Dewatering	$300,000	$300,000
Rehabilitation / Cleaning of AB No. 1	$350,000	$350,000
Subtotal Treatment Ponds	**$2,225,000**	**$2,345,000**
Contingency (30%)	$668,000	$704,000
Subtotal Construction	**$2,893,000**	**$3,049,000**
Allowance for Engineering/ Admin/ CM/ Inspection (30%)	**$868,000**	**$915,000**
Total Project Cost [c]	**$3,800,000**	**$4,000,000**

[a] Mgal/d = million gallons per day.
[b] 20 horsepower (hp) brush aerators in incremental sizing at $40,000 per aerator installed.
[c]\ 2008 Dollars.

5.2.2 OPTION 2: PRETREATMENT OF F&A DAIRY EFFLUENT AND RECIRCULATION INTO AB NO.1

Option 2 includes the pretreatment of F&A Dairy wastewater to municipal wastewater BOD_5 strength (approximately 300 mg/l) and recirculation of flow from the Oxidation Pond into AB No.1. As discussed previously, F&A Dairy's high strength wastewater represents over half the organic load entering the WWTP and has significant variability in strength compared to municipal wastewater. Pretreatment options for the industrial wastewater are discussed in Chapter 6.

In Option 2, the aerators in AB No.1 would be replaced with approximately 66-hp and 79-hp of brush aeration at existing and permitted flow, respectively. There would be no need for additional mechanical aeration in AB No. 2 or the Oxidation Pond for both existing and permitted flow conditions. However, recirculation to AB No. 1 would be necessary, and could be provided by extending the existing recirculation channel or by extending the pipeline from the new effluent storage basin. A schematic of this option is presented in Figure 5-2.

The estimated cost for Option 2 is $3.7 to $4.1 million for existing conditions and $4.2 to $4.6 million for permitted flow conditions (Table 5-3). Costs associated with pretreating F&A Dairy wastewater are presented in Chapter 6 and include $1.8 million for an anaerobic pond system and $2.2 million for an anaerobic digester. Since F&A dairy discharges directly into the municipal sewer the pretreatment must take place on the F&A Dairy site unless the F&A Dairy wastewater can also be conveyed separately to the wastewater treatment plant for pretreatment before combining with the municipal wastewater at the plant. With this option, there is a conveyance cost of $2.4 to $3.4 million depending on the conveyance route.

Table 5-3
City of Newman Planning Level Capital Cost Estimates for Option 2

	Current Conditions 1.10 Mgal/d [(a)]	**Permitted Flow Conditions 1.44 Mgal/d [(a)]**
Distribution & Piping	$75,000	$75,000
Recirculation Pump Station No. 2 & 3	$50,000	$50,000
Aeration Equipment [(b)]		
Aeration Basin No. 1(Replacement)	$90,000	$160,000
New Electrical Service		
Electrical Service Extension	$75,000	$75,000
Conduits & Conductors	$25,000	$35,000
Transformer		$150,000
Switchgear	$175,000	$225,000
Allowance for Sitework & Dewatering	$300,000	$300,000
Rehabilitation / Cleaning of Aeration Basin No. 1	$350,000	$350,000
Subtotal Treatment Ponds	**$1,140,000**	**$1,420,000**
Contingency (30%)	$342,000	$426,000
Subtotal Construction	**$1,482,000**	**$1,846,000**
Allowance for Engineering/ Admin/ CM/ Inspection (30%)	$445,000	$554,000
Subtotal WWTP Project Cost	**$1,927,000**	**$2,400,000**
Pretreatment Cost **at F&A Dairy Facility [(c)]**	$1,800,000 - $2,200,000	$1,800,000 - $2,200,000
Total Project Cost [(d)]	$3,700,000 - $4,100,000	$4,200,000 - $4,600,000

(a) Mgal/d = million gallons per day.
(b) 20 horsepower (hp) brush aerators in incremental sizing at $40,000 per aerator installed.
(c) If pretreatment occurs at WWTP site, an additional $2-3 million would be needed for conveyance.
(d) 2008 Dollars.

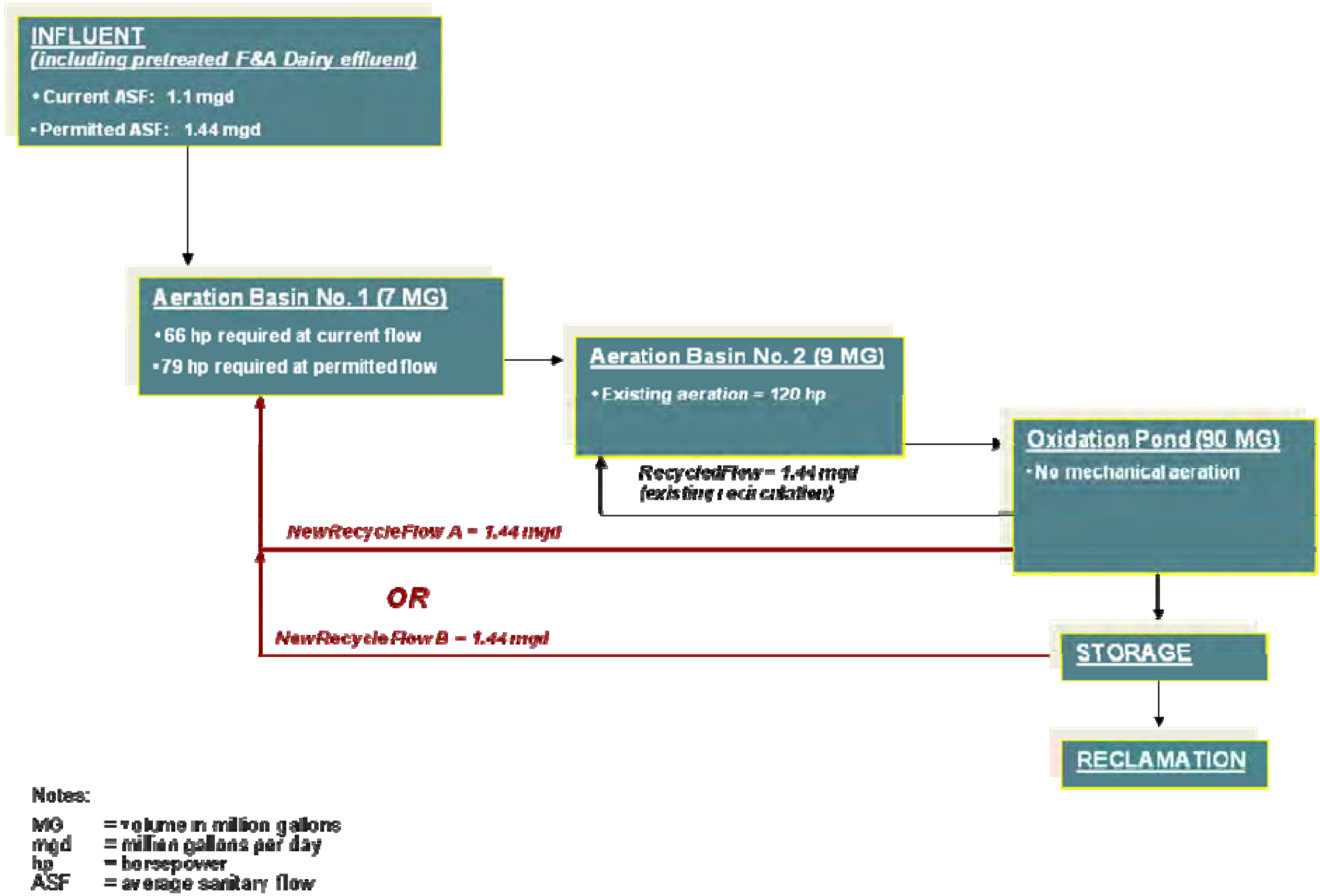


Figure 5-2
City of Newman WWTP
Option 2: Pretreatment of F&A Dairy Effluent and Recirculation into AB No.1

5.2.3 OPTION 3: CONSTRUCTION OF NEW AERATION BASINS

Option 3 includes constructing two new aeration basins (AB No. 1A and No. 1B) and cleaning and decommissioning the existing AB No. 1. A schematic layout of how the new aeration basins could be incorporated into the WWTP is provided in Figure 5-3.

The new basins would be lined with a depth of 6 feet to provide a total volume of 18 MG of treatment and configured so that they could be taken out of service for periodic cleaning. Oxidation Pond effluent would be recirculated to each of the basins to distribute BOD_5 load across the ponds, minimize odor, and provide additional re-aeration; thereby reducing the surface aerator horsepower for each basin. Effluent could also be recirculated from the new storage basin.

For this option, a total of 152-hp of aeration would be required for the two new basins (AB No. 1A and AB No. 1B) for existing conditions and 166-hp to meet permitted flow conditions. Approximately 13-hp of additional mechanical aeration would also be required in the Oxidation Pond during winter months.

The planning level cost estimates for Option 3 are provided in Table 5-4.

Table 5-4
City of Newman Planning Level Capital Cost Estimates for Option 3

	Current Conditions 1.10 Mgal/d [(a)]	**Permitted Flow Conditions 1.44 Mgal/d [(a)]**
New Lined Aeration Basins No. 1A & 1B	$1,800,000	$1,800,000
Recirculation Pump Stations	$70,000	$70,000
Distribution & Piping	$100,000	$100,000
Aeration Equipment [(b)]		
New Aeration Basin 1A	$200,000	$240,000
New Aeration Basin 1B	$80,000	$90,000
Oxidation Pond		$40,000
New Electrical Service		
Electrical Service Extension	$75,000	$75,000
Conduits & Conductors	$40,000	$50,000
Transformer	$150,000	$150,000
Switchgear	$225,000	$250,000
Allowance for Sitework & Dewatering	$350,000	$400,000
Cleaning & Decommissioning of Old Aeration Basin No. 1	$350,000	$350,000
Subtotal Treatment Ponds	**$3,440,000**	**$3,615,000**
Contingency (30%)	$1,032,000	$1,084,500
Subtotal Construction	**$4,472,000**	**$4,699,500**
Allowance for Engineering/ Admin/ CM/ Inspection (30%)	$1,341,600	$1,409,850
Total Project Cost [(c)]	**$5,900,000**	**$6,200,000**

(a) Mgal/d = million gallons per day.
(b) 20 horsepower (hp) brush aerators in incremental sizing at $40,000 per aerator installed.
(c) 2008 Dollars.

5.3 SUMMARY

Descriptions of the three options proposed for each influent condition, including associated costs, advantages, and disadvantages are summarized in Table 5-5.

Option 1 appears to offer the most flexibility, least capital cost (though slightly higher operation and maintenance cost than the other options), and least investment in infrastructure. Least investment in infrastructure is an important consideration should significant groundwater degradation be found from on-going studies, which require the existing users to phase out of the existing WWTP and into mechanical treatment in the long-term.

In addition to existing treatment requirement, the effluent storage and disposal requirements are also a consideration. With construction of the previously designed supplemental storage basin, the existing WWTP will be able to store effluent and 1-in-100 year precipitation events and has sufficient storage capacity up to the permitted flow. However, since this basin will be built on existing reclamation area, an additional approximately 100 acres of effluent reclamation area will be needed. The cost of this additional land will depend on the specific area identified, but will likely be on the order of $2 million, including land, effluent conveyance to the land, and on-site improvements. The City should begin the process of securing future disposal land as soon as practical.

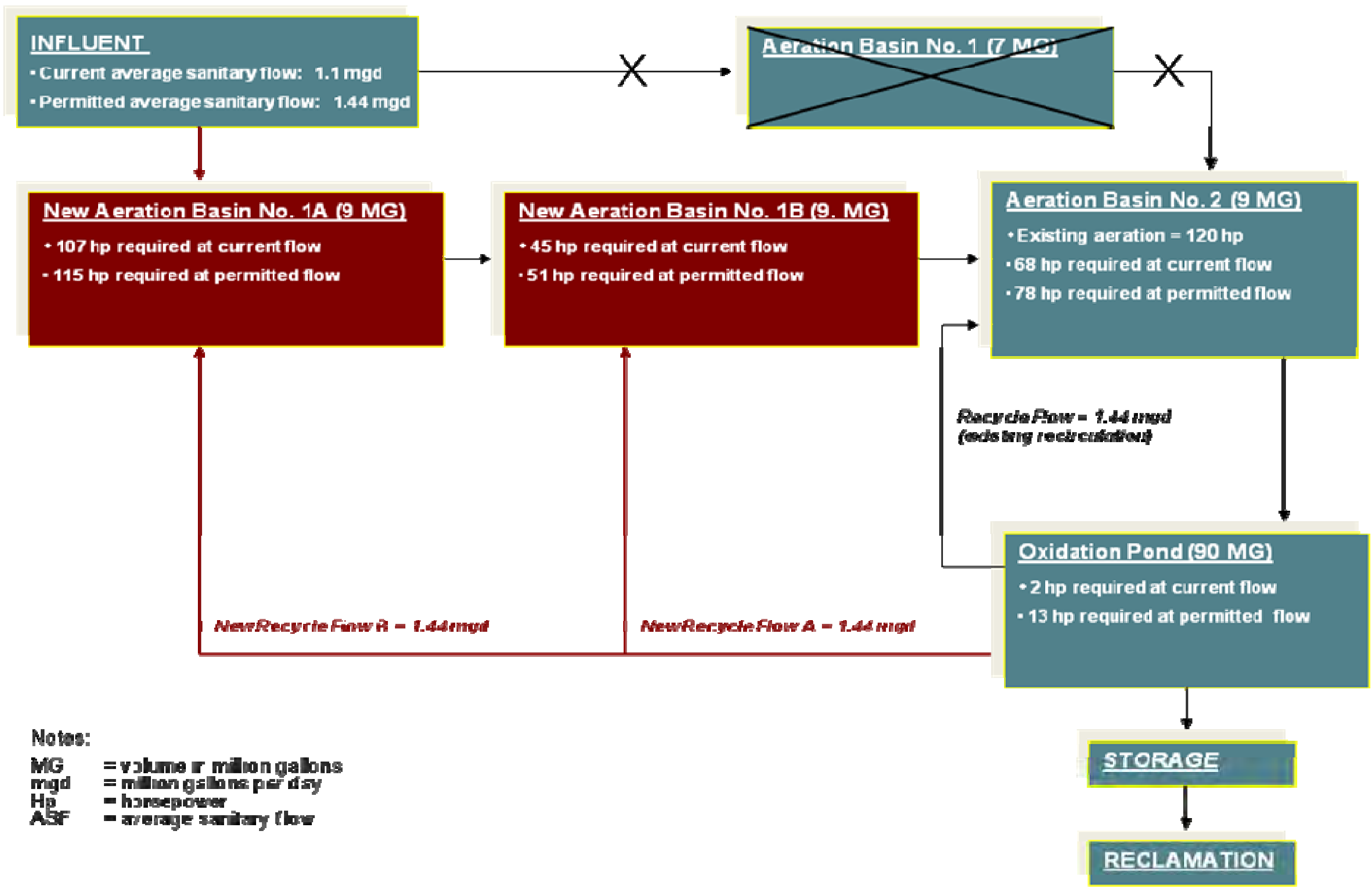


Figure 5-3
City of Newman WWTP
Option 3: Construction of New Aeration Basins

Table 5-5
Summary of City of Newman WWTP Improvement Options

Description	**Option 1** Baffle 5 acres of Oxidation Pond to create new Aeration Basin (AB No. 3) and split influent flow into all aeration basins		**Option 2** Pretreat F&A dairy wastewater and extend recirculation to Aeration Basin No. 1 (AB No.1)		**Option 3** Construct new Aeration Basins No. 1A & 1B and Decommission AB No. 1	
Additional Horsepower Required	**Existing Flow**	**Permitted Flow**	**Existing Flow**	**Permitted Flow**	**Existing Flow**	**Permitted Flow**
AB No. 1	46-hp	51-hp	66-hp	79-hp	AB No. 1A: 107-hp AB No. 1B: 45-hp	AB No. 1A: 115-hp AB No. 1A: 51-hp
AB No. 2	No Additional Aeration Required	No Additional Aeration Required	No Additional Aeration Required	No Additional Aeration Required	No Additional Aeration Required	No Additional Aeration Required
AB No. 3	72-hp	79-hp	N/A [a]	N/A [a]	N/A [a]	N/A [a]
Oxidation Pond	26-hp	41-hp	None Required	None Required	None Required	13-hp
Total Horsepower Required (including existing) [b]	227-hp	263-hp	142-hp	173-hp	220-hp	257-hp
Costs						
WWTP Capital Cost	$3.8M	$4.0M	$ 2.6M	$ 3.0M	$5.9M	$6.2M
Pretreatment Capital Cost	--	--	$1.8M [c] to $2.2M	$1.8M [c] to $2.2M	--	--
Total Capital Cost	$3.8M	$4.0M	$3.7M to $4.1M	$4.2M to $4.6M	$5.9M	$6.2M
Total Annual Electrical Cost for Aeration Only [d]	$180,000	$210,000	$110,000	$140,000	$170,000	$200,000
Advantages and Disadvantages						
Advantages	❐ Maximizes existing treatment system ❐ Requires less construction ❐ Lowest capital cost ❐ No additional operations and maintenance skill required		❐ Reduction of wastewater strength ❐ Reduced variability in influent strength ❐ Lowest annual electrical cost (excluding pretreatment) ❐ Lowest capital cost at WWTP		❐ Decommissioning existing aeration basin (AB No.1) ❐ No additional operations and maintenance skill required	
Disadvantages	❐ Requires more aeration and energy ❐ Highest annual electrical cost ❐ Reduces oxidation pond volume ❐ Requires maintenance of baffle		❐ Requires additional treatment process and cost for F&A dairy discharge ❐ Additional operations and maintenance skills may be required for pretreatment system		❐ More construction required ❐ Potential for more land acquisition to be required for new aeration basins ❐ Highest capital cost	

(a) Options 2 and 3 do not contain a third aeration basin.
(b) Total horsepower required is at peak aeration needs and includes existing aeration in AB No. 2 (splash aerators) and replacing existing aeration in AB No. 1 with brush aerators.
(c) Does not include conveyance cost of an additional $2-3 million.
(d) Based on $0.15 per kilowatt-hour and 80% efficiency. Does not include pretreatment energy costs for Option 2.

Chapter 6

Future Treatment and Effluent Disposal Alternatives

The purpose of this chapter is to describe the future treatment and effluent disposal alternatives available to City of Newman (City). Treatment and disposal options are typically evaluated together since the method of disposal dictates the type of treatment needed. Alternatives to the current practice of unlined ponds and restricted reclamation on agricultural land are being considered because the current treatment and disposal practices have the potential to impact local groundwater.

Since the potential impact of the wastewater treatment plant (WWTP) on groundwater cannot be predicted at this time, this Master Plan addresses the long-term potential wastewater treatment needs by bracketing the two extremes of options. This approach gives the City a plan which can easily be adjusted based on the results of groundwater monitoring and degradation analysis. The actual path the City pursues will be dictated by the results of the groundwater monitoring and input from the Regional Water Quality Control Board (Regional Board) as well as policy decisions of the City Council on what type of resource it views the City's wastewater. This Master Plan assumes that effluent reclamation will continue to be the City's primary disposal method. Treatment options range from the current unlined treatment ponds to tertiary-level mechanical treatment and are not mutually exclusive. The extremes of the range of options include:

- Continue to use the existing, unlined treatment ponds for existing residents and future residents to permitted capacity. Expand the WWTP pond system for new development. This option presumes that the existing ponds and disposal practices do not have an impact on local groundwater.
- Construct a new mechanical WWTP for new development and phase the existing residents out of the existing ponds and into mechanical treatment over time. This option presumes that the existing unlined ponds show some degree of impact on the local groundwater.

The remainder of this chapter is organized into the following major sections:

- Introduction
- Summary of Reclamation Disposal Alternatives
- Summary of Treatment Alternatives
- Industrial Pre-Treatment Alternatives
- Future Effluent Storage and Disposal Requirements

6.1 INTRODUCTION

As discussed in Chapter 5, the existing WWTP is a series of ponds where necessary oxygen for treatment is provided by both mechanical aerators and surface reaeration from the atmosphere. Wastewater effluent is stored during the wet season and reclaimed as irrigation water on City-owned agricultural lands during the dry season. Emerging concerns related to the operation and expansion of the existing WWTP include:

- The City’s effluent has higher salinity than other irrigation water used in the vicinity. Therefore, the City’s effluent reclamation practice has the potential to cause salinity degradation of underlying groundwater. The major source of salinity in the City’s effluent is the City’s potable water supply. This City’s Water Master Plan provides a plan for a potable water supply improvement project to address this concern.

- The City’s wastewater treatment ponds are unlined and in direct contact with shallow groundwater. Due to this contact, there is concern that salts, nitrates, pathogens, pesticides, and/or metals may be causing groundwater contamination. As discussed in Chapter 4, although a wastewater treatment pond in direct contact with groundwater has the potential to contaminate that groundwater, it has generally been observed that contamination does not occur. The City currently is studying whether its treatment pond system acts in a similar manner. Also in need of study is whether unacceptable nitrogen degradation is occurring in the effluent reclamation areas.

- The City’s potable water shift from groundwater to a high quality, more expensive surface water may put the City in a position to offset potable water with reclaimed effluent for some to all urban landscape irrigation water in new development areas. This is common practice in Southern California and is becoming more common in areas of Northern California where potable water is becoming more expensive and/or difficult to reliably obtain.

- Once the potable water supply improvement project is complete, effluent salinity concentrations should be acceptable to the Regional Board. The remaining concern includes determining whether nitrogen degradation of groundwater is occurring under the reclamation area due to the pond effluent. Pond treatment (as compared to nitrification/ denitrification activated sludge) is generally not considered a reliable method for removing nitrogen from wastewater.

- The City’s effluent reclamation areas are on lands with naturally high groundwater levels, which also tend to be areas of naturally high salinity. To control shallow groundwater levels and soil salinity so as to allow agriculture to occur, much of the land immediately east of the City has been “reclaimed” by 1) the addition of subsurface shallow groundwater drainage pipes that drain to the San Joaquin River, and 2) flushing the historically accumulated salinity via application of surface water and/or groundwater to the soil. Although effluent reclamation on soils needing subsurface drainage is not prohibited, it is not encouraged if alternative effluent reclamation lands are feasible.

Once the potable water supply improvement project is completed, effluent salinity concentrations should be acceptable to the Regional Board. As mentioned above, the remaining concerns to be addressed include the potential for groundwater degradation due to the unlined ponds and nitrogen degradation due to the existing reclamation practices. In addition, the other major concern will be creating WWTP capacity to accommodate City growth beyond the existing City limits (as discussed in Chapter 2).

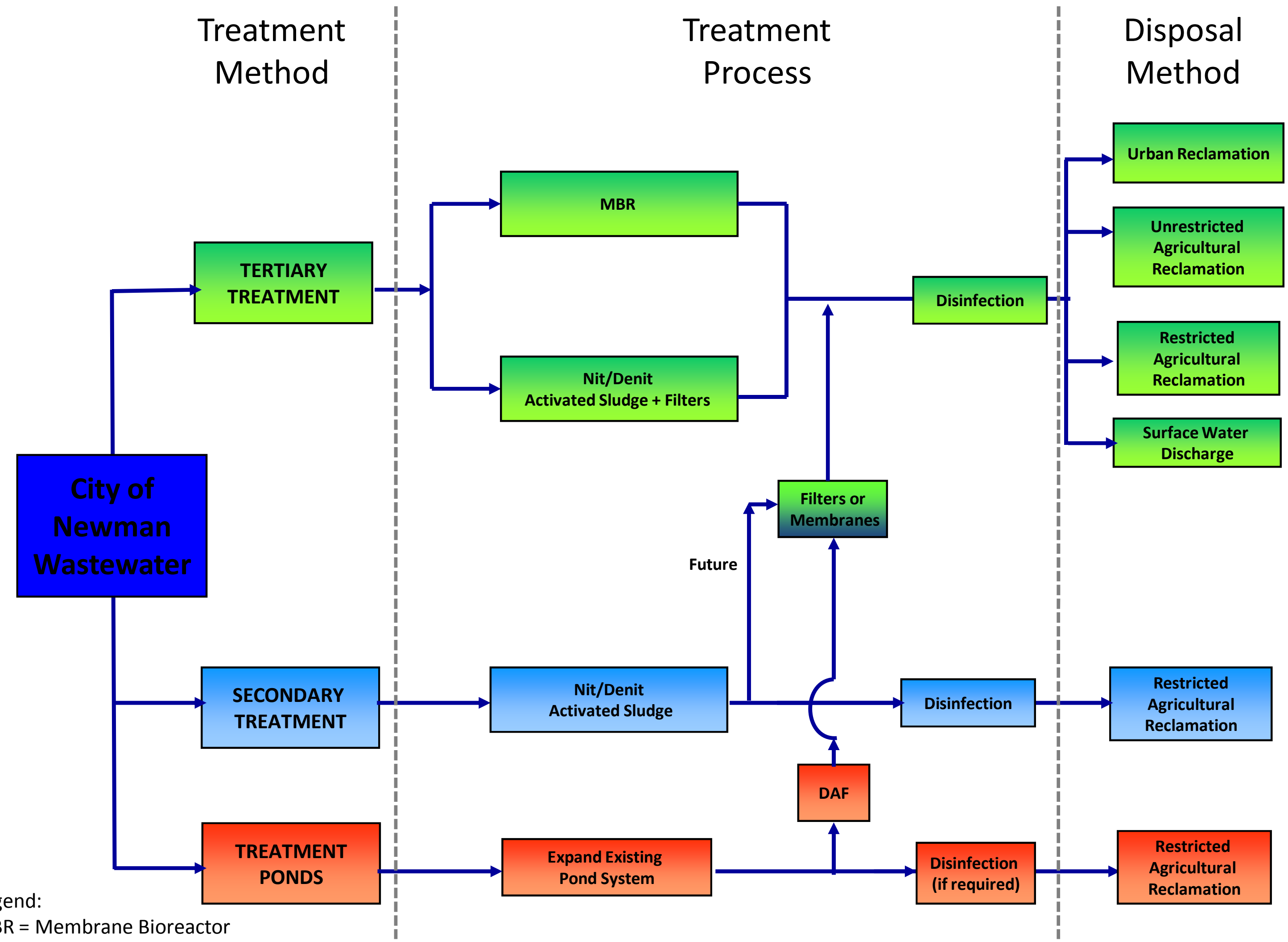
A fundamental aspect of any future WWTP expansion is that disposal governs treatment. The level of treatment required is dictated by where and how the effluent will be disposed. If more flexibility is needed or desired, or if degradation potential exists, then a higher level of treatment is required. The level of treatment required and other considerations for various effluent disposal methods are described in Table 6-1. As shown, for most disposal options besides current practices, tertiary treatment is required. A more detailed flowchart of the specific treatment processes needed for different disposal options is provided in Figure 6-1. Of particular importance is that all treatment methods, except for pond treatment, allow the process to be upgraded as necessary to include nitrogen removal, conventional or membrane filtration, and/or disinfection. The disadvantage of this flexibility is that there is an additional capital and operational cost associated with mechanical treatment. Technological advantages continue to improve nitrogen removal with pond treatment, but reliable removal is still uncertain with ponds.

Table 6-1
Level of Treatment Required and Considerations for Effluent Disposal Methods

Effluent Disposal Method	Level of Treatment	Additional Considerations
Urban Reclamation (e.g., Irrigation of parks, schools, greenbelts, parkways, commercial landscaping, front yards, and/or back yards)	Tertiary	❒ Significant costs for distribution ❒ Community input/perception ❒ Needs to be incorporated early into the General Planning process ❒ Reduces potable water demands and, therefore, potable water supply capital and annual costs
Unrestricted Agricultural Reclamation (e.g., food crops)	Tertiary	❒ City typically buys the land to assure the long-term viability of this method
Restricted Agricultural Reclamation (e.g, fodder crops; current practice)	Secondary (or equivalent secondary)	❒ Disinfection needed unless all stormwater is contained on-site

6.2 RECLAMATION

The Regional Board encourages the reclamation and reuse of wastewater, where practicable, and requires as part of a Report of Waste Discharge (RWD) an evaluation of reuse and land disposal options as alternative disposal methods. Use of effluent for reclamation purposes (also called recycled water) is governed by the California Department of Health Services Title 22, Chapter 4, of the California Code of Regulations (Title 22). Title 22 defines four



Legend:
MBR = Membrane Bioreactor
Nit/Denit = Nitrification/Denitrification
DAF = Dissolved Air Floatation

Figure 6-1
Level of Treatment Required for Various Disposal Option

types of recycled water, determined by the treatment process and certain effluent requirements. The four categories of recycled water are:

- Undisinfected Secondary Recycled Water
- Disinfected Secondary-23 Recycled Water
- Disinfected Secondary-2.2 Recycled Water
- Disinfected Tertiary Recycled Water

A description of the type of treatment required and the type of irrigation allowed for each of these categories is provided in Table 6-2. The first three categories are generally referred to as "restricted reclamation". The fourth category is referred to as "unrestricted reclamation". These two types of reclamation are discussed below. For all reclamation systems that store water seasonally and apply the water in the irrigation season, the system must contain all flow and rainwater resulting from a 1-in-100 year wet season. Monitoring of local groundwater is also required.

6.2.1 RESTRICTED RECLAMATION

Currently, the City uses ponds to provide equivalent secondary level treatment for disposal on alfalfa used for nonhuman consumption on City owned lands (Figure 6-2). Because the water is not disinfected, the treatment system is designed and operated to prevent runoff of effluent irrigation water and prevents public access to the disposal area. The City currently falls under the category of "Undisinfected Secondary Recycled Water" (Table 6-2) and has restricted effluent disposal options.

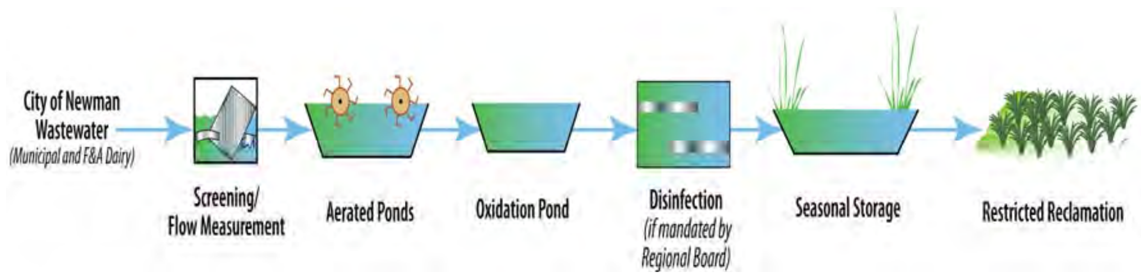


Figure 6-2
City of Newman Existing Wastewater Treatment and Disposal Process

6.2.2 UNRESTRICTED (AND URBAN) RECLAMATION

For wastewater effluent to be used for unrestricted reclamation, tertiary level treatment and effluent disinfection is required. Tertiary treatment includes a biological treatment process followed by filtration or membrane filtration. Tertiary level treatment could be accomplished through a secondary level aerated treatment process followed by filtration and disinfection or through a combined process, such as a membrane bioreactor (MBR). Disinfection can be either through the use of chlorine or ultraviolet light (UV) disinfection. Wastewater treated to tertiary standards (as defined by Title 22), can be reclaimed in an urban or agricultural setting. As shown in Table 6-2, the types of crops that can be irrigated with tertiary treated

Table 6-2
Title 22 Uses of Recycled Water for Irrigation

	Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
	Unrestricted Reuse →			**Restricted Reuse**
Treatment Description	Aerated mechanical treatment, filtration or membrane filtration, with UV or chlorine disinfection	Aerated mechanical treatment with chlorine disinfection	Facultative ponds or aerated ponds or aerated mechanical treatment with chlorine disinfection	Facultative ponds or aerated ponds with no disinfection
Irrigation Type	❐ Food crops, including all edible root crops where recycled water comes into contact with the edible portion of the crop ❐ Parks and playgrounds ❐ School yards ❐ Residential landscaping ❐ Unrestricted access golf courses	❐ Food crops where the edible portion is produced above ground and NOT contacted by the recycled water	❐ Any nonedible vegetation with controlled access so that area can NOT be used as park, playground, or school yard. ❐ Ornamental nursery stock and sod farms where access to the public is NOT restricted ❐ Pasture for animals producing milk for human consumption ❐ Freeway landscaping ❐ Restricted access golf course ❐ Cemeteries	❐ Orchards where recycled water does NOT come into contact with edible portion of the crop ❐ Vineyards where recycled water does NOT come into contact with edible portion of the crop ❐ Non food-bearing trees including Christmas tree farms [(a)] ❐ Fodder and fiber crops and pasture for animals not producing milk for human consumption ❐ Seed crops not eaten by humans ❐ Food crops that must undergo commercial pathogen destroying processes prior to human consumption ❐ Ornamental nursery stock and sod farms

[(a)] Provided irrigation does not occur for a period of 14 days prior to harvesting, retail sale, or allowing access by the general public.

water are much more expansive compared to secondary treated water. In addition, tertiary treated water can be used on parks and playgrounds, residential and commercial landscaping, and golf courses. The same amount of acreage is needed for storage and disposal. However, the City would have the added flexibility of reclaiming the water on discrete parcels, the ability to use the water on different types of crops, and may be able to enter into a long-term lease instead of a land purchase.

6.3 SUMMARY OF TREATMENT ALTERNATIVES

This section provides a summary of the treatment options and their various advantages and disadvantages. Generally, three levels of treatment are available for the City of Newman, including equivalent secondary level treatment using ponds, secondary level treatment using a mechanical activated sludge process, and tertiary level treatment using an activated sludge process in conjunction with membranes or filters.

6.3.1 POND TREATMENT

The City's existing wastewater treatment ponds are unlined and in direct contact with shallow groundwater. Due to this contact, there is concern that salts, nitrates, pathogens, pesticides, and/or metals may be causing groundwater contamination. The potential exists for groundwater degradation due to the unlined ponds and nitrogen degradation due to the existing reclamation practices. The implementation of the State's Anti-Degradation policies is technology driven and requires that a discharge be regulated to meet Best Practicable Treatment and Control (BPTC) to assure that pollution or nuisance will not occur (i.e., beneficial uses will not be unreasonably affected) and the highest water quality consistent with the maximum benefit to the people of the state is maintained. For new construction, the use of lined ponds is well precedented. Lined treatment ponds may be an acceptable long-term alternative for new development if the City can demonstrate that agricultural reclamation of the resulting effluent is not causing excessive nitrogen application rates to the crops, resulting in unacceptable nitrogen degradation of groundwater. However, even if groundwater degradation is not occurring, the City should evaluate the risks verses benefits of continuing to expand the pond system. Pond treatment does not offer reliable nitrogen removal at this time without going to the added expense of dissolved air flotation (DAF) and a separate nitrification/denitrification step (Figure 6-1). The potential need for these steps verses the cost (and cost effectiveness) of nitrification/denitrification activated sludge need to be considered by the City. These and other factors are discussed further below.

If groundwater degradation due to nitrogen is occurring under the reclamation fields, then the City would need to plan to provide treatment via a nitrification / denitrification secondary or tertiary treatment process. Upgrading treatment for existing residents would need to be negotiated with the Regional Board. For new growth (and possibly existing residents), some effluent disinfection prior to irrigation of the fodder crops appears likely to be necessary when the current WDRs are renewed based on current Regional Board policy. However, that policy is in conflict with other Regional Board policies being implemented at this time. Therefore, the proper course of action for the City at this time is to plan for disinfection, but not implement it until mandated by the Regional Board.

A summary of the pond treatment alternatives and their costs is provided in Table 6-3. As shown, synthetic liners for large, unaerated treatment ponds add a significant capital cost and would likely drive the City to higher rate aerated ponds constructed with synthetic liners if expansion of the treatment ponds is pursued.

Table 6-3
City of Newman Pond Treatment Alternatives Summary

	Lined, Unaerated	Lined, Aerated
Description	Synthetic lining to prevent leakage to groundwater; No mechanical aeration	Synthetic lining to prevent leakage to groundwater; Addition of mechanical aeration
Disposal	Restricted agricultural reclamation (unless treatment is upgraded with at least DAF, filtration, and disinfection. A post DAF nitrogen removal process may be necessary)	Restricted agricultural reclamation (unless treatment is upgraded with at least DAF, filtration, and disinfection. A post DAF nitrogen removal process may be necessary)
Advantages	❐ Familiar treatment and operation process ❐ Lowest O&M cost	❐ Addition of aerators reduces size of treatment ponds
Disadvantages	❐ Restricted disposal option compared to other types of treatment ❐ Separate location required for treatment [a] ❐ Lining of ponds is <u>very</u> expensive ❐ Very large treatment area required ❐ May be inconsistent with long-term growth plans of City ❐ Upgradable only at significantly higher overall cost than other options. Generally not considered upgradable.	❐ Restricted disposal option compared to other types of treatment ❐ Separate location required for treatment [a] ❐ May be inconsistent with long-term growth plans of City ❐ Upgradable only at significantly higher overall cost than other options. Generally not considered upgradable.
Capital Cost (2 Mgal/d; 2008$) [b]	$49.1 million	$21.2 million
Additional O&M Cost (2010$) [c]	$0	$270,000

(a) Insufficient space exists at current site for additional treatment ponds. New treatment ponds would need to be sited at another location.
(b) Capital cost is for a 2 Mgal/d treatment plant, costs do NOT including storage and disposal capital costs.
(c) Operation and Maintenance (O&M) costs are per year in addition to current O&M costs, at full capacity.

6.3.2 SECONDARY TREATMENT

If it is determined that groundwater degradation is occurring in the reclamation fields due to nitrogen in the effluent, a nitrification / denitrification secondary treatment process (Figure 6-3) would be required at least for new growth. The Regional Board should give existing residents time to upgrade their treatment process, if needed. Secondary treatment, alone, does not significantly expand the disposal options available to the City. Secondary treatment would facilitate upgrading the WWTP in the future to a higher level of treatment, if regulations and/or disposal methods dictate. Because the capital and annual costs of secondary treatment are not significantly different from lined, unaerated treatment ponds and require a fraction of the land for treatment, the City should pursue secondary treatment if it does not want to embark on more extensive groundwater degradation studies or take the risk that groundwater degradation would cause a shift in treatment processes in the future. It is also possible that a nitrification / denitrification secondary treatment process could handle either all of the City's wastewater or a portion, if only a partial reduction in nitrogen is necessary to protect groundwater quality and still satisfy crop nitrogen needs.

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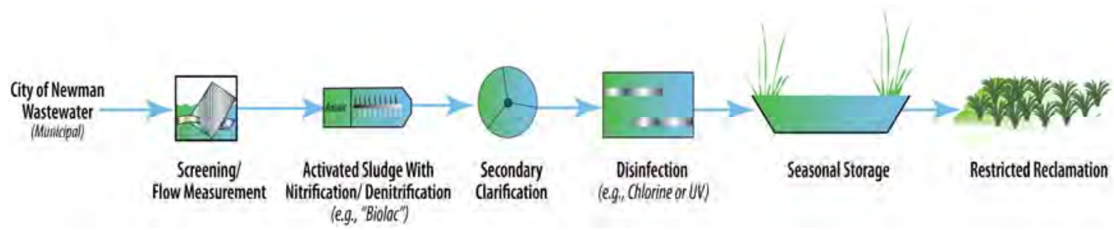


Figure 6-3
Example Secondary Treatment Process

Activated sludge is a form of secondary treatment, which uses a high rate biological process in which wastewater is treated with microorganisms. It can be divided into two processes: the aeration tank and the clarifier. Within the aeration tank, the wastewater comes in contact with a mixed, aerated culture of microorganisms. During this contact period, the dissolved organics are removed and transported into the microbial cells. In the clarifier, the activated sludge is separated from the liquid phase by sedimentation and recycled to the aeration tank to maintain a high concentration of biomass for treatment. The activated sludge will continue to build up until it is necessary to waste some of the activated sludge to a solids treatment process. The active sludge process can also be configured to biologically remove nitrogen and phosphorus from the wastewater. Activated sludge has the distinct advantage over pond treatment in that the amount of space needed for treatment is greatly reduced and the process can be upgraded in the future by adding tertiary processes for turbidity removal and enhanced disinfection. A summary of a secondary level treatment alternative is provided in Table 6-4.

Table 6-4
City of Newman
Overview of Secondary Treatment Using Activated Sludge Process Alternative

	Secondary Level Treatment
Description	"Biolac" nitrification/denitrification activated sludge treatment process with chlorine disinfection
Disposal	Restricted agricultural reclamation (unless upgraded with filtration and enhanced disinfection)
Advantages	• Upgradeable treatment system • Consistent with current disposal practices • BPTC with respect to nitrogen and salinity • All treatment could occur on existing wastewater treatment plant site
Disadvantages	• Restricted disposal options • More costly than aerated ponds • Separation of industrial flows is likely cost effective
Capital Cost (2 Mgal/d; 2008$) [(a)]	$38.7 million
Additional O&M Cost (2010) [(b)]	$500,000

(a) Capital cost is for a 2 Mgal/d treatment plant, costs do NOT including storage and disposal capital costs.
(b) Operation and Maintenance (O&M) costs are per year in addition to current O&M costs, at full capacity.

6.3.3 TERTIARY TREATMENT

If the City prefers to 1) have the most flexibility in terms of effluent disposal options, and/or 2) reduce potable water supply costs, then tertiary treatment should be planned for new development – either for near-term new development or as a future treatment option. For wastewater effluent to be used for unrestricted reclamation, tertiary level treatment and effluent disinfection are required (as shown in Figure 6-1). Tertiary treatment (Figure 6-4) includes a biological treatment process followed by filtration or membrane filtration. Disinfection can be either through the use of chlorine or ultraviolet light (UV) disinfection. Wastewater treated to tertiary standards (as defined by Title 22 of the California Code of Regulations) can be reclaimed in an urban or agricultural setting. Tertiary treatment would give the City the ability to reclaim water in an urban setting, which would either reduce the capital and annual costs of the new surface water supply system (if it is sized to allow reclamation to meet some to all urban irrigation use demands), or reduce the input of poor quality groundwater into the potable water supply system when urban irrigation demands are greatest. The City would have the added flexibility of reclaiming the water on discrete parcels (such as urban landscaping, parks, greenbelts, commercial landscaping, etc), the ability to use the water on different types of crops, and may be able to enter into a long-term lease instead of a land purchase with an area farmer.

Tertiary treatment could be accomplished through a secondary treatment process followed by filtration or through a combined process, such as a membrane bioreactor (MBR). Tertiary treatment removes pathogenic bacteria and viruses so the water can be used in "unrestricted reuse" applications. Although both processes are considered tertiary treatment, the use of membranes (microfiltration or nanofiltration) provides an order of magnitude better treatment than conventional filtration (particle filtration). The range of removal provided by different types of filtration is provided in Figure 6-5. Tertiary treatment using membranes often is accomplished through the use of membrane bioreactors (MBR). MBRs are a treatment process where the membranes are submerged in the activated sludge and the effluent is extracted through the membrane, leaving the solids behind. MBRs eliminate the need for secondary clarifiers and are more modular compared to separate secondary and tertiary treatment steps. For either of these treatment options, treatment is further followed by UV disinfection. The same amount of acreage is needed for storage and disposal. A summary of the tertiary treatment alternatives is provided in Table 6-5.

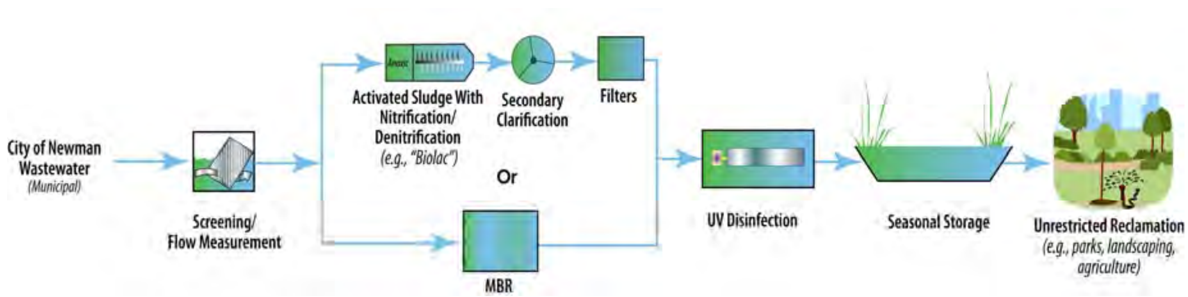
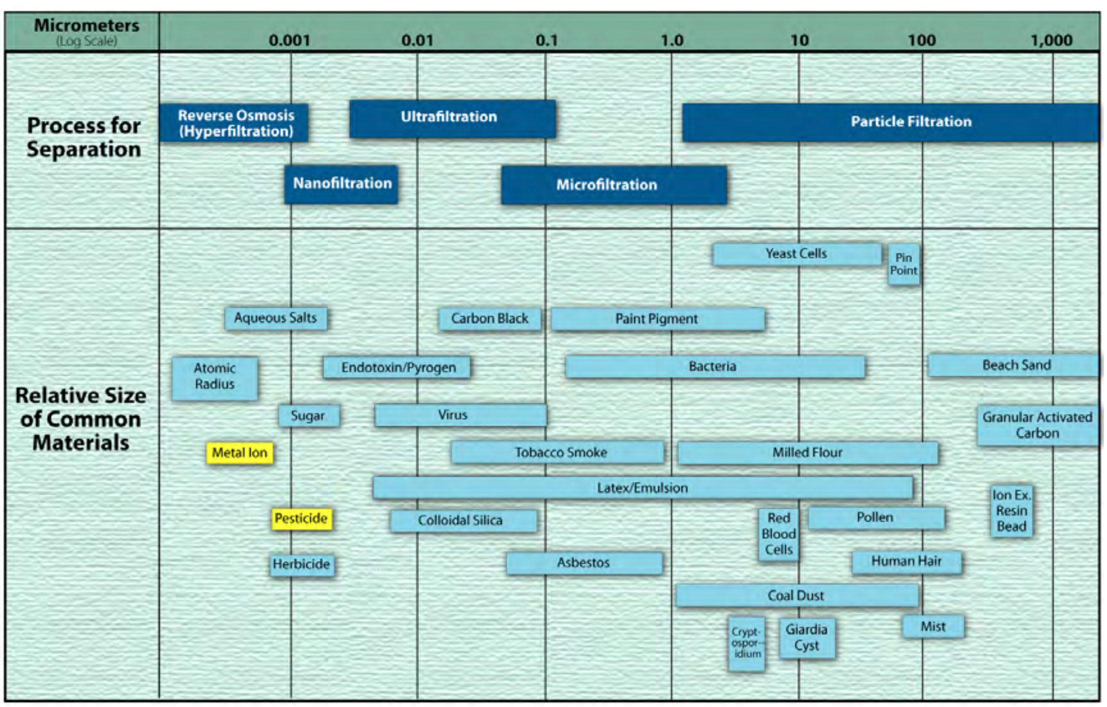


Figure 6-4
Example Tertiary Treatment Process

Figure 6-5



Comparison of Filtration Technologies

Table 6-5
City of Newman
Tertiary Treatment Alternatives Summary

	Secondary Treatment with Filters and UV Disinfection	MBR with UV Disinfection
Description	"Biolac" biological treatment process with conventional filters (disk filtration) and UV disinfection	Membrane bioreactor with UV disinfection
Disposal	❐ Urban reclamation ❐ Unrestricted agricultural reclamation ❐ Restricted agricultural reclamation ❐ Limited surface water discharge may be possible to reduce storage costs in wet winters	❐ Urban reclamation ❐ Unrestricted agricultural reclamation ❐ Restricted agricultural reclamation ❐ Limited surface water discharge may be possible to reduce storage costs in wet winters
Advantages	❐ High level of treatment ❐ Opportunities for multiple disposal options ❐ BPTC with respect to nitrogen and salinity ❐ All treatment could occur on existing wastewater treatment plant site	❐ Highest level of treatment ❐ Modular treatment system ❐ Opportunities for multiple disposal options ❐ BPTC with respect to nitrogen and salinity ❐ All treatment could occur on existing wastewater treatment plant site
Disadvantages	❐ Provides higher level of treatment than currently needed ❐ More costly than aerated ponds ❐ Separation of industrial flows is likely cost effective	❐ Provides higher level of treatment than currently needed ❐ Highest capital cost ❐ Highest O&M cost ❐ Separation of industrial flows is likely cost effective
Capital Cost (2 Mgal/d; 2008$) [b]	$45.0 million	$55.1 million
Additional O&M Cost (2010) [c]	$640,000	$710,000

[a] Capital cost is for a 2 Mgal/d treatment plant, costs do NOT including storage and disposal capital costs.
[b] Operation and Maintenance (O&M) costs are per year in addition to current O&M costs, at full capacity.

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6.4 INDUSTRIAL PRE-TREATMENT ALTERNATIVES

In addition to future treatment of residential wastewater, the future treatment of F&A Dairy wastewater also needs to be considered. The higher strength food process wastewater from F&A Dairy represents over half the total organic load currently entering the WWTP. Pond systems are generally well suited for food processing wastewater due to the fact that the systems can tolerate large swings in organic load on a daily, weekly, or monthly basis. Analysis of the existing WWTP capacity (described in Chapter 5) assumes that F&A Dairy flows and loads remain the same. Given this assumption and with the existing system improvements completed, the current WWTP should be able to accommodate the current flow and load from F&A Dairy.

When considering future treatment, it is assumed that F&A Dairy will not increase production and, therefore, their flow and load contribution will not change. The size and associated capital cost as well as the operation and maintenance cost of activated sludge treatment processes are greatly affected by the influent organic loading. Therefore, if activated sludge secondary or tertiary treatment is used for future growth, it will be most cost effective only to treat municipal wastewater with this process. If F&A Dairy increases its loading to the City's WWTP or if results of the groundwater assessment indicate that the existing users (including F&A) are required to phase out of the existing ponds, it will be more cost effective to provide a separate pretreatment process for F&A Dairy wastewater to reduce the amount of organic load to municipal strength.

Generally, high organic strength wastewater (with a 5-day biochemical oxygen demand (BOD_5) of greater than 1,000 milligrams per liter (mg/l)) is better suited to be treated using an anaerobic process instead of an aerobic process (such as activated sludge). There are many reasons to consider anaerobic pretreatment of the F&A Dairy wastewater, including:

- Low sludge yield - Anaerobic systems typically produce a small fraction of the sludge generated by aerobic systems.
- Lower electrical requirements - Because an anaerobic system does not require oxygen, the high horsepower requirements of surface aerators or blowers are avoided.
- Higher organic loading - Anaerobic systems are capable of providing high treatment efficiencies at BOD concentrations ranging from 1,000 mg/l to 20,000 mg/l. These systems are also typically more effective than aerobic systems at BOD_5 removal.
- Energy production - A byproduct of anaerobic degradation of organics is the production of a methane-rich biogas which can be used to supplement or replace natural gas for fueling plant boilers, engine generators, and other energy systems.
- Good process stability - The anaerobic process is very stable under varying hydraulic and organic loadings and other conditions that may cause upsets in other types of biological systems.
- Lower nutrient requirements - Anaerobic systems require a fraction of the nitrogen and phosphorus that an aerobic system does.

- Lower operating costs - Because anaerobic systems require less nutrients and electrical input and generate less sludge than aerobic systems, they have inherently lower operating costs than an aerobic system.
- Pretreated industrial wastewater can be discharged to the municipal sewers and the combined municipal sewage flows can then be treated aerobically.

Two options for anaerobic pretreatment of F&A Dairy wastewater include anaerobic ponds and an anaerobic digester.

Anaerobic ponds reduce the organic matter content of wastewater by enhancing the activity of gas-producing microbes. Anaerobic ponds function much like open septic tanks where solids settle and are broken down by bacteria which thrive in the absence of oxygen. Under warm, neutral pH conditions in the absence of oxygen, methane producing bacteria's predominate and release methane and carbon dioxide. Under more acidic conditions, other bacteria producing sulphur-containing and other gases predominate. Any gases produced escape to the atmosphere, while the microbial sludge settles in the bottom of the pond. Anaerobic pond can achieve up to 70% BOD_5 removal. To treat the existing F&A Dairy effluent to a municipal strength of 300 mg/l, an anaerobic pond of about 0.5 acre would be needed with a detention time of approximately 20 days. Due to the odor generation potential and land restrictions near F&A Dairy, pretreatment of effluent with an anaerobic pond would require separate effluent conveyance of the industrial wastewater to the City's WWTP. Potential conveyance pipeline routes are shown in Figure 6-6.

Industrial wastewater biological strength can also be reduced by an anaerobic digester. In this process, organic waste is digested in a controlled process that limits access to oxygen and encourages the generation of methane and carbon dioxide by microbes. Due to the variations in flow and loads of F&A Dairy, an equalization tank would be needed. Anaerobic digesters typically achieve 80 to 90% BOD_5 removal. An example anaerobic digester is a process called the upflow anaerobic sludge blanket process (UASB). The UASB has been used extensively for the treatment of higher strength industrial wastewaters, including milk and cheese processing water. The system would likely include a chemical conditioning tank followed by the UASB reactor itself. F&A Dairy wastewater could be pretreated at F&A and then conveyed to the WWTP in the municipal sewers for eventual aerobic treatment.

A summary of pretreatment alternatives for F&A Dairy is provided in Table 6-6.

Table 6-6
City of Newman
F&A Dairy Industrial Pretreatment Alternatives

	Anaerobic Pond	Anaerobic Digester (e.g., UASB)
Percent Removal	❒ Approximately 70% of influent BOD_5	❒ Approximately 90% of influent BOD_5
Advantages	❒ Simple construction ❒ Lower Capital and O&M cost ❒ Simple, non-mechanical system to operate	❒ Odors and flies significantly reduced or eliminated ❒ Less space required ❒ Treatment can occur near F&A Dairy site and effluent can be conveyed in the existing municipal sewer ❒ Methane and carbon dioxide (greenhouse) gas emissions are reduced ❒ Biogas is produced which can be used to generate heat or electrical power ❒ Pathogens are substantially reduced ❒ Treatment usually occurs quicker
Disadvantages	❒ Very high odor potential ❒ Larger land requirement ❒ Treatment usually takes longer ❒ Treatment is affected by seasonal variations in temperature ❒ Large volumes of sludge are removed every 2-5 years that can be costly to dispose	❒ Higher capital cost ❒ Higher O&M cost ❒ Requires skilled operations staff
Conveyance Costs (2008$)	$2.4 to 3.4 million	Within existing municipal sewers
Capital Cost (2008$) [(a)]	$1.8 million	$2.2 million

[(a)] Capital cost is to treat existing F&A Dairy flow (0.18 Mgal/d).

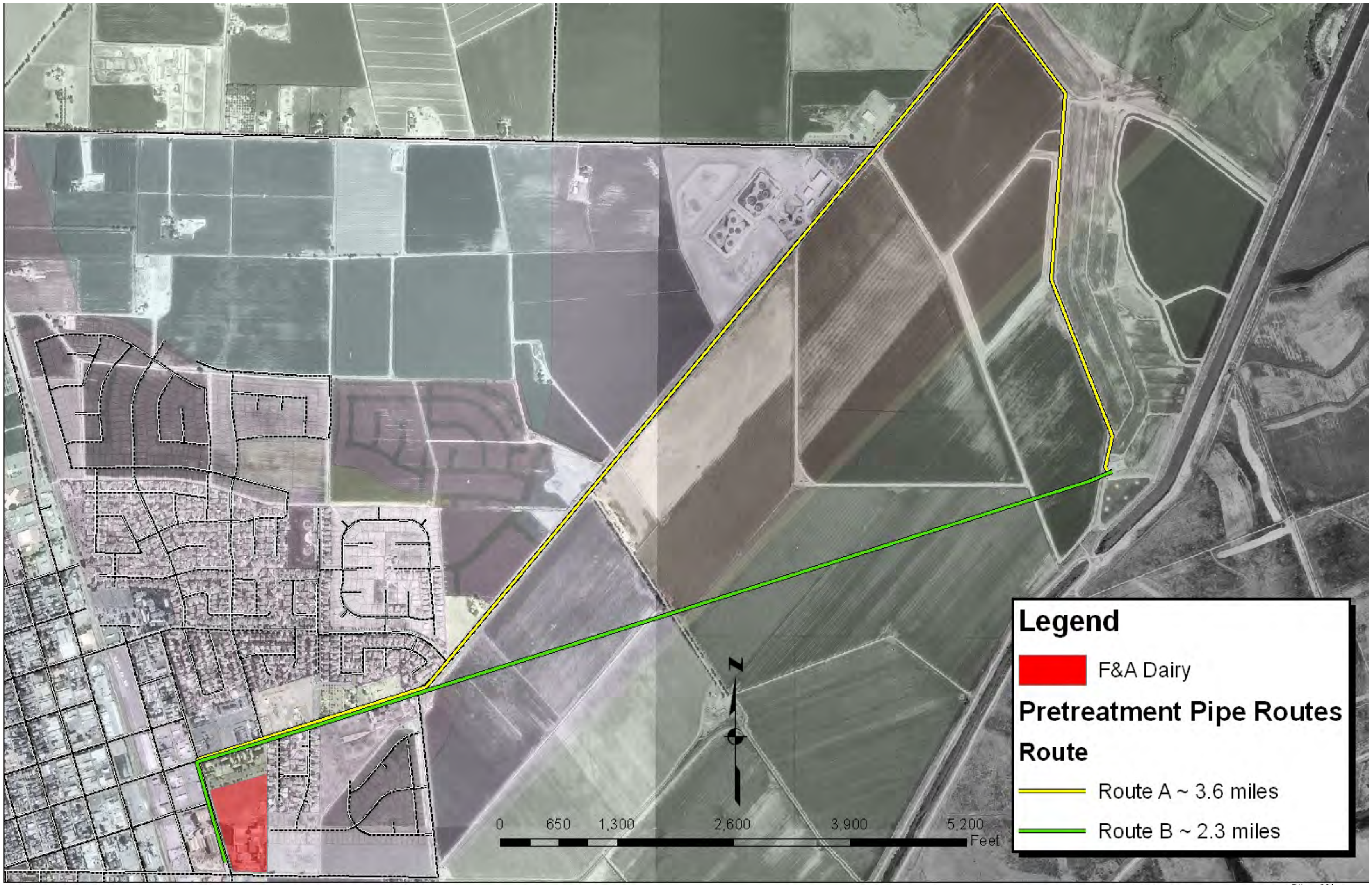

Figure 6-6
City of Newman – F&A Dairy Potential Conveyance Pipeline Routes for Pretreatment at Newman WWTP

6.5 FUTURE EFFLUENT STORAGE AND DISPOSAL REQUIREMENTS

Future storage needs are independent of the treatment and reclamation disposal method used. Storage must be designed to accommodate the wastewater generated during the wet season as well as 1-in-100 year precipitation. For the Primary SOI, approximately 33 acres beyond the existing WWTP are needed. At full buildout of the Secondary SOI, approximately 150 total acres are needed (117 additional acres). Reclamation disposal land depends on the amount of urban reclamation used. If only restricted agricultural reclamation is employed, 208 acres of land is needed for the Primary SOI and an additional 570 acres is needed for the Secondary SOI. A schematic of the land area that will be required for storage and restricted reclamation at full buildout of the Secondary SOI is shown in Figure 6-7. The areas identified in Figure 6-7 are not intended to be the exact parcels, but instead to demonstrate the amount of land area needed. Also, these areas do not include additional land for treatment, if needed.

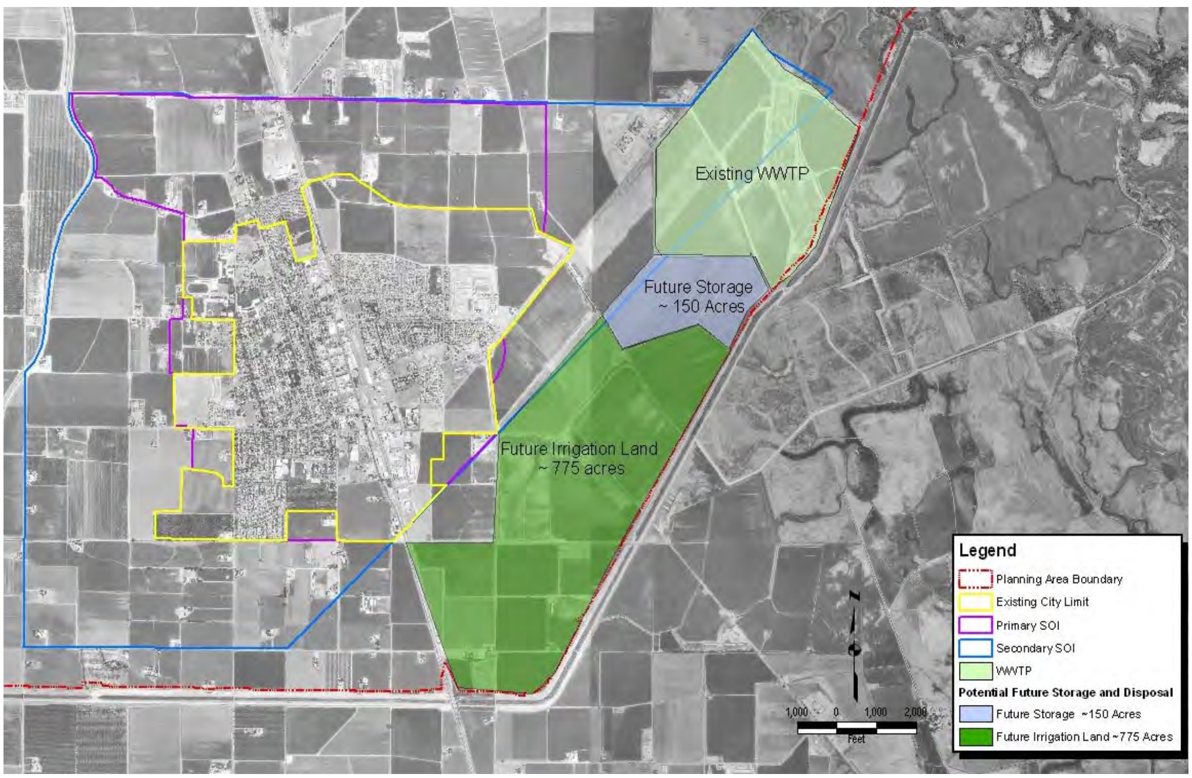

Figure 6-7
City of Newman Future Storage and Disposal Land Requirements – Full Buildout of Secondary SOI

Chapter 7

Recommended Plan

The preceding chapters outline the regulatory concerns, treatment and disposal options, and unknowns related to the potential for groundwater degradation. Given this information, it is recommended that the City of Newman (City) follow a plan that allows for the most flexibility in the future. The City has a unique, one-time opportunity to create a plan that is both consistent with regulations and also conserves resources.

Growth within the existing City Limits can be accommodated in the existing WWTP with some near-term, and possibly long-term, upgrades. Growth in the Primary SOI and Secondary SOI that wishes to annex to the City will need to fund construction infrastructure (including water and wastewater utilities) to serve these annexations. As discussed in the companion Wastewater Collection System Master Plan, these areas will need new trunk sewers to accommodate future wastewater flow to the WWTP (Figure 7-1). This “separate” collection system creates a distinction between new and existing users. There is a logical separation of new users to a new treatment process compared to the existing users who have already put a significant investment into their existing WWTP. F&A Dairy’s wastewater is also limited to flowing to the existing pond system, which is better able to accommodate the high and variable strength wastewater than activated sludge or an MBR. This flexibility of separation of the new and existing users exists in very few Cities. In addition, if a higher level of treatment is selected for new growth, there is a nexus between that higher cost and the beneficiaries of the infrastructure being created. With a higher level of treatment being funded by the annexed areas, these areas can be required to be plumbed to use tertiary effluent on parks, school yards, commercial landscaping, etc., including consideration of residential front yard irrigation in all years, and back yard irrigation in drought years when the City’s surface water allocation from the California Aqueduct may be reduced. It is prohibitively expensive to retrofit the existing City with urban reclamation “purple pipes” to allow the level of reclamation and water supply security possible for the annexed areas.

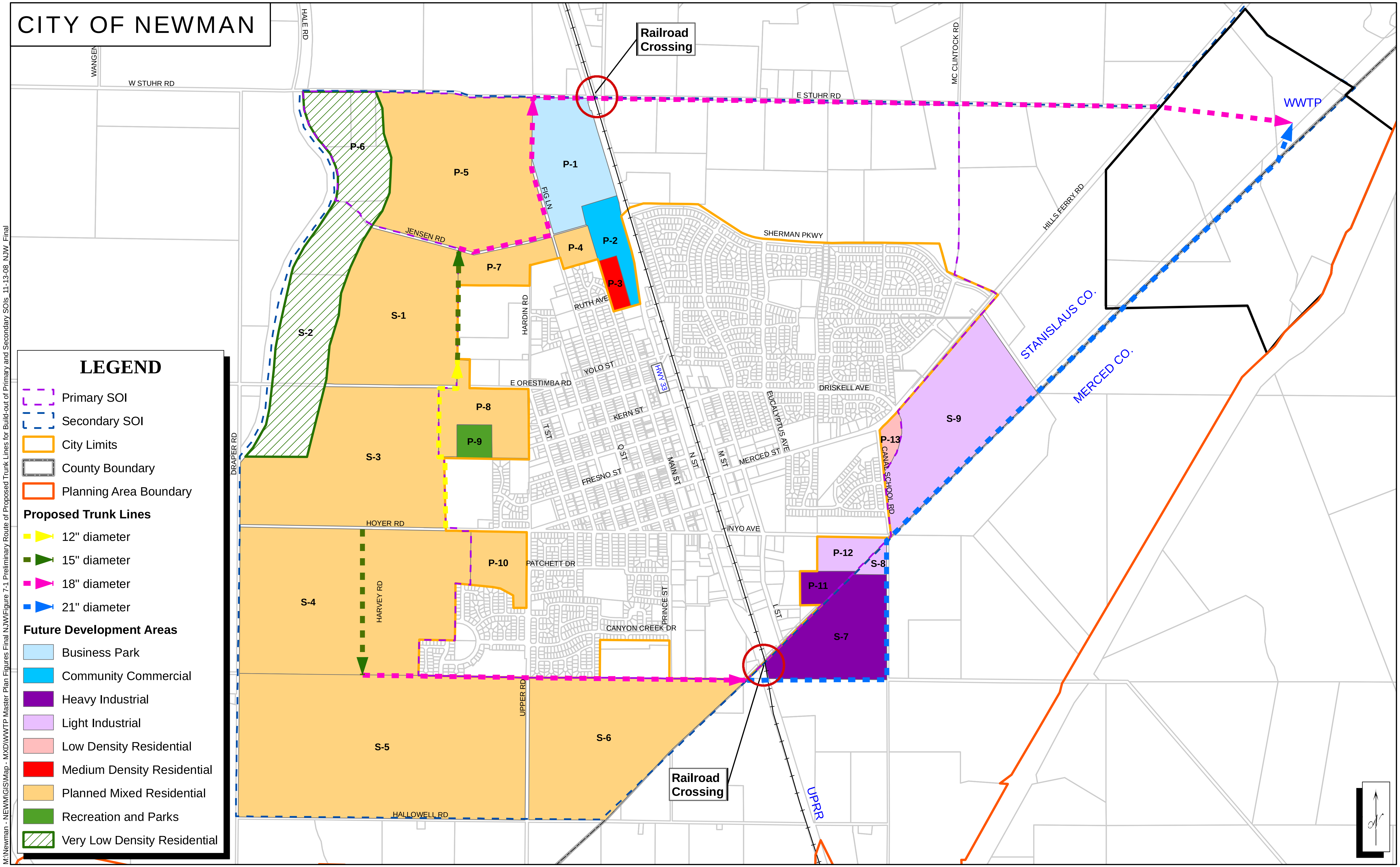

Figure 7-1
Preliminary Wastewater Collection System Routes of Proposed Trunk Lines for Build-out of Primary and Secondary SOIs

Based on the foregoing concepts, the following major actions are recommendations as part of this Master Plan:

- **Plan for diversifying effluent disposal options in the future.** Continued expansion of the City's pond system to serve future growth is based on the ability of the City to acquire large parcels of land suitable for treatment and disposal ponds and restricted reclamation and, more importantly, the demonstration that the existing WWTP does not degrade groundwater either from the unlined ponds and/or from the reclamation practices. It is essentially impossible to predict if either of these concerns will surface in the future. Other communities that use secondary or tertiary treatment processes instead of pond treatment have the distinct advantage of being able to construct add-on processes to remove nitrogen, turbidity, pathogens, and even trace pollutants that allow the effluent to be disposed or reclaimed for other uses. For this reason, it is recommended that new development 1) treat its wastewater to a higher level, and 2) provide alternative means of effluent disposal.

- **Acquire more disposal reclamation land.** Concurrent with planning for diversified effluent disposal options, it is also prudent planning to secure suitable disposal land (ideally near the WWTP). This land can be used on either an interim basis and/or for long-term future reclamation needs and will allow the WWTP to expand as needed to accommodate growth, regardless of the treatment and disposal methods pursued on a long-term basis.

- **Assume new development in the Primary and Secondary SOIs will be required to treat their wastewater to tertiary standards.** As noted above, diversifying effluent disposal options requires a higher level of wastewater treatment. Current BPTC is a lined wastewater treatment process that removes total effluent nitrogen to less than 10 milligrams per liter, unless the effluent discharger specifically demonstrates that the level of treatment is not needed to prevent degradation of underlying groundwater. The burden of proof rests with the City for new growth beyond the 1.44 Mgal/d (average sanitary flow basis) permitted capacity of the existing facility. Coupling BPTC with the need to diversify effluent disposal results in the recommendation that annexations to the City fund tertiary level treatment providing pathogen-free effluent that can be applied in an unrestricted manner to agricultural crops and urban landscaping. While there are several types of treatment processes that produce tertiary quality effluent, fiscal planning around a new membrane bioreactor (MBR) facility is recommended. MBRs have comparable costs to conventional tertiary systems and many of the new WWTPs built in California today are MBRs.

- **Plan future City parks, schoolyards, landscape medians, greenbelts, etc. for irrigation with tertiary effluent.** This recommendation implements diversifying effluent disposal and takes steps to either reduce the size and cost of the new potable water supply and/or maintain the quality of that water supply by reducing the need to operate existing potable water wells (with poor quality water) during maximum potable water demand days driven by landscape irrigation water needs. As discussed previously, this plan can only be implemented to any great extent in new development areas because of the high cost to retrofit existing developed areas with dual "purple pipe" systems needed for effluent reclamation. The City may wish also to consider effluent reclamation in residential front yards, and possibly in back yards during severe drought when the City's allocation of California Aqueduct Water may be reduced. With modern, reliable tertiary wastewater treatment facilities, front and back yard effluent irrigation is becoming increasingly common in prestigious communities. The "perception problem" is diminishing and since this practice would only be occurring in new areas, the people buying the home would be accepting the use as evidenced by the fact that they bought the home. This is a very different perspective than a forced retrofit where existing people have no choice.

- Under this plan, the layout of the new water, wastewater, and reclaimed water (i.e., effluent) pipes in the annexed areas would be consistent with California Department of Public Health "Title 22" requirements. This includes use of "purple pipe" to designate non-potable uses, addition of backflow preventers from the City's potable water lines, separate water lines to bathrooms/ drinking fountains, and selection of certain types of sprinkler heads to minimize overspray in public areas. Many communities have amended their city design standards to include the Title 22 provisions, even before reclaimed water is available. The new UC Merced campus is an example of such planning where the irrigation system is designed to switch over to reclaimed water when sufficient wastewater is generated by the students. Since it is very expensive to retrofit existing areas, it is recommended that city design standards be modified so that the City has options for how new urban landscaping could be watered in the future.

- **Develop a revenue program that equably funds wastewater treatment and disposal for both existing and new users.** Funding these initiatives will impact both the City's monthly wastewater rates (for capital projects related to achieving the permitted capacity of the existing WWTP and new operational costs benefiting existing users) and wastewater capital fees (for capital projects benefiting City growth, including expansion of the WWTP beyond the current permitted capacity). A detailed revenue program is needed to determine funding of the items discussed above. Depending on the outcome of the groundwater monitoring, input from the Regional Board, and evaluation of the ability to off-set potable water demands, the City may desire to construct a new tertiary WWTP for new development and recycle that water on new urban and agricultural areas. Since funding major facility upgrades through monthly sewer rates is expensive and difficult to implement equitably across all users, it is recommended to base capital fees for development of the Primary and Secondary SOIs on the costs for constructing a new tertiary MBR treatment facility. A new MBR facility with a capacity of 1.0 Mgal/d and accommodations for future growth is estimated to cost $33 million (for treatment only) in 2008 dollars. Capital fees based on this amount would be adjusted each year to an inflation index tied to the construction industry. At this point, the plan recommends only <u>collecting</u> fees associated with the tertiary WWTP as a means to minimize risk to the City. If the various unknowns related to treatment and disposal practices can be resolved with some surety, then a portion of the collected money could be refunded to parties who funded the construction of the actual facilities.

Appendix A

BOD/COD/TOC Special Testing Results Summary

Appendix A

City of Newman BOD/COD/TOC Special Testing Results Summary

This summary discusses some of the results and conclusions of the special wastewater testing conducted by the City of Newman on August 22nd, 2007 and September 12th, 2007. Wastewater samples were collected from three locations: F&A Dairy effluent, a manhole in the City prior to F&A Dairy discharge, and the influent to the wastewater treatment plant (WWTP). In addition, a sample of the "City without the Dairy" wastewater was blended with the Dairy effluent in approximate proportion to the flows (85 percent City wastewater to 15 percent F&A Dairy effluent). Time-composite samples were collected by the City at the manhole and at the WWTP. The F&A Dairy samples were collected by the Dairy's flow proportional composite sampler. Samples were analyzed for 5-day biochemical oxygen demand (BOD_5), 20-day biochemical oxygen demand (BOD_{20}), chemical oxygen demand (COD), and total organic carbon (TOC). Results and conclusions from the testing are shown in Table 1 and discussed below.

1. The BOD_5 of the F&A Dairy waste varies substantially. On August 22nd, F&A Dairy BOD_5 was 1,130 mg/L (a load of 1,610 lb/day) and on September 12th, the BOD_5 was 4,460 mg/L (5,660 lb/day). Historical F&A Dairy BOD_5 data indicates that the BOD_5 load has been as high as 7,250 lb/d (March 2006). BOD load affects WWTP costs in two ways:

    a. The cost of the treatment facilities.

    b. The monthly cost to maintain and operate those treatment facilities.

    This variability in BOD load raises the question as to whether F&A Dairy has paid for 7,250 lb/d of BOD treatment facilities, or is using facilities paid for by others, and paying only for the maintenance and operation of those facilities.

2. The BOD_5/BOD_{20} ratios for the Dairy samples were 0.74 and 0.84 on August 22nd and September 12th, respectively. Milk waste should be readily biodegradable and have a very high BOD_5/BOD_{20} ratio. The lower ratio values of the samples suggest the possibility that there may be residual disinfection agents (or other limiting compounds) in the Dairy waste, which slow the BOD_5 test kinetics. Slow kinetics cause the reported BOD_5 concentrations to be lower than if the BOD_5 test were free of disinfectants. The hypothesis of slow kinetics from disinfectants in the Dairy wastewater is supported by the 85 percent/15 percent blend data where the "actual" BOD_5/BOD_{20} ratio (and therefore kinetics) is greater than the "theoretical" BOD_5/BOD_{20} ratio. The greater ratio (and therefore kinetics) in the actual blend could be a result of the greater quantity City wastewater (1.038 Mgal/d) diluting the disinfectant in the smaller quantity of Dairy wastewater (0.171 Mgal/d), thus, reducing the effect of the disinfectant on the BOD_5 test.

Table 1
City of Newman
BOD/COD/TOC Special Study Results

August 22, 2007 Flow Data:		
WWTP flow	1.209	Mgal/d
Dairy flow	0.171	Mgal/d
City flow w/o Dairy	1.038	Mgal/d

September 12, 2007 Flow Data:		
WWTP flow	1.293	Mgal/d
Dairy flow	0.152	Mgal/d
City flow w/o Dairy	1.141	Mgal/d

			85%:15% Blend Before Outfall		**85.9%:14.1% Blend after Outfall**	
	City w/o Dairy	**Dairy**	**Actual (combined sample)**	**Theoretical (Calculated)**	**Actual (measured at WWTP)**	**Theoretical (Calculated)**
August 22, 2007 Results						
BOD_5, mg/L	303	1,130	405	427	771	420
BOD_{20}, mg/L	490	1,530	544	646	795	637
BOD_5/BOD_{20}	0.62	0.74	0.74	0.66	0.97	0.66
COD, mg/L	593	2,260	684	843	965	828
BOD_{20}/COD	0.83	0.68	0.80	0.77	0.82	0.77
TOC	1,080	509	1,500	994	206	999
BOD_5/COD	0.51	0.50	0.59	- - -	0.80	- - -
August 22, 2007 Results						
BOD_5, mg/L	206	4,460	827	844	866	806
BOD_{20}, mg/L	350	5,330	1,010	1,097	1,080	1,052
BOD_5/BOD_{20}	0.59	0.84	0.82	0.77	0.80	0.77
COD, mg/L	370	7,080	1,380	1,376	1,490	1,316
BOD_{20}/COD	0.96	0.75	0.73	0.80	0.72	0.80
TOC	57.1	2,330	355	398	268	378
BOD_5/COD	0.56	0.63	0.60	- - -	0.58	- - -

3. Since Dairy waste is typically both organic and readily biodegradable, the relatively low ratio of BOD_{20}/COD for the Dairy waste on August 22nd (0.68) is somewhat surprising. This ratio suggests that the Dairy waste contains a substantial amount of compounds (presumably organic compounds) that are not biodegradable over 20 days. Two questions arise from this observation:

    a. What are the compounds that make up the difference between BOD_{20} and COD observed in the Dairy waste?

    b. Is the oxygen demand of these compounds truly refractory (i.e., never expressed) in the WWTP or are they an oxygen demand on the WWTP that adds cost to the design and operation?

A credible guess is that some fats in the Dairy waste may take more than 20 days to degrade, but that ultimately they will degrade. These compounds would show up in a COD analysis, but not the BOD_{20} test. Since the WWTP retention time is greater than 20 days, these compounds would add cost to the design and operation of the WWTP.

4. Another observation of interest is the difference between the actual BOD_5 concentration measured after the outfall conveyed the blended wastes to the WWTP headworks (771 mg/L) and the theoretical BOD_5 concentration (420 mg/L) on August 22nd. This difference was not measured on September 12th. The differences observed could be a result of one or more factors that include:

    a. Warmer wastewater temperatures on August 22nd could cause more biodegradation in the outfall to the WWTP. This “pre-treatment” in the outfall pipe by bacteria growing in the pipe can accelerate BOD_5 kinetics.

    b. The major differences in Dairy wastes between August 22nd and September 12th could cause the differences observed.

    c. Natural seeding of the wastewater by bacteria growing on the walls of the outfall piping, which could accelerate BOD_5 kinetics, particularly if the Dairy waste contains organics (such as fats) that may not be readily biodegradable by common wastewater bacteria.

    From available data, a best guess is that fats in the Dairy wastewater may tend to collect in the outfall pipe downstream of where Dairy wastewater enters the City’s collection system (and any residual disinfectants in the Dairy wastewater are neutralized by dilution by the much larger City flow). The collected fat on the outfall piping walls begins to decay bacterially and sheds into the wastewater (1) bacteria evolved to metabolize Dairy waste fats and (2) shorter chain organics from that metabolic process that are readily biodegradable by a wide spectrum of wastewater bacteria. These effects of the outfall pipe on wastewater BOD kinetics would be greater with higher wastewater temperatures.

5. The BOD_5/BOD_{20} ratio for typical municipal wastewater is generally in the 0.6 to 0.7 range. City waste was 0.62 and 0.59 on the two sampling dates (i.e., on the low end of “typical”). At the WWTP (after the outfall), the BOD_5/BOD_{20} ratios were 0.97 and 0.80, both well above the typical range. Although the actual total organic load at the WWTP (as measured by BOD_{20}, or possibly COD) may not change from the City to the WWTP, the “apparent” organic load as measured by the BOD_5 test appears to increase.

    For example, if the BOD_5/BOD_{20} ratio is 0.6 and the “true” biodegradable organic load (as measured by the BOD_{20} test) is 400 mg/L, then the “apparent” load on a BOD_5 basis would be 240 mg/L (400 mg/L x 0.6 = 240 mg/L). If the BOD_5/BOD_{20} ratio is 0.8, the “apparent” load on a BOD_5 basis would be 320 mg/L (400 mg/L x 0.8 = 320 mg/L). This change in BOD_5/BOD_{20} ratio from the City to WWTP headworks may be the explanation for the “mystery” BOD load. In other words, the “mystery” BOD load was never there, but rather was a relic of using the BOD_5 test and the BOD_5/BOD_{20} ratio changing from the City to the WWTP, apparently as a result of both the Dairy and the outfall.

These results are preliminary because they are based on only two observations. However, the results are significant and need to be considered by both the City and F&A Dairy in how they conduct business with each other. Specific points appearing to need discussion and resolution between the City and F&A Dairy include:

1. The BOD_5 test may not be a representative indicator of the oxygen demand placed on the WWTP by the F&A Dairy waste. COD appears to be the superior indicator. Because the

Dairy monthly operational billing basis is BOD_5 load, the relationship between COD and BOD_5 needs to be established. This relationship should be based on the typical BOD_5/COD ratio for City waste. For the two sampling events in the study, the typical (i.e., average) City wastewater BOD_5/COD ratio is 0.534. Based on this very preliminary value, the August 22nd BOD_5 "billing value" for F&A Dairy would be 1,210 mg/L (2,260 mg/L COD x 0.534 = 1,210 mg/L BOD_5), not 1,130 mg/L. For September 12nd, the BOD_5 "billing value" would be 3,780 mg/L (7,080 mg/L COD x 0.534 = 3,780 mg/L BOD_5), not 4,460 mg/L.

2. If F&A Dairy wastewater strength (i.e., organic load) will to continue to vary, the funding of the construction, maintenance, and operation of the treatment facilities needed/reserved for Dairy use needs to be evaluated. As an example, if the Dairy will have months producing 7,200 lb/d BOD_5, then the City needs to have facilities built and reserved to treat those Dairy loads when they occur, even if they only occur periodically. BOD treatment capacity reserved for occasional "on-demand" use by the Dairy is not available for other uses, such as City growth.

3. If it is determined that Dairy waste, either immediately or after passing through the outfall pipe, is causing an unusually high immediate oxygen demand at the WWTP then modifications to the WWTP to address this high immediate oxygen demand are needed and the source of funding needs to be determined.

Although only two sets of tests were concluded, the results of these tests provide an explanation for the "mystery" BOD load that prompted the study. The results also suggest that F&A Dairy is a significant and varying organic load on the WWTP.

Appendix B

March 14, 2006 Water/Wastewater Planning Letter to Regional Board

ECO:LOGIC

Consulting Engineers

March 14, 2006

JoAnn Kipps, PE
California Regional Water Quality Control Board
Central Valley Region
Fresno Branch Office
1685 "E" Street
Fresno, CA 93706-2007

Re: City of Newman Wastewater/Water Planning

The purpose of this letter is to provide the Regional Board with an update on City of Newman wastewater and water planning. The City's planning effort is intended to be comprehensive and transparent so that all involved parties (from residents, to businesses, to the Regional Board) understand what the City is doing as a responsible public entity, and why. All parties are being included in the planning process to maximize understanding and consensus.

<u>Overview of the Problem</u>

The City's groundwater potable water supply has a salinity of about 1,700 μS/cm. The recommended upper limit for water supply salinity is 900 μS/cm. Reducing the salinity of the City's water supply is desirable, though not essential, from a consumer use perspective.

Based on the 1,700 μS/cm water supply, the wastewater influent to the wastewater treatment plant (WWTP) site has a salinity of about 2,800 μS/cm. This 1,100 μS/cm salinity increase is relatively high (a typical value is less than about 500 μS/cm), and is a result of water conservation measures, industrial/commercial discharges, and extensive use of water softeners in town to compensate for the 450 mg/L hardness of the water supply. The residential salinity increase may be about 900 μS/cm; therefore, control of industrial/commercial dischargers, alone, will not resolve the salinity problem.

The 2,800 μS/cm wastewater is treated in unlined ponds. This poses two potential problems:

- Pond treatment may evaporatively concentrate more salt than the aeration equipment of a nitrification/denitrification activated sludge process. An activated sludge process also achieves some net transport of salt off-site via landfill disposal of dried sludge.
- The unlined ponds leak some wastewater into area shallow groundwater. Carollo Engineers estimated the overall average leakage to be 2.1 ft/yr (2 x 10-6 cm/sec under roughly 6 feet of hydrostatic head which translates into an equivalent one-foot thick pond liner with a permeability of 3.4 x 10-7cm/sec). This leakage rate is comparable to that from clay lined ponds. In other words, the ponds have "de facto" clay liners, which is in agreement with EPA observations regarding leakage from ponds.

Regardless of semantics, there is leakage; and therefore there is the potential for groundwater degradation. Potential groundwater degradation problems include salinity, pathogens, nitrogen compounds, and soil redox related problems (e.g., mobilization of iron, manganese, and arsenic). Further study of all potential problems is necessary, based on our experiences, and the experiences reported by EPA (see Attachment A), if there is to be an actual understanding of what specific shallow groundwater quality transformations are occurring under the WWTP site relative to the immediate environs. Of these potential problems, it is known that salinity leakage is occurring. Whether this leakage is causing degradation depends on shallow groundwater salinity in the area, which currently is ill-defined in our opinion.

As a result of tailwater return from the effluent reclamation area as well as evaporation from the ponds, the City's effluent prior to reclamation has a salinity of about 3,500 μS/cm. This 3,500 μS/cm water is applied to land to grow crops. Since no other farmer is believed to be using 3,500 μS/cm water for surface irrigation or flushing purposes in the area, it would appear by inspection that the WWTP operation should be degrading shallow groundwater. However, this is not necessarily the case because the Newman-specific situation gets complex with regards to what constitutes "natural" or "background" shallow groundwater salinity between the City of Newman and the San Joaquin River, and whether "natural" or "background" salinity is the basis for compliance assessment. In this letter, "natural" conditions refer to pre-irrigation conditions for the general area, i.e., prior to the Delta-Mendota Canal and Central California Irrigation District. "Background" conditions refer to conditions as they exist today, i.e., as impacted by man and in a state of flux based on land uses, irrigation water supplies and practices, crops grown, fertilizer use, subsurface drainage, etc., as will be discussed. For compliance assessment purposes, "natural" conditions are superior to "background" conditions because background conditions are not the natural state of things; and background conditions are in a constant state of flux which implies that compliance could also be in a constant state of flux depending on the uncontrolled actions of others. Unfortunately, natural conditions no longer exist in the area. These complexities are discussed below.

Natural and Background Shallow Groundwater Concentrations and Gradients

Whether the WWTP operation is causing degradation (salinity, nitrogen, or otherwise) can only be determined based on knowledge of natural or background shallow groundwater concentrations, and gradients specific to the site. Natural concentrations and gradients no longer exist on site, but may be discernable from historical records, soils types, and more natural sites in the greater area. Background concentrations and gradients could have been determined before the site was used to reclaim effluent as was done at Mountain House (see Attachment B); but, background concentrations were not a concern of the Regional Board at the time that the site was converted to effluent reclamation. However, background concentrations can be estimated; and the Mountain House data are an important example of possible relevance to the Newman situation. This is because, at Mountain House, if background groundwater data had not been collected before the fact of reclamation, it would have been concluded erroneously that the change in shallow groundwater salinity from up-gradient to down-gradient on the site was caused by reclamation when in fact the salinity gradient was a background phenomenon.

At Newman, the preponderance of data as summarized by DWR (see Attachment C) is that there is both a natural and background salinity gradient across the WWTP site as observed at Mountain House. Consequently, a critical factor to the entire compliance issue at Newman is establishing a credible estimate of natural and/or background salinity concentrations and gradients for the WWTP site prior to reclamation occurring. This is complex, as will be discussed, because of the variability in shallow groundwater salinities and gradients in the area (see Attachments D and E, and compare D to C).

At the Newman WWTP site, current up-gradient shallow groundwater salinities (i.e., background salinities as measured by MW#1 and MW#4) suggest that shallow groundwater flowing easterly under the WWTP site may have an average salinity of about 3,600 μS/cm. The City's irrigation records suggest that this groundwater is sufficiently shallow that it is being tapped (directly or via capillary action) by the alfalfa once it is well rooted. If this is the case on the WWTP site as well as on adjacent properties, then evapotranspiration of water by plants (crops or native vegetation) tapped into the shallow groundwater can cause the shallow groundwater salinity to increase relatively quickly. As an example, DWR's database (Attachment D) shows groundwater salinity at 9,590 μS/cm south of the WWTP. This high shallow groundwater salinity would reduce the yield of most crops; therefore, it is probably a result of evapotranspiration by salt tolerant vegetation and/or evaporation of capillary water rising up from shallow groundwater, i.e., natural conditions. Typically, a farmer would irrigate his crop to keep the salinity of water in his crop's root zone well below 9,590 μS/cm. In other words, in shallow groundwater settings, farmers may need to irrigate, not to meet the water demands of their crops, but rather to control the buildup of salts in the crop's root zone. Irrigation of crops overlying naturally shallow groundwater to control root zone salinity results in the need to artificially drain the soil. Drain lines and other artificial drainage practices are common in the Newman/Gustine area.

The preponderance of evidence is that shallow groundwater exists in the area, which can lead to high natural salinity concentrations and gradients, which are reduced/controlled by irrigation, which exacerbates shallow groundwater conditions, which results in the need to drain area soils by man-made means. The net effect of 1) irrigation to control salinity buildup, and 2) soil drainage to prevent water buildup, typically, is a reduction in shallow groundwater salinity concentrations compared to natural conditions. With all of the irrigation and drainage in the Newman area, "natural" shallow groundwater salinities probably no longer exist. "Background" salinities do exist, but are variable as a result of parcel-specific irrigation and soil drainage practices.

The foregoing raises the question of what constitutes background or natural shallow groundwater salinity for compliance assessment purposes. By natural forces, shallow groundwater salinity would increase by plant evapotranspiration and capillary evaporation. The 9,590 μS/cm salinity measured south of the WWTP site is an indication of the salinity concentration potential of natural forces. At the City of Woodland adjacent to the westside of the Sacramento River flood plain, tritium dated "pre-modern" shallow groundwater had a salinity of 15,000 μS/cm. At Mountain House, shallow groundwater salinities as high as 16,600 μS/cm were observed. Thus, the natural evapotranspirative/evaporative potential of the Newman site appears to be such that the "natural" unflushed salinity of shallow groundwater on the west side of the San Joaquin River flood plain could be about 10,000 µS/cm. However, with irrigation and soil drainage practices in the Newman area the current "background" salinity should be maintained at a much lower concentration by area agriculturalists to maximize crop yields. Considering the 2001 (post-drought) DWR map of the area's shallow groundwater salinity (Attachment C), the "A-line" drain salinity data, and the MW #1 and MW #4 data, it appears that background shallow groundwater salinity in the area based on current irrigation and soil drainage practices is probably maintained in the 2,000 µS/cm to 4,000 µS/cm range. There may be a general trend of shallow groundwater salinity in the Newman area increasing from west to east (i.e., towards the historical flood plain of the San Joaquin River) based on the 2001 DWR salinity map (Attachment C).

As stated earlier, a critical question to be answered is whether the basis for groundwater degradation compliance assessment is the "natural" high salinity resulting from root and capillary extraction of pure water from shallow groundwater, or the current "background" shallow groundwater salinity that is a function of local irrigation and drainage practices? While it may be possible to estimate "natural" shallow groundwater salinity by researching early agricultural studies of the Newman area, current "background" salinity will vary from parcel-to-parcel as a function of parcel-specific crops, irrigation practices, irrigation water supply, shallow groundwater levels, subsurface drainage practices, etc.

An example of the variability in background shallow groundwater salinity is provided by the "A-line" with a salinity of about 2,400 µS/cm at the WWTP property line versus the roughly 3,600 µS/cm salinity of the City's up-gradient monitoring wells. The "A-line" water represents irrigation water that has percolated through the soil to the drain line relatively quickly and directly. Therefore, the "A-line" water has experienced relatively little of the natural salt concentrating effects operative on shallow groundwater in poorly drained soil. This is different from the poorly drained shallow groundwater slowly approaching the WWTP site (and up-gradient monitoring wells) from the west. This slow moving shallow groundwater would be expected to experience more of the salt concentrating effects, and therefore have a higher salinity as indicated by available data.

Because of these spatial and temporal variabilities in "natural" and "background" shallow groundwater salinity in the Newman area, the City hopes to avoid attempting to establish a "natural" or "background" salinity when such a salinity may not exist. The City has conceived an alternative compliance assessment protocol that is presented under "The City Plan". If the alternative compliance assessment protocol is not acceptable to the Regional Board, then the City will begin the process of estimating a most probable number for both the "natural" and "background" salinities for the Newman area based on 1) historical records, and 2) construction of additional monitoring wells.

To estimate current area background salinity concentrations and gradients on the WWTP site after many years of effluent reclamation on the WWTP site requires construction of background up-gradient and background down-gradient monitoring wells on properties north and south of the WWTP site. Results from these wells would be used to estimate salinity concentrations and gradients on the WWTP site as if the WWTP operation did not exist. The down-gradient background salinity estimated for the WWTP site would then become the long-term, average, salinity water quality objective (WQO) for the WWTP site. This WQO would be the basis for determining what water salinities can be contained in unlined ponds, and what water salinities can be evapotranspiratively concentrated by effluent reclamation (unless sections of the California Water Code are invoked to permit water reclamation independent of salinity issues, as will be discussed).

The City Plan

The following is the overall wastewater facilities compliance plan that the City is pursuing. Aspects of the plan are beyond City control; therefore, the plan may need to change as development of the plan progresses.

Correcting the Basic Problem. The basic problem is that the water supply is very salty (1,700 µS/cm) by drinking water standards, and has a lot of hardness which results in the use of water softeners in town. Based on preliminary contact with the Central California Irrigation District (CCID), the City is seriously pursing a $20 million potable water supply and treatment project to convert the City from bulk groundwater (1,700 µS/cm) to Delta Mendota Canal (DMC) surface water (500 µS/cm average annual salinity in the post-Delta Barriers Project era). This project will reduce average potable water supply salinity (and therefore average wastewater salinity) by 1,200 µS/cm, and is estimated to increase the combined monthly water and sewer bill by $50/month. This increase is substantial and may prompt initiation of "lifeline" water and/or sewer base rates for limited income residents. Such a subsidy program will increase the fees paid by all other dischargers to something more than a $50/month fee increase.

Converting the water supply from groundwater to surface water should reduce influent wastewater salinity from the current 2,800 µS/cm concentration down to about 1,600 µS/cm. A 1,600 µS/cm influent wastewater salinity would evaporatively increase on an average annual concentration basis to about 2,000 µS/cm after pond treatment and storage based on the 25 percent increase in salinity currently occurring from influent to storage. Effluent in this salinity range could leak from unlined ponds and not cause degradation based on all available data.

To reduce wastewater salinity to the extent feasible, another aspect of the City plan is public education to try to reduce the use of water softeners in the community once water softeners are no longer needed because of the relatively "soft" DMC surface water supply. The public education effort will be complemented with a careful review of City ordinances regulating the salinity of commercial/industrial discharges to the sewer system. The City's objective is to reduce the influent wastewater salinity to less than 1,600 µS/cm to the extent feasible over time, though with increased water conservation as the City grows, a long-term decrease in salinity may not be observed.

Addressing the "Unlined" Treatment Ponds. If the Carollo Engineering estimates of pond leakage are correct (2.1 feet per year), this leakage rate under 6 feet of head is equivalent to the ponds having an intact one foot thick clay liner with a permeability of roughly 3.4×10^{-7} cm/sec. De facto clay liner or not, the real issue is whether the ponds are causing groundwater degradation/pollution. This is not known because background groundwater quality concentrations specific to the WWTP site have not been established for salinity or any other contaminant; and there are no monitoring wells hydraulically down-gradient from the treatment ponds to measure their impact on shallow groundwater quality. Regarding degradation/pollution, what can be said is the following:

1. Salinity: If influent salinity is reduced to roughly 1,600 μS/cm by switching to a DMC potable water supply, it is highly unlikely that the treatment ponds will be degrading the groundwater with salinity. Once the conversion to DMC water is made, it may take several years for the effect of the change to be detectable in monitoring wells because of slow horizontal flow rates in area shallow groundwater, and the long-term integrating effect of monitoring well screens more than a few feet long.

2. Nitrogen: The current "best guess" is that background total nitrogen concentrations are at or below the 10 mg/L water quality objective (WQO). Therefore the down-gradient wells will probably need to have total nitrogen concentrations not exceeding 10 mg/L on a long-term average basis for the ponds to remain in service. Based on our experience and EPA's report, we do not expect nitrogen to be a problem in this particular situation; but, this needs to be confirmed by down-gradient monitoring well results.

3. Pathogens: The more we learn about the site, the more complex meaningful pathogen testing becomes. Coliform bacteria are too large to move far in the fine-grained, poorly drained soils, even if those soils are saturated. The presence of coliform bacteria in any of the down-gradient wells to be constructed will most likely be an indicator that the well was contaminated during construction, has a faulty sanitary seal (a common problem with shallow monitoring wells in clay soils with shrink/swell potential), or was sampled without use of sterile techniques. It is possible that if groundwater is within a few feet of ground surface at the well site, coliform could be migrating down from the ground surface at the well site, rather than horizontally from the treatment ponds.

   The actual indicator of potential virus movement from the treatment ponds into shallow groundwater was expected to be a virus of coliform. Unfortunately, if shallow groundwater is within a few feet of ground surface at the well site, then soil coliform and their virus naturally could be in the soil and groundwater immediately around the well site, and flow into the well during purging and sampling.

   Based on the City of Brentwood experience of the 1980's and 1990's, coliform may be living in shallow groundwater on particles or on the surfaces of pipes and well casings, but not in the water. If coliform bacteria are present locally, then coliform virus will be present locally right in the monitoring well casing and sand pack. In this particular situation, it appears that neither coliform nor coliform virus testing, alone, will answer the question of whether virus leakage from the ponds is occurring. It appears that coliform virus concentrations in the down-gradient treatment pond monitoring wells will have to be compared to coliform virus concentrations in wells constructed in similar soil and hydrogeologic conditions in the area. Additionally, the wells may need to be cleaned, super chlorinated, and gently purged immediately prior to each coliform virus sampling event to reduce the influence of well casing coliform and virus growths on groundwater monitoring results.

The proper approach to resolve this complex matter is to carefully site, construct, and test the wells, first. If there are no coliform virus present, then there is no pathogen leakage problem from these ponds. If coliform virus are present, the City needs to take the additional coliform virus monitoring steps identified above before concluding whether the ponds do (or do not) have a detectable pathogen leakage problem.

4. Iron, Manganese, and Arsenic: Mobilization of soil iron, manganese, and/or arsenic is believed to be a potential problem with the ponds. The reason for this is two-fold:

   - The Oxidation Pond is large and effectively cuts off all atmospheric molecular oxygen transfer to the underlying groundwater. Without atmospheric molecular oxygen transfer, even a relatively small organic load to the underlying groundwater has the potential to reduce the reduction/oxidation potential (i.e., redox potential) of this environment. A low redox can mobilize naturally occurring iron, manganese, and/or arsenic.

   - Though leakage from the Oxidation Pond is quite low (estimated to be 2.1 feet/year), this leakage water is believed to contain more BOD than molecular oxygen; thus, a reduction of redox potential in groundwater underlying the Oxidation Pond is likely.

   Whether a serious iron, manganese, and/or arsenic problem exists can only be determined via monitoring down-gradient shallow groundwater quality, and comparing those results to background concentrations.

If all of the foregoing testing shows that the “de facto lined” treatment ponds are not degrading or polluting groundwater, then the ponds will remain in service. If only salinity degradation/pollution is a problem, then the ponds will remain in service if the DMC water supply is obtained. Groundwater pollution from nitrogen, pathogens, or iron/ manganese/ arsenic probably necessitates replacing the treatment ponds at some point. The cost of replacing the treatment ponds, in-kind, with above ground, lined, aerated treatment ponds is estimated to cost roughly $18 million. Conversion to the lowest cost form of activated sludge would cost nearly $30 million considering the high BOD of current City wastewater.

The cost of replacing the current treatment ponds (which does not address potential salinity degradation caused by the reclamation area) would almost certainly preclude the DMC potable water supply project on a near-term basis because implementing both projects would result in a monthly fee increase of roughly $80 to $100, or more, depending on final construction and operational costs. Such a fee increase is not believed to be viable with the Newman electorate. Consequently, the most cost effective plan appears to be to implement the DMC water supply, now, and to address the treatment pond problem, if necessary, when financially feasible.

If there is pollution from the current treatment ponds, there is some rational technical basis for deferring pond replacement (in addition to economic reality). That basis is that background shallow groundwater salinity is roughly 3,000 μS/cm, or more, which places this water in the category of being brackish. Brackish water is not used as a potable water supply (without extensive treatment or dilution). If the water does not have domestic water supply beneficial use, then WQOs protecting potable use have bearing via the Basin Plan and tributary rule, but not directly on-site in a technical sense. If hydraulically down-gradient where this brackish shallow groundwater enters a receiving water, the problem has corrected itself by additional soil treatment, then it is technically feasible to allow the ponds to remain in current service (but not expanded service) until existing dischargers realistically can fund the pond replacement project or alternative mitigation measure.

In this regard, part of the overall City plan is to allow infill within the existing City limits to connect to the existing WWTP because these properties are as much a part of the existing City as existing homes and businesses. This infill would not necessitate any increase in the existing treatment plant capacity beyond the permitted 1.69 million gallons per day. These existing properties will participate in the revenue bonds which is how existing residents and businesses will fund improvements needed for themselves, but not for new growth. Annexations to the City, which is how all major City growth will occur, will be required to build new treatment and disposal facilities. Though the new treatment facilities may be at the existing WWTP site, the new disposal facilities will not be at the existing WWTP site because of the soil drainage problems on this site. However, additional reclamation fields may be added to the existing site for the dual purposes of 1) adding capacity for near-term use by new growth while an entirely new reclamation site is located and acquired, and 2) reducing the long-term effluent load to area groundwater by the existing users who will use any lands added to the WWTP site once the new reclamation site for new growth is operable.

Resolving Reclamation Degradation Issues. Agronomic irrigation (including effluent reclamation) evapotranspiratively concentrates salt, potentially by a factor of up to about 3 to 4 depending on crop, irrigation method, rainfall, and averaging period. Effluent typically has a greater salinity than other irrigation water supplies; therefore, agronomic irrigation with effluent typically results in greater salinity degradation of underlying shallow groundwater than would occur with use of other irrigation water supplies. Salinity degradation resulting from effluent reclamation runs contrary to State Board Resolution No. 68-16 which was adopted in 1968. However, the California legislature superseded this resolution relative to salinity degradation from water reclamation projects by adopting California Water Code (CWC) Section 13523.5. This law facilitated the legislature's desire to encourage wastewater reclamation as stated in CWC Sections 13510, 13511, 13512, etc. The legislature appears to be saying in CWC Section 13523.5 that the need to reclaim wastewater is a higher priority that the salinity degradation that results from wastewater reclamation at this time. The City supports the legislature's intent, but believes that interpretation of Section 13523.5 needs to be balanced with judgment to avoid abuses and actions not consistent with maximum, long-term benefit to the people.

In this context the City plans to continue effluent reclamation but needs to involve the Regional Board in the development of that plan. The City plan, as currently envisioned, involves the following elements:

- CWC Section 13523 states, "(a) Each regional board…shall… prescribe water reclamation requirements for water which is used… as reclaimed water." The City reclaims its wastewater and requests that the current permit be revised to include "water reclamation requirements" (WRRs) as required by CWC Section 13523.

- CWC Section 13523.5 states, "A regional board may not deny issuance of water reclamation requirements to a project which violates only a salinity standard in the basin plan." The City requests that the Groundwater Limitations in the requested WRR's reflect CWC Section 13523.5.

- To avoid abuses under the foregoing, the City proposes the following approach, which is simple to implement, is as protective as current laws related to agricultural use of groundwater, passes the "reasonable man" test, and is economically feasible.

  - Bulk groundwater under the City (as evidenced by the City's current municipal water supply) as a long-term average salinity of about 1,700 μS/cm.

  - Bulk groundwater should become somewhat more saline to the east of the City as the historical alkali flats of the San Joaquin River are approached, and as suggested by DWR groundwater salinity maps for the area. Based on these state maps and the associated City data, a credible estimate for bulk groundwater salinity at the current WWTP site is about 2,000 μS/cm.

  - This groundwater could be used by local farmers for irrigation purposes without regulation.

  - The City requests that the WRR's require a flow-weighted, average annual salinity for water applied to the effluent reclamation areas of no more than 2,000 μS/cm .

  - Because of the evaporative salt concentrating effect of pond evaporation and tailwater return, a reclaimed water salinity limit of 2,000 μS/cm represents an equivalent influent wastewater average annual salinity limit of about 1,600 μS/cm. This is a 1,100 μS/cm increase over the 500 μS/cm DMC water supply. This increase is comparable to the current salinity increase, and therefore should be achievable after the change in the potable water source. Achieving this level of compliance is an important milestone for City residents who will be funding the improvements. Having achieved this milestone of reduced wastewater salinity, the City's salinity reduction program would seek means to reduce the salinity increase further over time via education and regulation.

- The foregoing approach avoids the almost impossible task of establishing an actual (as opposed to a negotiated) "natural/background" salinity for this site. The situation at Newman is more complex than at Mountain House because at Newman it appears that in the absence of irrigation, lands immediately west of the San Joaquin River could be alkaline flats caused by evapotranspiration of salt-tolerant vegetation, evaporation of capillary groundwater, and evaporation of flood water from the San Joaquin River. In other words, the WWTP site has probably been reclaimed for agricultural production by the introduction of irrigation to the area.

- The City's approach of using the quality of the bulk natural water resource for the area as the basis for establishing compliance appears to be in agreement with CWC Section 13551 and the California Supreme Court's recent construction of the legislature's intent in the case of City of Burbank v. State Board.

Summary

The foregoing is a reasonable representation of City staff planning relative to improving conditions at the existing WWTP. The major planned tasks include:

- Converting to a DMC potable water supply to reduce water supply salinity and hardness if 1) CCID can provide the needed water, and 2) the City has adequate funds after making any urgently needed WWTP pond improvements.

- Working with residents, businesses, and industry to reduce salinity increases to the extent feasible.

- Revising the WDRs to include WRRs for the water reclamation activities, with limitations being included to avoid abuses.

- Determining "natural" and "background" shallow groundwater contaminant concentrations and gradients only to the extent needed based on the foregoing results and negotiations.

- Requiring annexations to the City to fund new treatment and disposal facilities.

This is an ambitious plan, and the City wants to start as quickly as possible. One of the first steps is receiving comments from the Regional Board so that Newman residents and businesses know their City government is acting responsibly on their behalf by working with the Regional Board.

If you have any questions about the proposed plan, please feel free to give me or Michael Holland at the City a call. We are already in negotiation with CCID because this is such an important element of the plan.

Sincerely,

ECO:LOGIC ENGINEERING

Rich Stowell, PE, PhD

cc: Michael Holland, City of Newman
Robert W. Emerick, PE, PhD, ECO:LOGIC Engineering
Gerry LaBudde, PE, ECO:LOGIC Engineering

Attachments:
A Excerpts from EPA Manual on Ponds
B Mountain House Background Groundwater Data
C 2001 DWR Shallow Groundwater EC Map
D 1995 DWR Shallow Groundwater EC Map
E DWR Shallow Groundwater EC Data Near Newman

Attachment A

EPA Data Regarding Pond Leakage and Degradation

EPA-625/1-83-015

DESIGN MANUAL

MUNICIPAL WASTEWATER STABILIZATION PONDS

U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Research and Development
Municipal Environmental Research Laboratory
Center for Environmental Research Information

Office of Water
Office of Water Program Operations

October 1983

Use of conventional construction equipment is usually suitable for this purpose.

Seepage collars should be provided around any pipes penetrating the dike (4) (5). The seepage collars should extend a minimum of 0.6 m (2 ft) from the pipe. Proper installation of transfer pipes can be assured by building up the dike at least 0.6 m (2 ft) above the pipe elevation, digging a trench for the pipe and seepage collar, backfilling the trench, and compacting the backfill.

In some circumstances it may be necessary to control seepage and ensure bank stability at the exterior toe. A filter blanket material can be used (6). Another method of preventing seepage where embankment material cannot be adequately compacted is placement of an impervious core in the levee with imported material.

4.3 Pond Sealing

4.3.1 Introduction

The need for a well-sealed stabilization pond has impacted modern pond design, construction, and maintenance. The primary motive for sealing ponds is to prevent seepage. Seepage effects treatment capabilities by causing fluctuation in the water depth and can cause pollution of groundwater. Although many types of pond sealers exist, they can be classified into one of three major categories: (1) synthetic and rubber liners, (2) earthen and cement liners, and (3) natural and chemical treatment sealers. Within each category also exists a wide variety of application characteristics. Choosing the appropriate lining for a specific site is a critical issue in pond design and seepage control. Detailed information is available from manufacturers, and in other publications (4)(6).

4.3.2 Seepage Rates

Stander et al. (7) presented a summary of information (Table 4-1) on measured seepage rates in wastewater stabilization ponds. Seepage is a function of so many variables that it is impossible to anticipate or predict rates even with extensive soils test. The importance of controlling seepage to protect groundwater dictates that careful evaluations be conducted before construction of ponds to determine the need for linings and the acceptable types.

The Minnesota Pollution Control Agency (8) initiated an intensive study to evaluate the effects of stabilization pond seepage from five municipal systems.

The five communities were selected for study on the basis of geologic setting, age of the system, and past operating history of the pond. The selected ponds were representative of the major geomorphic regions in the state, and the age of the systems ranged from 3 to 17 years.

Estimates of seepage were calculated by two independent methods for each of the five pond systems. Water balances were calculated by taking the difference between the recorded inflows and outflows, and pond seepage was determined by conducting in-place field permeability tests of the bottom soils at each location. Good correlation was obtained with both techniques.

Field permeability tests indicated that the additional sealing from the sludge blanket was insignificant in locations where impermeable soils were used in the construction process. In the case of more permeable soils, it appeared that the sludge blanket reduced the permeability of the bottom soils from an initial level of 10^{-4} or 10^{-5} cm/sec to the order of 10^{-6} cm/sec. At all five systems evaluated, the stabilization pond was in contact with the local groundwater table. Local groundwater fluctuations had a significant impact on seepage rates. Reduced groundwater gradient resulted in a reduction of seepage losses at three of the sites. Contact with groundwater possibly explains the reduction in seepage rates in many ponds; in the past this reduction in seepage rates has been attributed totally to a sludge buildup. In an area underlain by permeable material where little groundwater mounding occurs, there is probably little influence from the water table on seepage rates. The buildup of sludge on the bottom of a pond appears to improve the quality of the seepage water leaving the pond. Sludge accumulation apparently increases the cation exchange capacity of the bottom of the pond.

Groundwater samples obtained from monitoring wells did not show any appreciable increases in nitrogen, phosphorus, or fecal coliform over the background levels after 17 years of operation. The seepage from the ponds did show an increase in soluble salts as great as 20 times over background levels. Concentrations of 25 mg/l to 527 mg/l of chloride were observed.

A comparison of observed seepage rates for various types of liner material is presented in Table 4-2 (4). If an impermeable liner is required, it appears that one of the synthetic materials must be used.

4.3.3 Natural and Chemical Treatment Sealing

The most interesting and complex techniques of pond sealing, either separately or in combination, are natural pond sealing and chemical treatment sealing (5)(9).

Natural sealing of ponds has been found to occur from three mechanisms: (1) physical clogging of soil pores by settled solids, (2) chemical clogging of soil pores by ionic exchange, and (3) biological and organic clogging caused

Attachment B

Mountain House Pre-Reclamation Groundwater Monitoring Results

ANNUAL REPORT

SOIL, GROUNDWATER, AND AGRICULTURAL DRAIN MONITORING

MOUNTAIN HOUSE WASTEWATER RECLAMATION FACILITY

Prepared for
Trimark Communities
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Tracy, CA 95376

Prepared by
Condor Earth Technologies, Inc.
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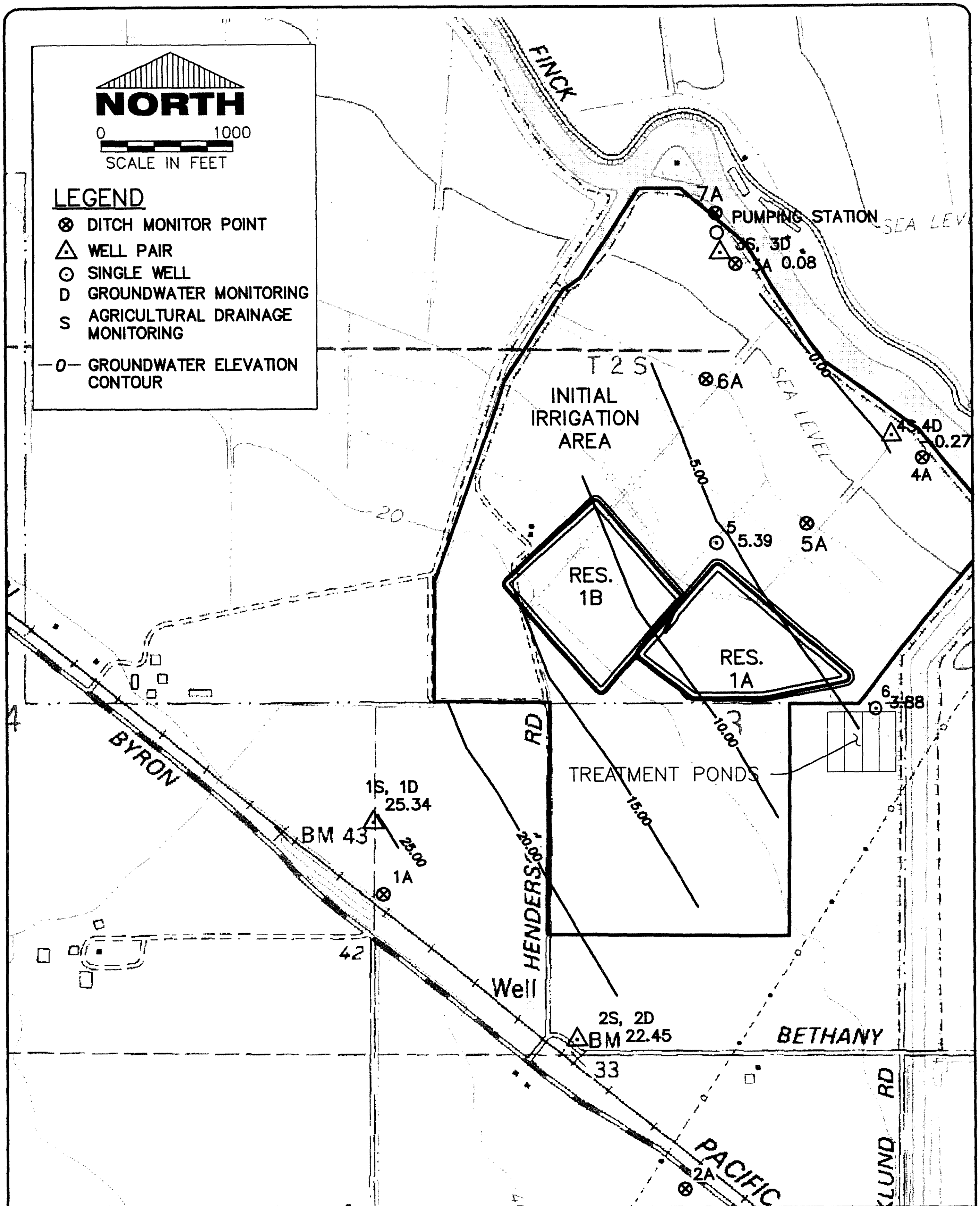
January 22, 2003
Condor Project No. 1587X2

CONDOR



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Job No.	1587X2
Date	12/23/02
Scale	AS SHOWN
Drawn / Chk'd	AWA / TKH

GROUNDWATER CONTOUR MAP
OCTOBER 30, 2002
MOUNTAIN HOUSE, CALIFORNIA

FIGURE 4

File No. 1587X2F4

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Table 6: Historical Groundwater Monitoring Data

		Total Coliform	Total Dissolved Solids	Depth to Water	Groundwater Elevation	Nitrates (NO3)	Electrical Conductivity (E.C.)	Field E.C.	Field pH	Field Temp
SITE	DATE COLLECTED	MPN/100ml	mg/L	(feet)	ft (MSL)	mg/L	umhos/cm	(uS/cm)	(SU)	(oC)
1D										
Measuring pt.	02/28/2001	<2	1930	9.14	29.63	24	1770	1562	7.61	17.7
38.77	04/03/2001	<2	1460	9.24	29.53	23	1566	1501	7.71	18.6
ft msl	05/02/2001	<2	1490	7.86	30.91	22	2230	2250	7.6	19.0
	06/07/2001	<2	1910	8.75	30.02	26	2340	2180	7.6	21.6
	07/02/2001	<2	1570	10.84	27.93	1.7	2450	1980	7.65	22.1
	08/06/2001	<2	1620	14.32	24.45	31	1626	2520	7.67	16.1
	09/04/2001	<2	1630	15.55	23.22	25	2520	2410	7.82	18.7
	10/03/2001	<2	1600	15.88	22.89	28	2540	2190	7.64	22.2
	11/05/2002	<2	1780	16.80	21.97	25	2439	1950	7.61	20.0
	12/13/2001	<2	1676	15.25	23.52	6.3	2199	2410	7.51	17.6
	01/14/2002	<2	1780	13.41	25.36	24	1896	2390	7.69	16.4
	02/04/2002	<2	1720	13.79	24.98	28	2130	1513	7.63	19.7
2D										
Measuring pt.	02/28/2001	<2	3230	8.64	25.94	45	3730	4990	7.47	18.2
34.58	04/02/2001	<2	2950	8.95	25.63	21	4370	3910	7.48	18.9
ft msl	05/02/2001	4	3100	8.27	26.31	43	4480	4470	7.45	20.6
	06/07/2001	<2	3010	8.97	25.61	41	4800	4360	7.44	22.2
	07/02/2001	<2	3140	9.92	24.66	<1.0	5020	3770	7.42	21.4
	08/06/2001	<2	3090	11.22	23.36	26	3540	5070	7.4	17.1
	09/04/2001	<2	3100	12.13	22.45	23	5900	4930	7.55	20.4
	10/03/2001	<2	3060	12.76	21.82	47	5280	4710	7.42	24.3
	11/05/2002	<2	3180	13.22	21.36	44	5460	4890	7.35	21.0
	12/13/2001	<2	3087	13.39	21.19	11	5256	4990	7.39	19.5
	01/14/2002	<2	3210	12.49	22.09	35	4424	5020	7.47	16.7
	02/04/2002	<2	3240	12.26	22.32	41	5040	4780	7.38	20.1
3D										
Measuring pt.	02/28/2001	<2	810	4.95	-0.2	<1.0	888	822	7.72	15.1
4.75	04/02/2001	<2	630	4.79	-0.04	<1.0	1120	959	7.73	16.2
ft msl	05/02/2001	<2	750	4.34	0.41	<1.0	1198	1145	7.67	18.8
	06/07/2001	<2	800	4.38	0.37	1.2	1304	1341	7.63	21.0
	07/02/2001	<2	990	4.95	-0.20	<1.0	1318	1239	7.47	20.2
	08/06/2001	<2	880	4.58	0.17	<1.0	939	1144	7.64	17.4
	09/04/2001	<2	850	4.64	0.11	<1.0	1300	1403	7.7	18.0
	10/03/2001	<2	970	4.79	-0.04	<1.0	1350	1439	7.63	22.3
	11/05/2002	<2	714	4.70	0.05	1.2	1181	989	7.52	19.2
	12/13/2001	<2	594	5.82	-1.07	0.3	1007	932	7.56	17.0
	01/14/2002	<2	650	4.59	0.16	<1.0	983	970	7.62	14.9
	02/04/2002	<2	740	4.94	-0.19	<1.0	1190	795	7.62	18.7
4D										
Measuring pt.	02/28/2001	<2	5310	6.31	-0.26	3.2	5560	6420	7.33	16.5
6.05	04/02/2001	<2	4760	6.16	-0.11	<1.0	6270	5300	7.39	17.2
ft msl	05/02/2001	<2	4940	6.37	-0.32	5.2	6180	6250	7.34	19.8
	06/07/2001	<2	4930	6.93	-0.88	ND	6380	6220	7.28	19.1
	07/02/2001	<2	5240	7.40	-1.35	<1.0	7220	5140	7.33	20.3
	08/06/2001	<2	5100	7.40	-1.35	<1.0	5360	7210	7.36	15.8
	09/04/2001	<2	4940	7.06	-1.01	<1.0	7750	7130	7.38	17.0
	10/03/2001	<2	4960	7.02	-0.97	<1.0	7590	6490	7.28	22.9
	11/05/2002	<2	4910	5.19	0.86	<1.0	7725	6850	7.36	18.8
	12/13/2001	<2	4884	7.35	-1.3	2.1	7233	7020	7.33	16.6
	01/14/2002	<2	5060	6.93	-0.88	<1.0	7570	6790	7.37	14.7
	02/04/2002	<2	5030	7.07	-1.02	9.6	7560	6540	7.31	18.9
5										
Measuring pt.	02/28/2001	<2	7000	8.39	5.41	54	7340	9700	7.35	17.3
13.80	04/03/2001	<2	8010	8.50	5.3	45	8250	8130	7.38	15.5
ft msl	05/02/2001	<2	3580	8.40	5.4	45	9620	10080	7.37	19.8
	06/07/2001	<2	8390	8.33	5.47	57	11170	9810	7.28	21.1
	07/02/2001	<2	8220	8.29	5.51	<1.0	11860	8220	7.30	21.3
	08/06/2001	<2	8200	9.30	4.5	31	9140	11770	7.32	17.3
	09/04/2001	<2	8830	9.90	3.9	<1.0	14650	12380	7.3	18.6
	10/03/2001	<2	8860	10.85	2.95	40	15800	12240	7.27	21.3
	11/05/2002	<2	9810	10.25	3.55	45	14100	11290	7.31	18.7
	12/13/2001	NC	NC	NC	NC	NC	NC	NC	NC	NC
	01/14/2002	<2	11320	9.07	4.73	49	15730	14520	7.22	15.0
	02/04/2002	<2	11000	9.26	4.54	44	16600	14110	7.18	19.0
6										
Measuring pt.	02/28/2001	<2	4400	12.49	4.59	53	4830	6500	7.43	15.7
17.08	04/03/2001	<2	4130	12.85	4.23	43	4800	4780	7.52	16.1
ft msl	05/02/2001	<2	3730	13.46	3.62	40	5630	5700	7.48	19.4
	06/07/2001	<2	4010	13.34	3.74	52	6040	5320	7.40	21.5
	07/02/2001	<2	4070	14.08	3.00	<1.0	6315	4800	7.45	20.3
	08/06/2001	<2	3920	15.80	1.28	61	4840	6180	7.42	18.2
	09/04/2001	<2	4170	17.04	0.04	27	5570	6240	7.45	17.3
	10/03/2001	<2	4020	17.49	-0.41	39	6940	5880	7.38	21.1
	11/05/2002	<2	4230	16.33	0.75	52	6968	6130	7.31	18.2
	12/13/2001	<2	4005	15.93	1.15	13	5796	5980	7.36	16.8
	01/14/2002	<2	3980	13.89	3.19	60	5520	5910	7.33	15.7
	02/04/2002	<2	4030	14.09	2.99	56	6890	5640	7.29	17.9

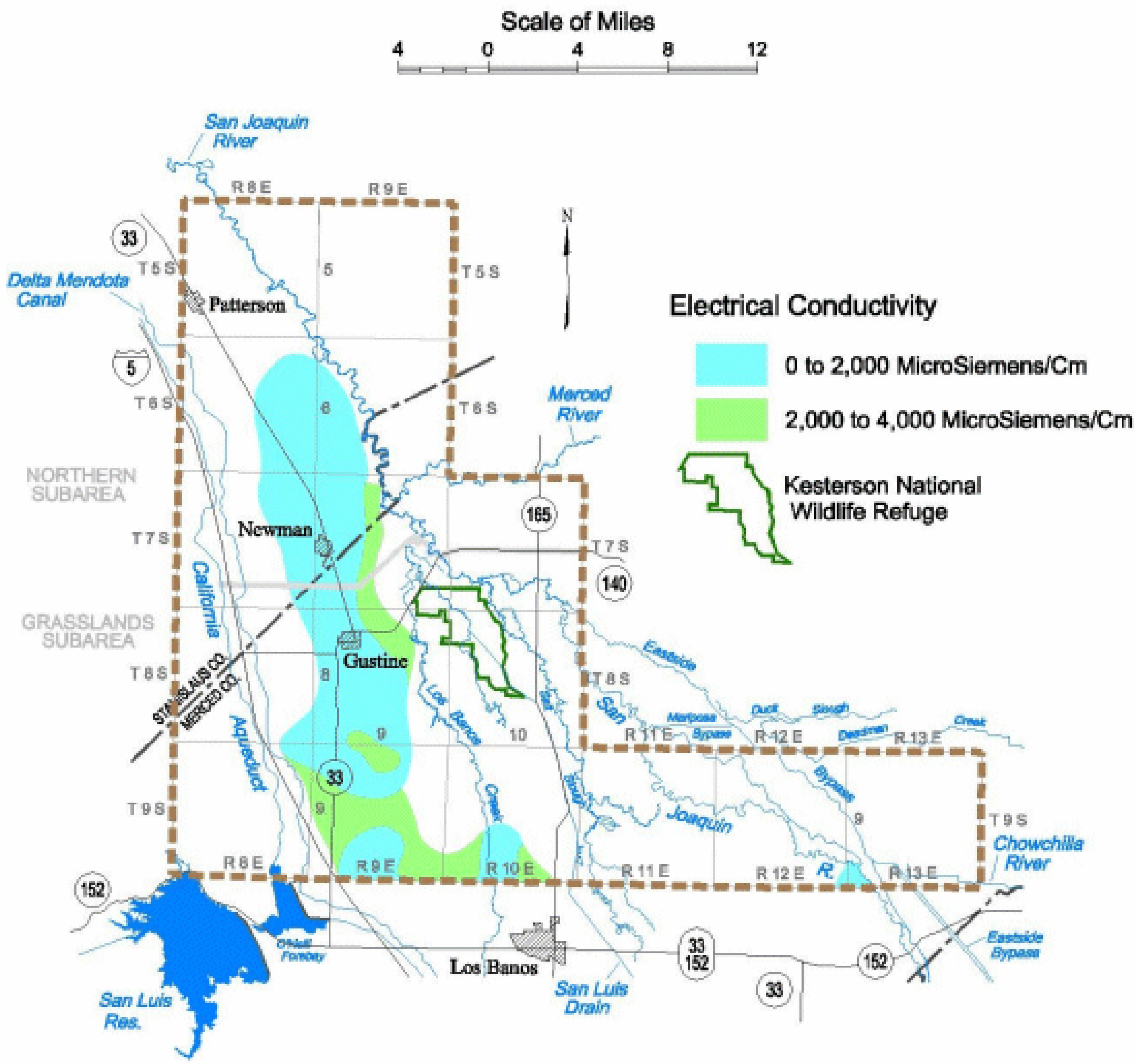
Note: NC = Not collected

Attachment C

DWR 2001 Map of Shallow Groundwater EC Trends

Kesterson

2001, Electrical Conductivity in Shallow Groundwater



Source: California Department of Water Resources, San Joaquin District

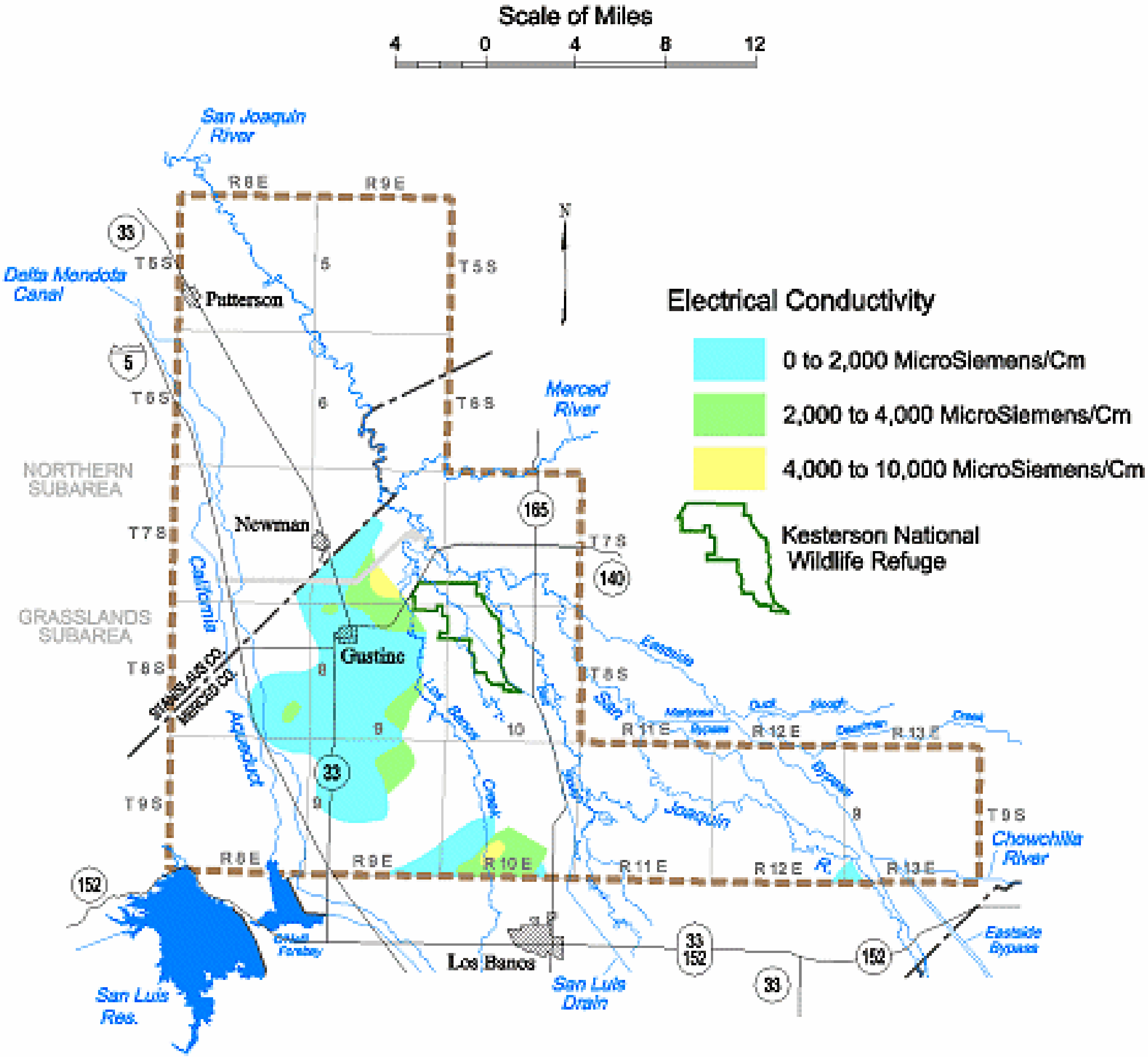
http://www.sjd.water.ca.gov/drainage/groundecmaps/maps/kest_ec01/index.cfm
downloaded 03/11/2006

Attachment D

DWR 1995 Map of Shallow Groundwater EC Trends

Kesterson

1995, Electrical Conductivity in Shallow Groundwater

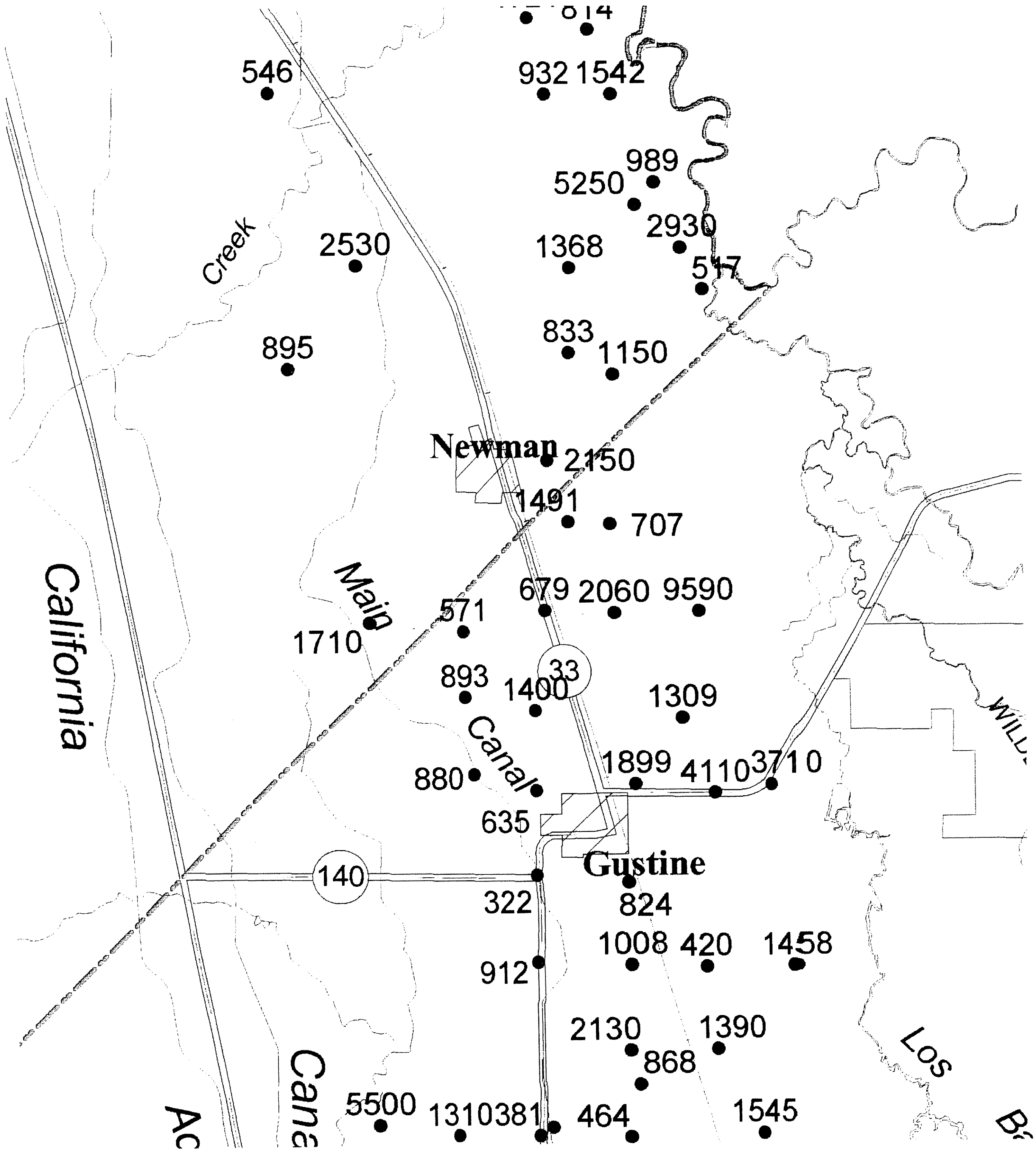


Source: California Department of Water Resources, San Joaquin District

Attachment E

DWR Data Showing Variability in Groundwater EC

DWR Groundwater Data in the Vicinity of the City of Newman



Data from Kurt Kovac DWR

6/24/05