1.0 INTRODUCTION

West Yost Associates (WYA) has prepared this draft *Soil and Groundwater Investigation Existing Conditions Report for the White Slough Water Pollution Control Facility* (report) on behalf of the City of Lodi (City). The objective of the groundwater investigation is to demonstrate the impacts, if any, which have occurred as a result of operations of the City's White Slough Water Pollution Control Facility (WPCF) and its associated agricultural reuse site.

1.1 ORGANIZATION

The major sections of this report are as follows:

- Section 1.0 provides an introduction, and a statement of the purpose and scope of the effort.
- Section 2.0 provides a description of the physical setting and history of the WPCF facilities. Also included in this section is a description of existing and planned treatment and reuse facilities.
- Section 3.0 describes the general land and water use in the vicinity of the White Slough WPCF.
- Section 4.0 describes the environmental setting of the WPCF.
- Section 5.0 provides a summary of water quality at the WPCF and its vicinity.
- Section 6.0 provides an assessment of potential sources of groundwater degradation. Also presented is a description of the fate and transport processes and potential receptors. Additionally, a brief discussion of potential Best Practicable Treatment and Control (BPTC) measures as they relate to the existing faculties is presented.
- References are provided in Section 7.0.
- Appendix A contains groundwater elevation contour maps for spring and fall 1998 from the Eastern San Joaquin Groundwater Basin Groundwater Management Plan (Northeastern San Joaquin County Groundwater Banking Authority, 2004); Groundwater Elevation Contour Maps Prepared for San Joaquin County Flood Control and Water Conservation District Semiannual Groundwater Monitoring Reports; and hydrographs of supply wells generated using groundwater elevation data from the Department of Water Resources (DWR) Water Data Library at http://wdl.water.ca.gov.
- Appendix B contains selected figures from the DWR publication Municipal Water Quality Investigations (MWQI) Program Summary and Findings from Data Collected August 1998 through September 2001, which presents a summary water quality data collected near or in the Delta.

- Appendix C contains tabulated nitrogen results collected between 1996 and 2004 for land development projects and small system supply wells within a three mile radius of the WPCF that have been compiled by the San Joaquin County Department of Environmental Health.
- Appendix D contains Stiff diagrams showing the major cations and anions for the individual WPCF monitoring wells.
- Appendix E contains graphs showing historic groundwater elevations and nitrate concentrations in the individual WPCF monitoring wells.
- Appendix F contains a descriptive overview of the soil-nitrogen cycle.
- Appendix G contains Stiff diagrams showing the major cations and anions for the potential sources of groundwater degradation at the WPCF site.
- Appendix H contains graphs showing the relationship between historic total dissolved solids (TDS) field loadings and electrical conductivity (EC) levels measured in select WPCF monitoring wells; and figures showing historic TDS loadings to each of the individual WPCF agricultural reuse field areas.
- Appendix I contains graphs showing the relationship between historic total nitrogen and nitrate-nitrogen (NO_3-N) field loadings and NO_3-N concentrations measured in select WPCF monitoring wells; a tabulated summary of the total nitrogen loading sources to the individual field areas; and figures showing historic total nitrogen loadings to each of the individual WPCF agricultural reuse field areas.
- Appendix J contains a summary of the soil data collected by the City. Included is a map showing the annual soil monitoring locations; depth versus concentration soil profiles for total kjedahl nitrogen (TKN), NO_3-N, and TDS based on soil data collected by the City at these locations; and a tabulated summary of soil sampling results taken during a one-time monitoring event in June 2006.
- Appendix K contains figures showing historic total biosolids loadings (in dry tons per acre) to each of the individual WPCF agricultural reuse field areas.

1.2 PURPOSE AND OBJECTIVES

In California, the State Water Resources Control Board has adopted Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California (anti-degradation policy). This policy requires that permitted discharges maintain the high quality waters of the State until it is demonstrated that any change in quality will be 1) consistent with maximum benefit to the people of the State; 2) will not unreasonably affect beneficial uses; and 3) will not result in water quality impacts that exceed the greater of applicable water quality objectives or background water quality.

The implementation of the State's anti-degradation policies is technology driven and requires that a discharge be regulated to meet best practicable treatment or 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. The level of water quality that must be maintained is dependant upon background conditions. Therefore, it will be essential to identify the background conditions to determine compliance. Based on a review of the groundwater data and analyses performed by the City to date, background conditions have not been fully characterized.

After the background conditions have been determined, the groundwater quality in each of the White Slough WPCF monitoring wells will be compared to these conditions using methods listed in California Code of Regulations (CCR) Title 27, Section 20415. If the City's practices are determined to have led to an increase in certain water quality parameters above background, the City will need to:

- Evaluate and implement additional Best Practicable Treatment and Control (BPTCs) measures (including source control and improved treatment and disposal methods)
- Cease the discharge of one or more of the sources of degradation, or
- Take some other action to prevent groundwater degradation.

Although the background conditions have not been determined, the data collected to date does suggest that the City's current practices have the potential to cause groundwater degradation. Therefore, the City will need to evaluate BPTCs measures for the treatment and disposal components of the facility, including agricultural reuse, to determine whether these practices have the potential to cause an increase in groundwater constituent concentrations above background. This report presents a detailed summary of the City's treatment and disposal practices with respect to their potential to cause increases in groundwater constituents above the background concentrations. This information will serve as the basis for a detailed BPTC assessment.

Therefore, the primary objectives of this existing conditions report are to:

- Document the existing regional and site-specific groundwater quality conditions.
- Identify sources of nitrate and other constituents that would have an impact on groundwater quality, their locations, and relative contributions.

1.3 SUMMARY AND RECOMMENDATIONS

This report presents a compilation of available surface water and regional and site-specific groundwater quality data. Additionally, a detailed assessment of the potential BPTCs for the sources of potential groundwater degradation associated with the WPCF facilities and the irrigation reuse area that receive treated effluent from these facilities is presented. Water quality parameters of particular concern are electrical conductivity (EC), sodium, chloride, and nitrate.

1.3.1 Source Control Assessment

The available information demonstrates that additional controls may be appropriate for reducing the potential for nitrate impacts associated with the City's facilities and land application practices. However, the City's WPCF facilities and land application practices are not likely to be causing groundwater degradation with respect to EC, sodium, and chloride. In fact, these facilities and practices may actually be improving underlying groundwater quality for these constituents.

There is also a significant potential for groundwater nitrate degradation to occur from the dairies located adjacent to and in the region of the WPCF. Additional evaluation is needed to discern the impacts associated with these sources (as well as the regional trends) from the potential impact associated with the City's facilities and land application practices. Nevertheless, additional controls have been proposed for the following:

- Influent Municipal Sewer
- Storage Facilities
- Land Application Facilities

1.3.1.1 Influent Municipal Sewer

Exfiltration associated with the deterioration of the influent municipal and industrial sewers is expected to have led to the groundwater impacts in the area of the WPCF. The City has already repaired much of this deterioration and is committed to repairing and/or replacing this rest of the deteriorated sewer in the 2007 to 2008 timeframe. Following the completion of these repairs, additional impacts are not expected.

1.3.1.2 Storage Facilities

Based on available data, the storage ponds may have an impact on the water quality observed in wells located in the northeastern corner of the City's property. The total nitrogen concentrations in the storage ponds are somewhat elevated, particularly during the winter months. The City currently is planning to reduce the nitrate loads to the storage ponds by upgrading the treatment facilities to provide improved denitrification. Additionally, the City is planning to redirect the biosolids lagoon supernatant to a point upstream of the aeration basins. This will result in a significant reduction in the ammonia and organic nitrogen loadings to the ponds during the winter months. Additional assessment is needed to determine whether these changes will be adequate to address potential groundwater impact issues associated with the storage ponds. If necessary, one of the following additional BPTC measures to reduce the potential for groundwater impacts could be developed:

- Lining the ponds with a synthetic geomembrane liner to ensure that the nitrogen in the storage ponds is not leading to elevated groundwater nitrate levels.
- Modifying the agricultural reuse system to further reduce the nitrogen loadings to the ponds.

1.3.1.3 Land Application Facilities

The irrigation application rates and total nitrogen loadings to the field areas are monitored to verify that they do not exceed the estimated annual crop uptake rates. Furthermore, no discernable patterns between irrigation loadings and groundwater nitrate have been observed in the available data. Therefore, a direct correlation between the total nitrogen and nitrate field loadings and the potential for groundwater nitrate impacts is not apparent.

A site-specific evaluation of the appropriate monthly loading rates for crops grown on the WPCF property is currently being developed. Once this evaluation is completed, the City can provide a better determination as to whether the current land application practices have the potential to lead to elevated levels of nitrogen in the underlying groundwater.

If necessary, the City will modify and/or expand the existing reuse system to ensure these rates are not exceeded. The detailed loading information developed for this report can be used to make assessments regarding the affects of potential system modifications on the overall loadings to the land application area.

In addition, there is a concern that the City's existing facilities may not allow for even distribution of the applied irrigation water and biosolids. Furthermore, there is a concern that the earthen conveyance ditches could be allowing excessive infiltration. However, distinguishing potential impacts associated with these facilities and the potential impacts associated with land application practices is difficult. Therefore, the site-specific field loading rates should first be evaluated to determine the potential for historic impacts associated with this source. If historic loadings are found to not have been excessive, one or more of the additional irrigation system modifications described below may be necessary.

With respect to irrigation water distribution, one potential BPTC practice would be to reduce the check length and/or decrease the irrigation water cutoff time (Hanson and Putnum, 2004). A second potential BPTC would be for the City to construct a sprinkler irrigation system that would allow for even distribution of the irrigation water over the field areas. This modification would also eliminate the potential for leakage from the existing earthen conveyance ditches. However, as the City's agricultural irrigation practices are regulated under the States Title 22 recycled water criteria, such a modification would also result in the requirement that the City provide year-round filtration and UV. Additionally, these modifications would result in the need for the City to develop an alternative means of biosolids distribution.

With respect to biosolids distribution, one potential BPTC would be to store either liquid or dewatered biosolids onsite until they could be distributed evenly over a large area at the beginning of the irrigation season using trucks. An alternative BPTC would be for the City to treat the biosolids so they could be disposed of offsite.

1.3.2 Groundwater Quality Assessment

The data indicates that groundwater quality at the WPCF and associated land application area is highly variable and significantly affected by regional-scale trends. These trends are largely influenced by current and historic land and water use variability in the region surrounding the property.

Groundwater EC is elevated regionally. Relatively high concentrations of chloride and sodium in some WPCF wells located closest to the Delta suggest that the EC levels in these wells may be the result of processes controlling regional groundwater quality. Specifically, intrusion of brackish to saline water into the Delta prior to the advent of Delta water projects during the last century has led to elevated groundwater salinity in this region.

Due to the regional influences on groundwater salinity levels, an additional well to the north of the WPCF land application area would be appropriate for monitoring background EC and general chemistry in groundwater. This well would need to be located outside of the influence of the WPCF land application area but within the region in which groundwater EC and general chemistry is influenced by the Delta. This well could also be used to help define the groundwater flow directions to the north of the WPCF. Comparison of EC and general chemistry data from this background well will help in determining whether the WPCF and land application areas have contributed to increases in these parameters.

Nitrate concentrations in groundwater exceed the 10-mg/L primary MCL in the immediate vicinity of the WPCF and in all WPCF monitoring wells to the north and east of the WPCF. The regional nitrate data shows that nitrate concentrations in supply wells frequently exceed the MCL to the northeast of the WPCF, but are generally less than 5 mg/L to the south and east.

Differentiating between the regional and potential source contributions to the nitrate groundwater concentration observed on and around the WPCF site is much more difficult than for salinity because the lateral and vertical extent of nitrate has not been clearly defined. Therefore, several additional monitoring wells are recommended as shown in Figure 1-1. These additional wells are as follows:

- Two monitoring well located northeast of the WPCF to establish the extent of the northeasterly flow, assess the extent of nitrate transport from the WPCF, and evaluate the nitrate impacts of the dairy located to the northeast of the WPCF. One well should be located between the two confined animal facilities associated with the dairy located adjacent to the City's property, and one well should be placed several thousand feet east (downgradient) of the dairy to help define the lateral extent of nitrate.
- Two new wells further to the north and east of the dairy located adjacent to the WPCF to assess background concentrations of nitrate in groundwater. These wells should be sited in land use areas that are similar to the land use in the vicinity of the WPCF. Based on the regional groundwater flow information, wells located in this area will be upgradient of the WPCF and the dairy. Comparison of nitrate data from these background wells will help in determining whether the WPCF and land application areas have contributed to increases in this parameter.
- One deeper well at the site of WSM-1 to assess the vertical extent of nitrate northeast of the WPCF site.
- One new well located to the north of WSM-16 to assess the potential for transport from this area to WSM-16 and southerly to the City's property (note that this well would also serve as the background monitoring well for EC).

- One new well located on Thornton Road, due east of WSM-4 to assess the extent of elevated nitrate detected in the vicinity of WSM-4 and to provide more complete monitoring of the land application area.
- One new well located southwest of the sludge lagoon to help resolve the sources of nitrate affecting WSM-2, WSM-3, WSM-4 and WSM-14, enable a more accurate measurement of the depth to groundwater beneath the facility, and confirm that releases are not occurring from the sludge lagoons.

In addition to these new wells, cone penetrometer testing (CPT)/Hydropunch testing is recommended along the following three transects (Figure 1-1):

- From WSM-1 to WSM-10.
- From a new well located between the two confined animal facilities associated with the dairy that is adjacent to the City's property to a new well several thousand feet east (downgradient) of this dairy.
- From WSM-4 to a new well located on Thornton Road due east of WSM-4.

The CPT/Hydropunch transects should be performed and evaluated before drilling the wells on either end of the transects. Each CPT/Hydropunch location along the transects should be sampled at various depths. This depth versus nitrate concentration information should be evaluated to help determine the best completion depths for the monitoring wells on either end at the transects. Analyses of nitrogen and oxygen isotopes along the transects may help differentiate sources of nitrate, whether dentrification is occurring, and the extent of transport from these sources.

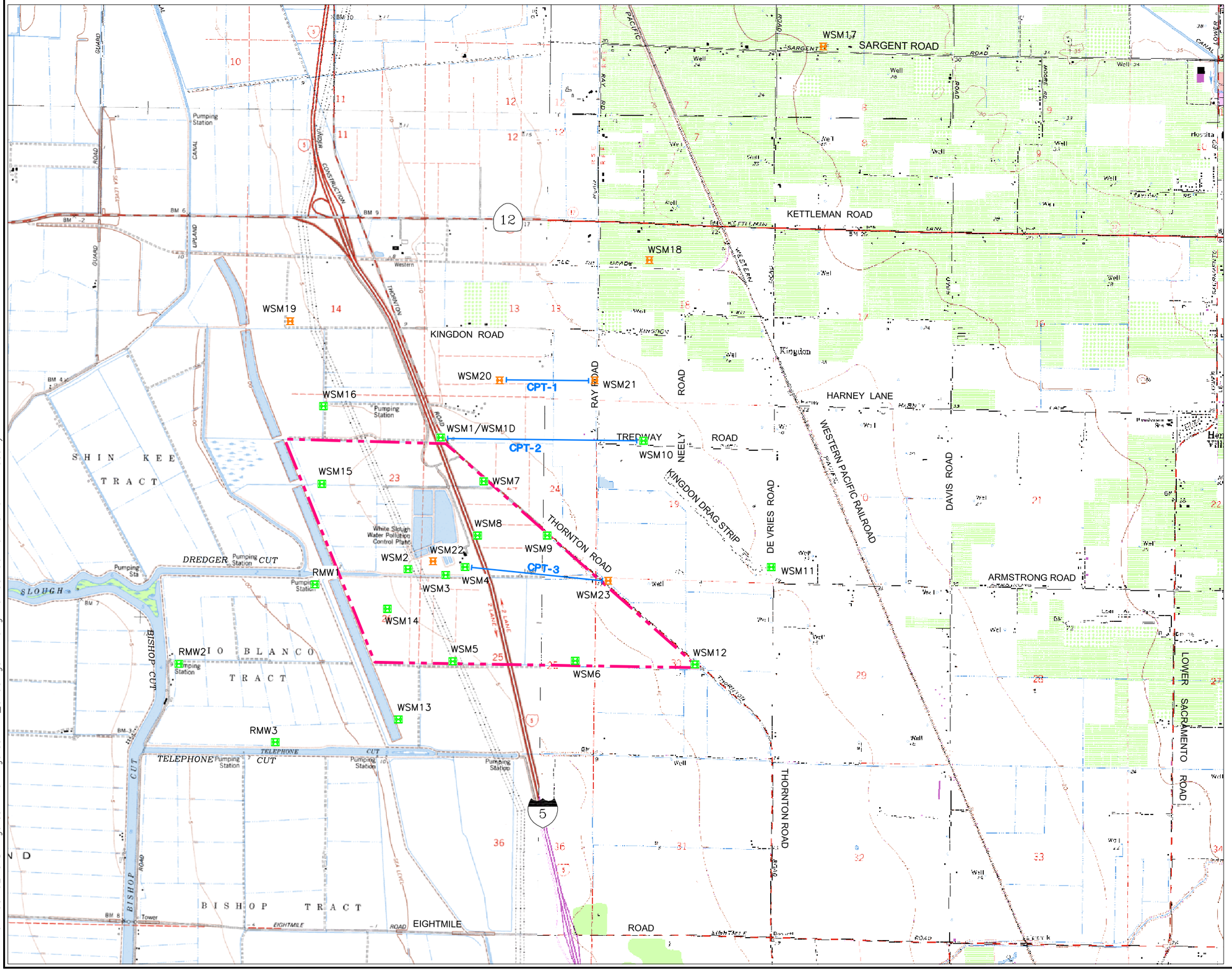

Figure 1-1
City of Lodi
White Slough WPCF
Groundwater Investigation
PROPOSED MONITORING WELL AND CPT/HYDROPUNCH LOCATIONS

LEGEND

WSM12	EXISTING MONITORING WELL
WSM23	PROPOSED MONITORING WELL
CPT-1	PROPOSED CPT/HYDROPUNCH TRANSECT
	EXISTING CITY-OWNED LAND

NOTES:

1. CPT – Cone Penetrometer Test.
2. WSM1D is a proposed deeper well located at the site of existing well WSM1. The depth of WSM1D will be determined based on the CPT/Hydropunch results from the west end of transect CPT-2.

N

0 1400 2800
SCALE IN FEET

WEST YOST ASSOCIATES
Consulting Engineers

I:\711\04-05-02\CAD\Figures\Final Figures\711_0405Fig5-11.dwg 9-05-06 01:18:49 PM dduffy