

# Technical Publication

Title: Data Summary and Economic Analysis Denitrification Process  
Monitoring Demonstration Project

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Prepared for: Fiesta Village  
Advanced Waste Treatment Facility  
Fort Myers, FL  
August 26, 1993

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# **ChemScan™ UV-6100 Process Analyzer**

## **DATA SUMMARY AND ECONOMIC ANALYSIS DENITRIFICATION PROCESS MONITORING DEMONSTRATION PROJECT**

**Fiesta Village  
Advanced Waste Treatment Facility  
Fort Meyers, Florida**

**Published by:**

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**FIESTA VILLAGE AWT**

**PROJECT SUMMARY**

## **Project Summary**

The purpose of this project was to demonstrate the capability of the UV-6100 Process Analyzer to perform on-line analysis of nitrate for control of a denitrification process at an Advanced Wastewater Treatment (AWT) facility in southern Florida. The information summarized in this report is from a demonstration project conducted in June and July of 1993.

The demonstration was conducted at the Fiesta Village AWT facility in Fort Meyers, Florida. Appendix A contains a brief process description and flow schematic of this 5 MGD (ultimate design) facility, currently operating at approximately 1.8 MGD.

The normal method of control for the denitrification process at the AWT facility is to feed methanol at two different rates, to approximate the high-flow and low-flow periods of the day. There is no equalization facility in the system, so the diurnal variation and inflow/infiltration are the governing flow factors. The operators normally reset the methanol feed pump each morning between 6-7 a.m. and 11 p.m. to 12 a.m. in an attempt to match the normal diurnal pattern.

The nitrate-nitrogen concentration from the oxidation ditch ranges from 5-15 mg/L. However, off-season daily flow variations range from 0.8-3.8 MGD during a typical 24-hour period. To cover most peak requirements for methanol a 6.5:1 methanol to nitrate-nitrogen ratio is used. With only two methanol feed adjustments per day, methanol application is not optimized and may be frequently overfed or underfed.

An objective of the demonstration was to show that the nitrate concentration of the influent to the process could be continuously monitored by the UV-6100 and that this information could be used to establish a control strategy based on nitrate demand. A control strategy of feed-forward control signals would include automatic adjustment of methanol feed based on a target setpoint for an optimal methanol-to-nitrate ratio. Feedback trim signals could also assist in the overall methanol feed control strategy based on continuous monitoring of denitrified effluent nitrate concentration to assure that the proper amount of methanol has been feed and that the denitrification objective has been accomplished.

The feed-forward control strategy was selected for testing, while the feedback trim signal monitoring was not tested at this installation because of successful monitoring at other test sites. Another objective was to provide an economic analysis of the instrument based on potential cost savings, process control features and waste minimization characteristics.

The objectives were both successfully accomplished. Data are presented that show that the nitrate concentration of the influent to the process was continuously monitored. Instrument results were within a fraction of a ppm when compared to the plant laboratory values. A 4-20 mA signal output from the UV-6100 was available, set to 5-15 mg/L nitrate-nitrogen. However, a suitable process water flow measurement was not immediately available at the denitrification process influent, so feed-forward control of the methanol pump did not occur, although it would have had an accurate flow measurement been available at that location.

Based on methanol savings alone, an economic analysis showed a 26-36 month payback of the UV-6100. This calculation included the cost of the instrument, installation and initial calibration. Other advantages such as generation of automated control statistics and waste minimization impact were not calculated into the payback formula, but would produce an even shorter payback schedule.

## Analyzer Description

The UV-6100 Process Analyzer is an on-line spectrometry system equipped with a multichannel array detector and an internal computer. This system is capable of simultaneously detecting numerous wavelengths of spectral information in the ultraviolet waverange from process solutions in a flow cell or optical probe. The information is processed by the analyzer and compared to calibration files stored in memory in order to calculate the concentrations of chemical substances that cause absorbance of ultraviolet light in specific patterns. The UV-6100 analyzer detects and analyzes the natural light absorbance characteristics of the process solutions and does not use ion-selective electrodes or chemical reagents to perform the analysis.

Figure 1 is an illustration of the ChemScan™ analyzer. The upper enclosure contains the light source, power supplies, temperature controls, spectrograph, computer board, communications boards, control panel and associated electronics. The lower enclosure (shown without the front panel) contains a flow cell, control valve and connection points for analog or serial communications.

## Denitrification Influent Tests

The UV-6100 analyzer was calibrated using a combination of laboratory and process samples for a nitrate-nitrogen range of 0-15 ppm, with most values falling the in 5-10 ppm range. Process samples were grabbed from the flow stream sample line and were analyzed on-site in the laboratory using an automated flow injection analyzer.

A sample line was connected from the secondary clarifier effluent water just prior to the clarifier overflow weir and connected to the UV-6100. A peristaltic pump controlled by the UV-6100 internal computer was used to deliver a fresh supply of sample through the flow cell. Sample lines were automatically flushed for a minimum of one minute intervals prior to each reading. Information from the analyzer was recorded in several ways.

The UV-6100 analyzer was programmed to halt the sample flow through the flow cell, scan the sample and calculate nitrate-nitrogen concentration at periodic (five-minute or less) intervals. This information could be converted to a 4-20 mA signal by the UV-6100 analyzer, with output to the plant data management network where the information could be available for recording, display by the computer system and/or used to control a piece of process equipment such as the Wallace & Tiernen Series AA single-head methanol metering pump.

The UV-6100 analyzer contains an internal memory available to accumulate an historical record of data from the analyzer over a period of time. This data logging capability was used to accumulate a running record of nitrate concentrations as measured by the analyzer at periodic (hourly or less) intervals during the demonstration period.

In addition, operators were requested to extract grab samples from the sample line at least once per shift throughout the demonstration period. At the time the sample was extracted, the operator was also asked to record the most recent nitrate-nitrogen value as shown on the display panel of the UV-6100 analyzer. In this manner, nitrate-nitrogen values from the laboratory analysis of the samples could be matched with the comparable values from the analyzer at or near the time when the sample was obtained. If a UV-6100 reading was not recorded by the operator, information from the internal data log or plant computer records could be obtained.

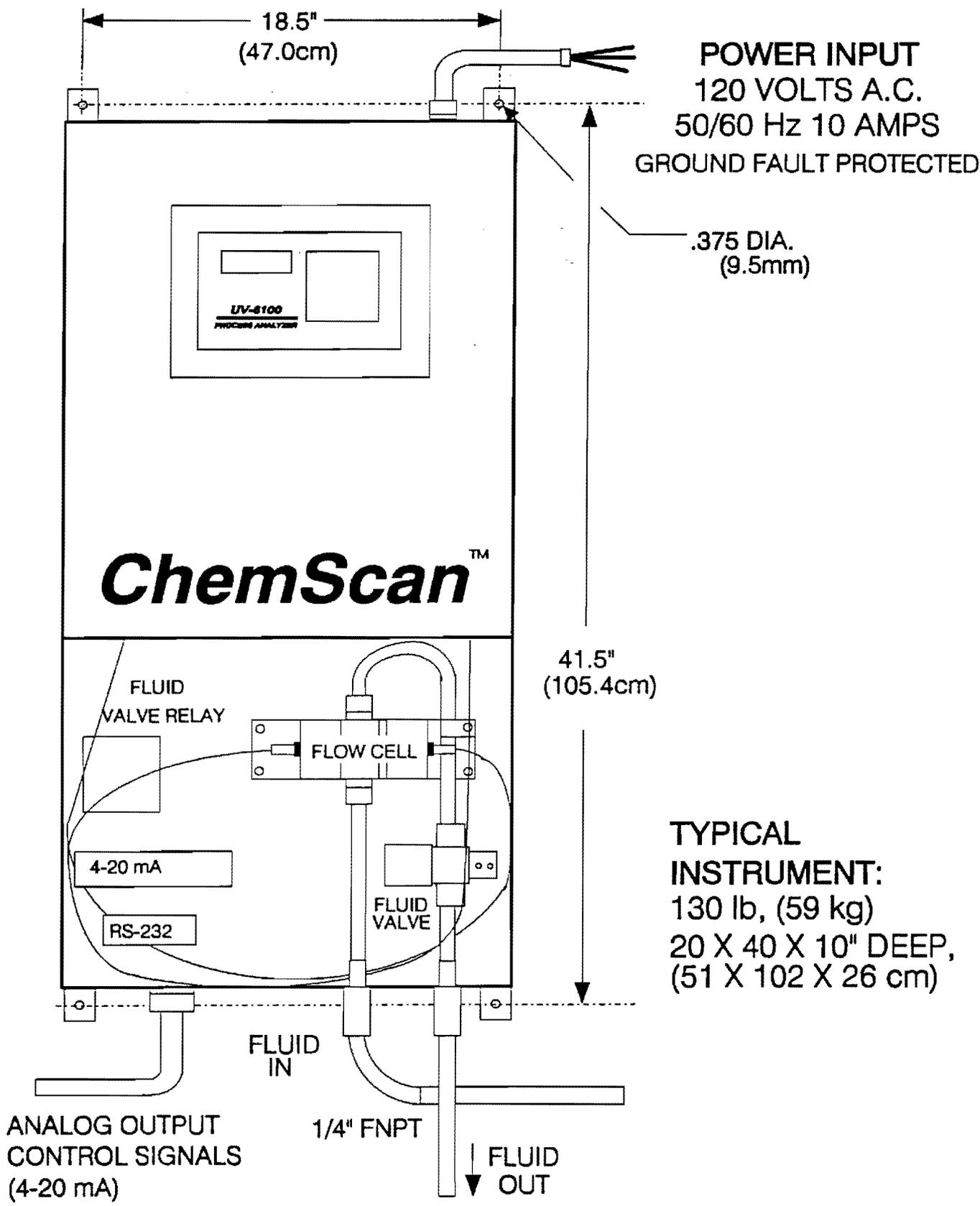


Figure 1.

**Denitrification Influent Results**

The ChemScan™ UV-6100 Process Analyzer was setup the week of June 22, 1993 for calibration and to measure nitrates on secondary clarifier effluent prior to methanol addition and subsequent denitrification. UV-6100 calibrations are constructed by building a set of files that contain the spectral characteristics of numerous samples and the corresponding concentrations of the analytes in each sample. The calibration files for the denitrification influent demonstration include a combination of laboratory prepared samples with known analyte values and process samples with analyte values based on process conditions. After initial calibration, sample analysis comparisons were made between the UV-6100 and the state certified plant laboratory. Monthly operating data for May, June and July 1993 are shown in Table 1.

The most graphic display of this demonstration project is illustrated in graphs FV1A-D. The actual UV-6100 results are plotted for each sample grabbed by the operations staff as they initiate a scan signal on the UV-6100 process analyzer. Graph FV1A shows that at all times during the July 6-20 period the UV-6100 scan values fell within two standard deviations of the laboratory analysis values for each comparison sample. Graph FV1B shows that most of the time for this period the UV-6100 scan values were within one standard deviation of the laboratory analyses.

Table 1

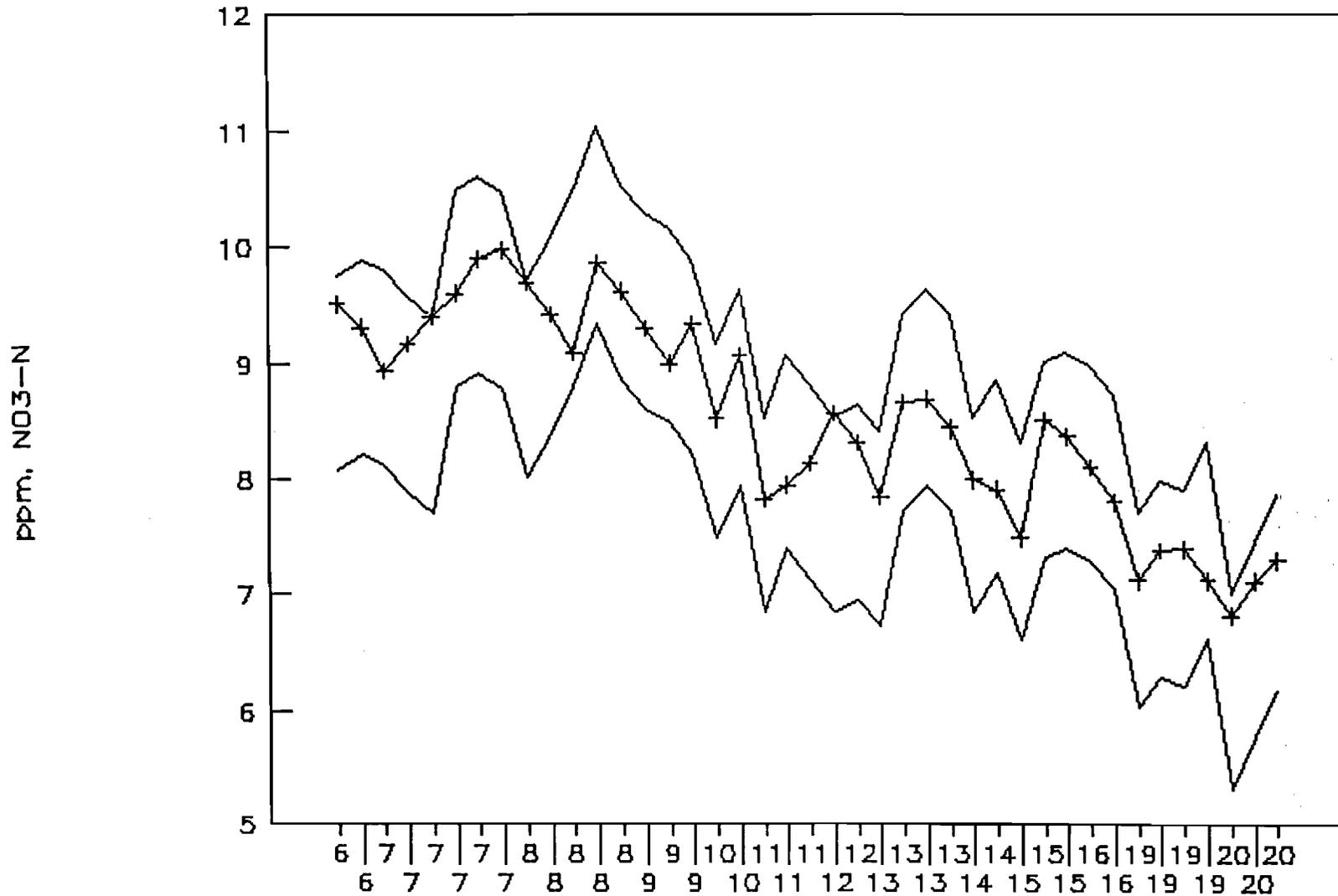
**FIESTA VILLAGE AWT PLANT  
Fort Meyers, Florida  
Monthly Operating Data  
May, June, July, 1993**

Month	Flow	BODs (mg/L)		TSS (mg/L)		Total N (mg/L)		Total P (mg/L)	
		Raw	Final	Raw	Final	Raw	Final	Raw	Final
May	1.723	182	1.5	215	0.7	31.7	2.8	6.2	0.2
June	1.749	170	1.3	177	0.8	28.0	1.4	5.5	0.2
July	1.894	145	1.8	225	1.1	26.1	1.2	5.2	0.2

Month	Average NO <sub>3</sub> -N <sub>3</sub> (mg/L)				Methanol (GPD)		
	SCE avg.	Final EFF avg.	Min.	Max.	Average	Min.	Max.
May	10.7	0.1	0.0	1.4	96.5	58	166
June	10.2	0.0	0.0	0.3	141.2	78	199
July	8.7	0.0	0.0	0.2	96.1	39	137.5

# Fiesta Village AWT

Lab vs. UV-6100



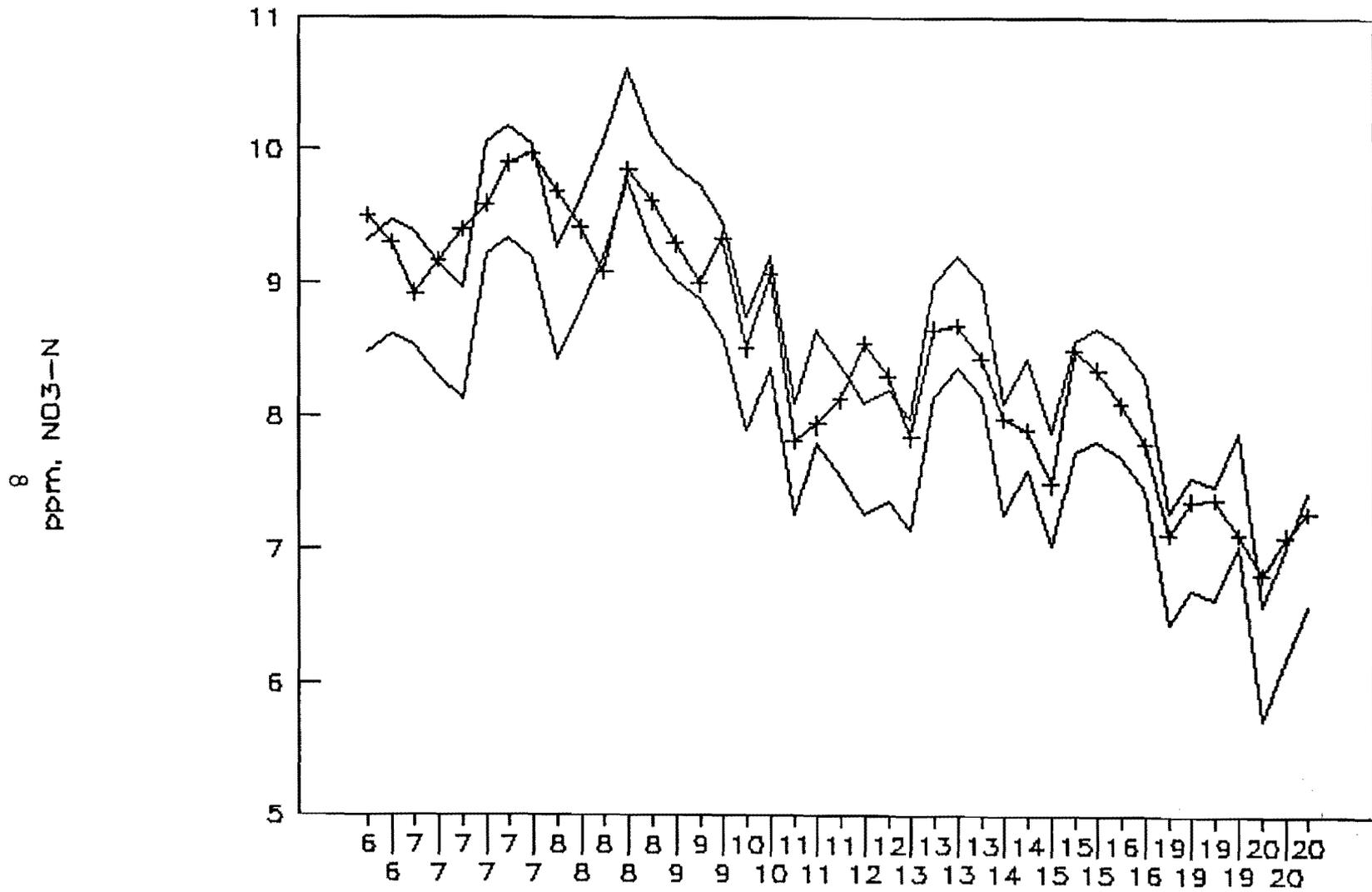
+ UV-6100 ACTUALS

— FV LAB +/- 2 S.D.

Graph FV1A

# Fiesta Village AWT

Lab vs. UV-6100



Starting 7-6-93

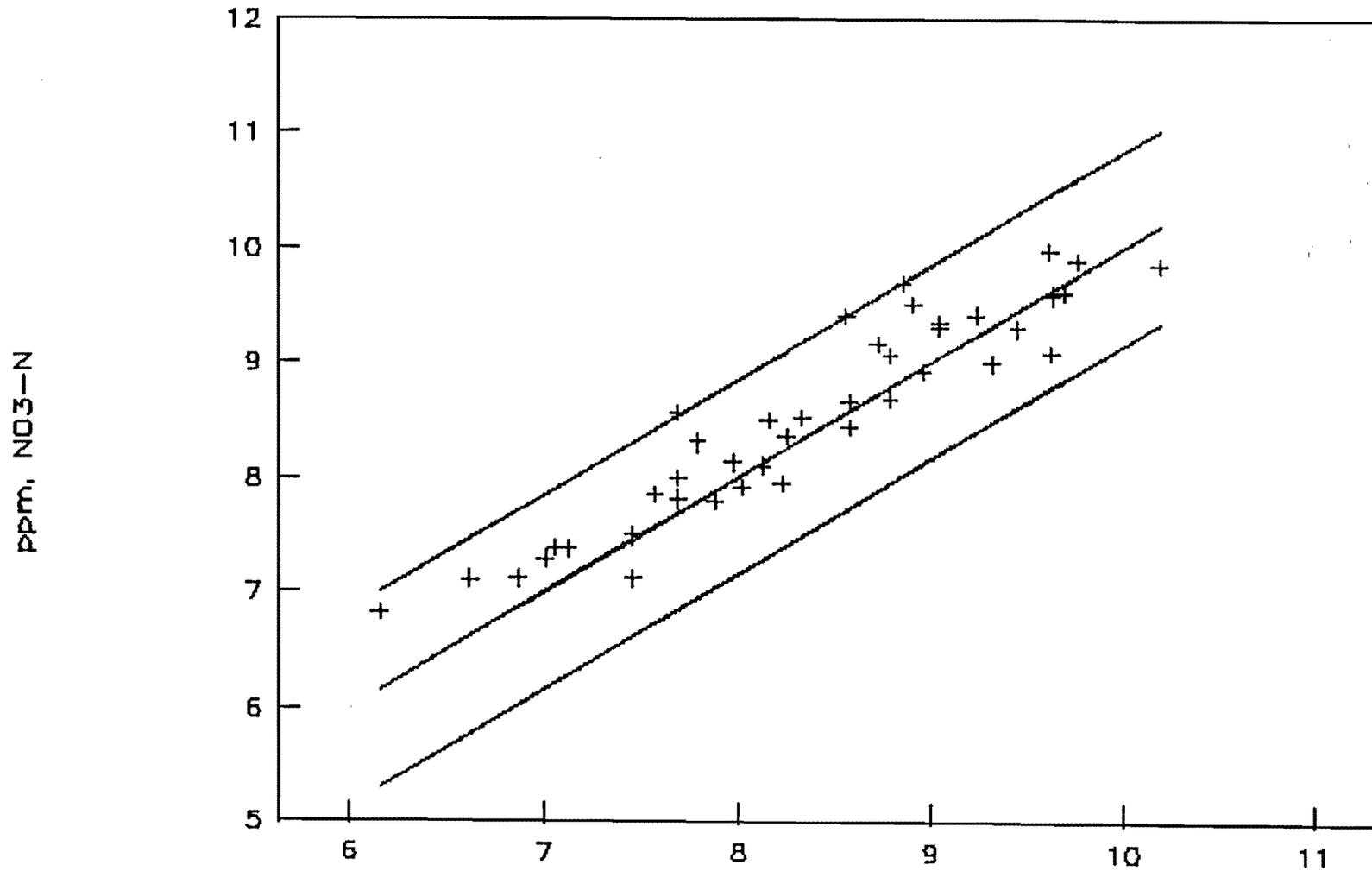
+ UV-6100 ACTUALS

— Plus/Minus One S.D.

Graph FV1B

# Fiesta Village AWT

Lab vs. UV-6100

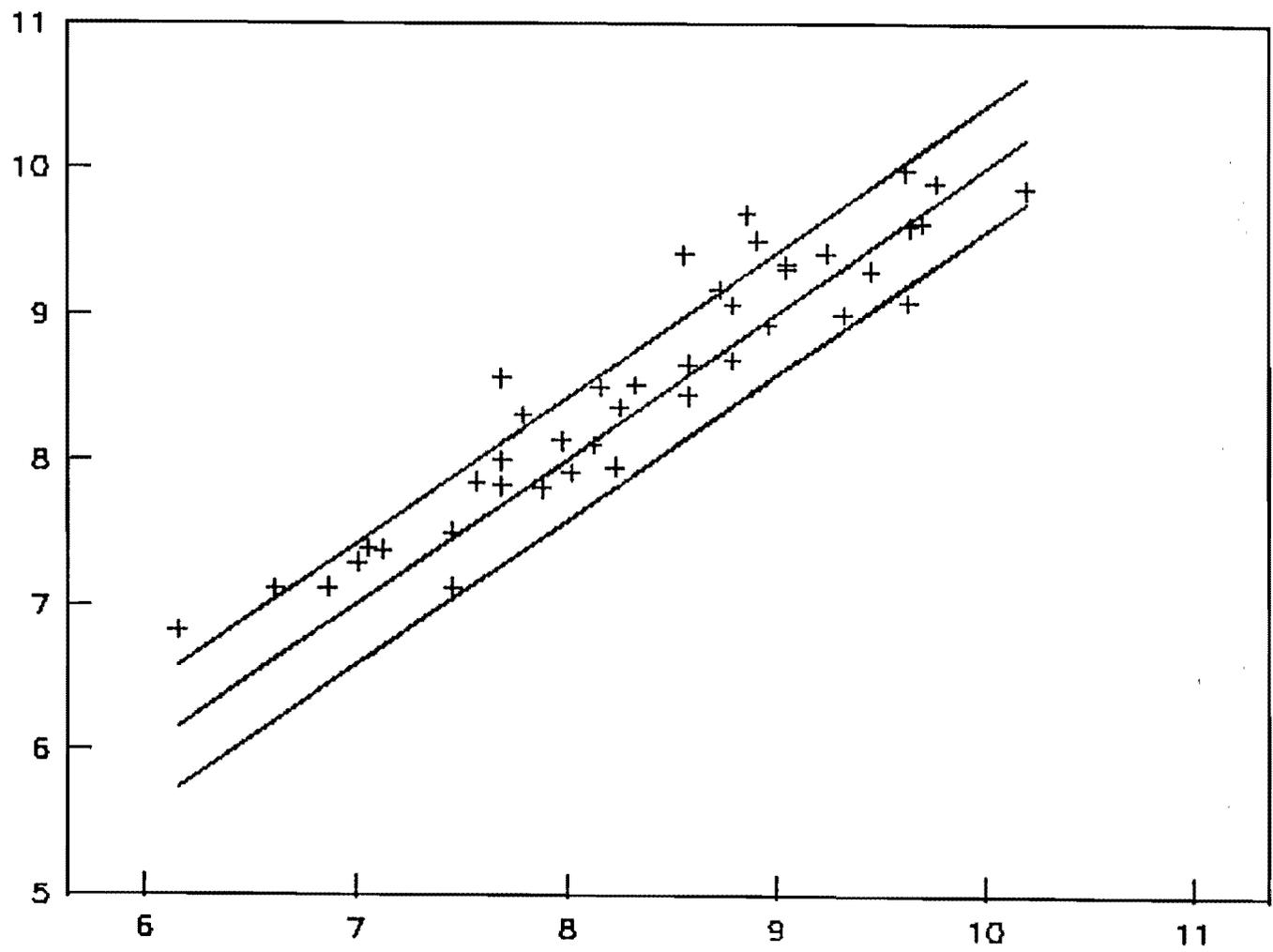


Week Starting 7-6-93  
— FV LAB VALUES    + UV-6100 ACTUALS    — Plus/Minus Two S.D.

Graph FV1C

# Fiesta Village AWT

Lab vs. UV-6100



Week Starting 7-6-93

— FV LAB VALUES    + UV-6100 ACTUALS    — Plus/Minus One S.D.

Graph FV1D

**In graphs FV1C and FV1D, the accuracy of the UV-6100 analyzer is illustrated by showing the location of nitrate-nitrogen values from the UV-6100 compared to a laboratory analysis value. The standard deviation was less than 0.5 ppm. Within the 6-11 ppm range, which was the expected operating range, nearly all values fell within plus or minus 1 ppm of the laboratory result.**

**A sample storage experiment conducted by the laboratory staff the week of July 6 confirmed the observation that non-preserved samples lose up to 1.0 ppm nitrate-nitrogen concentration with time (over a 2-3 day storage period), even when refrigerated. As a result, a computer generated 0.5 ppm nitrate offset that was initiated on July 7 on the UV-6100 was removed on July 14. All UV-6100 results shown are for actual nitrate values without the offset adjustment.**

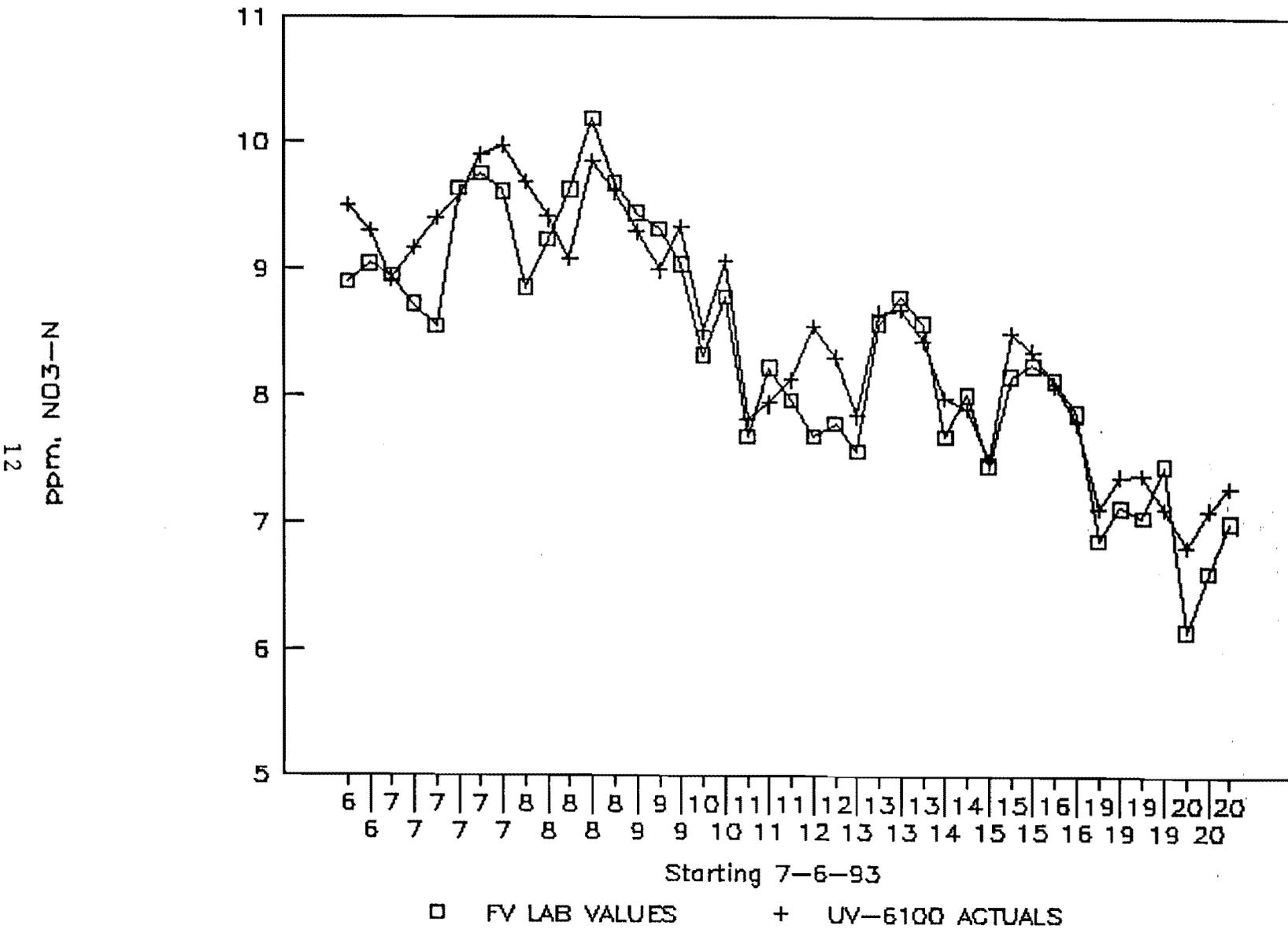
**To remedy this discrepancy, it was requested that the samples collected by operators be analyzed as soon as possible after collection. This solution seemed to bring the laboratory nitrate results in closer agreement with the UV-6100 results. The difference shown between real-time, on-line analysis and laboratory analysis of unpreserved samples store up to 3-4 days or longer brings attention to the possibility that the methanol dosage could be miscalculated in some instances and could cause inappropriate manual adjustments to be made to the methanol feed pump. With instantaneous, on-line analysis, sample deterioration is avoided.**

**During the July 4 holiday, the line used to collect laboratory samples became clogged with debris (small grease ball) and, therefore, laboratory results are not available for comparison during this period. From July 7 to July 20, there was fairly good agreement between laboratory analysis and the UV-6100 scans.**

**Graph FV2 compares the nitrate-nitrogen results from laboratory analysis of periodic grab samples with the corresponding UV-6100 values at the time the samples was obtained. Excellent agreement between these values can be observed, with an average error of less than 0.30 ppm over the range of 6.0 to 11.0 ppm.**

# Fiesta Village AWT

Lab vs. UV-6100



Graph FV2

**FIESTA VILLAGE AWT**

**ECONOMIC ANALYSIS**

**ECONOMIC ANALYSIS - UV-6100 FOR THE CONTROL OF METHANOL  
METERING TO A DENITRIFICATION PROCESS**

**Objective**

Methanol metering by monitoring nitrate prior to denitrification with the UV-6100 and controlling the methanol feed pump to deliver the optimum methanol dose to satisfy methanol requirements for both energy and synthesis needs, without excess methanol consumption or waste.

**Assumptions**

1. Software would be developed to calculate pounds nitrate entering the denitrification chamber. To do this, an accurate flow measurement at the point of methanol application, converted to 4-20 mA signal, would be needed.
2. Software would also calculate lbs. methanol needed, based on the lbs. nitrate (NO<sub>3</sub>-N) to be denitrified.
3. A lbs.:lbs. relationship would be used as a setpoint, whereby just slightly over stoichiometry values for methanol would be delivered prior to the denitrification chamber.
4. The UV-6100 would send a 4-20 mA signal to the methanol pump to increase or decrease methanol feed, based on incremental demand.

**Fiesta Village AWT Plant Example**

**A. Formula for Methanol Needed**

The stoichiometric formula to be used to calculate the amount of methanol required as a hydrogen donor for complete denitrification:



(From: Clark, Viessman and Hammer, Water Supply and Pollution Control, 3rd edition, Harper & Row, New York, 1977.)

All units in the above equation are mg/L. This information would be converted to lbs. methanol needed, based on the nitrate value expressed in lbs. The target setpoint ratio (lbs. methanol to lbs. NO<sub>3</sub>-N) would be determined, and the methanol pump would increase or decrease methanol delivery based on demand after each instrument read and calculate interval.

**B. Typical Values at the Denitrification Chamber Influent**

NO<sub>3</sub>-N = 8.0 mg/L (120 lbs./day at the daily flow of 1.8 MGD)

NO<sub>2</sub>-N = 0.2 mg/L

D.O. = 4.5 mg/L

Flow average = 1.8 MGD daily average off season

diurnal range = 0.8-3.8 MGD

Current information regarding methanol feed is estimated from verbal operator comments with regard to daily methanol consumption (100-130 gal./day) and methanol feed pump quantity per minute at 3% (100 ml/min) and 10% (380 ml/min.) diurnal methanol pump manual settings. (CAUTION: These volumes should be verified by actual measurements!)

**C. Methanol Pump Rate - Current Method**

**Methanol Pump Rate    Methanol Use-Ave. Day, Converted from ml/min. to Gallons per Day  
(% of max. flow)**

10	1,080 min @ 380 ml/min = 410,400 ml/day =	108.4 GPD
3	360 min @ 100 ml/min = 36,000 ml/day =	<u>9.5 GPD</u>
	<b>TOTAL</b>	<b>118.0 GPD</b>

Estimated methanol used = 780 lbs./day (118 GPD x 8.34 x .79 SP. Gr. of methanol)

**D. Methanol to Nitrate Ratio, Actual versus Predicted Optimums**

1. Actual methanol to NO<sub>3</sub>-N ratio = 780/120 = 6.5:1 or 52 mg/L methanol per 8.0 mg/L NO<sub>3</sub>-N
2. Predicted methanol requirement (stoichiometric calculation using given D.O., NO<sub>2</sub> and NO<sub>3</sub> values)

$$\frac{0.9 \times 4.5 + 1.5 \times 0.2 + 2.5 \times 8.0}{\text{ratio}} = 24.23 \text{ mg/L methanol to } 8.0 \text{ mg/L NO}_3\text{-N, or } 3.03:1.0$$

D.O.                      NO<sub>2</sub>                      NO<sub>3</sub>

(The methanol required for D.O. and NO<sub>2</sub>-N reactions is held constant, so the comparison is a comparison between actual and stoichiometric methanol to nitrate ratios.)

In a proportional feed-controlled system with methanol pump adjustments each 5 minutes, for example, a 3.1 to 1.0 ratio of methanol to nitrate may be sufficient the majority of the time. Thus, a feed rate of approximately 25 mg/L methanol, or 372 lbs./day (56.4 gal./day) should be possible with a proportional-feed, feedback and trim control system such as could be provided with the ChemScan™ UV-6100 system.

With a controlled system, it is estimated that methanol consumption could be cut in half if methanol pump adjustments were made 288 (or more) times per day versus only twice per day as is the current practice. With methanol cost at \$0.99/gal., substantial savings could be realized.

The chart below shows various methanol-to-nitrate ratios and associated cost of methanol. Constants used in the calculations are flow at 1.8 MGD, NO<sub>3</sub>-N at 8.0 mg/L and methanol cost @ \$0.99/gal.

<u>Ratio</u>	<u>mg/L</u>	<u>Lbs./Day</u>	<u>Gal./Day</u>	<u>\$\$/Day</u>	<u>\$\$ Saved/Day vs. Current Cost</u>
6.5:1	52	780.6	118.2	117.09	0
6.0:1	48	721.0	109.2	109.18	7.91
5.5:1	44	660.5	100.00	100.08	17.01
5.0:1	40	600.5	91.0	90.09	27.00
4.5:1	36	540.3	81.9	81.05	36.04
4.0:1	32	480.4	72.8	72.07	45.02
3.7:1	29.6	444.4	67.3	66.63	50.46
3.5:1	28.0	420.3	63.7	63.05	54.04
3.3:1	26.4	396.3	60.0	59.45	57.64
<u>3.1:1</u>	<u>24.8</u>	<u>372.3</u>	<u>56.4</u>	<u>55.84</u>	<u>61.25</u> (Recom. feed ratio)
3.03:1	24.24	363.9	55.1	54.58	62.51 (Stoich. ratio)

### **E. Economic Evaluation**

In addition to the more subjective values of information using the UV-6100 to generate operating statistics as part of an overall SPC system, there is a hard potential payback on a \$50,000 capital expenditure to install a UV-6100 system for a controlled process feedback system. The projected payback for various methanol to nitrate-nitrogen ratios are presented below:

<u>Methanol:NO<sub>3</sub>-N Ratio</u>	<u>Payback</u>
4.0:1	36.5 months
3.5:1	30.4 months
3.1:1	26.8 months

It has been noted that the diurnal operator adjustment to methanol feed does not always correspond to flow/demand fluctuations at the chlorination point. This lead/lag offset is one possible explanation for greater chlorine and subsequent dechlorination agent demand.

In addition, from a waste minimization prospective, the following would represent the material reduction realized by establishing and controlling a lesser ratio of methanol to nitrate:

<u>Ratio</u>	<u>Gal. of Methanol Saved/Year</u>
4.0:1	16,600
3.5:1	19,900
3.1:1	22,600

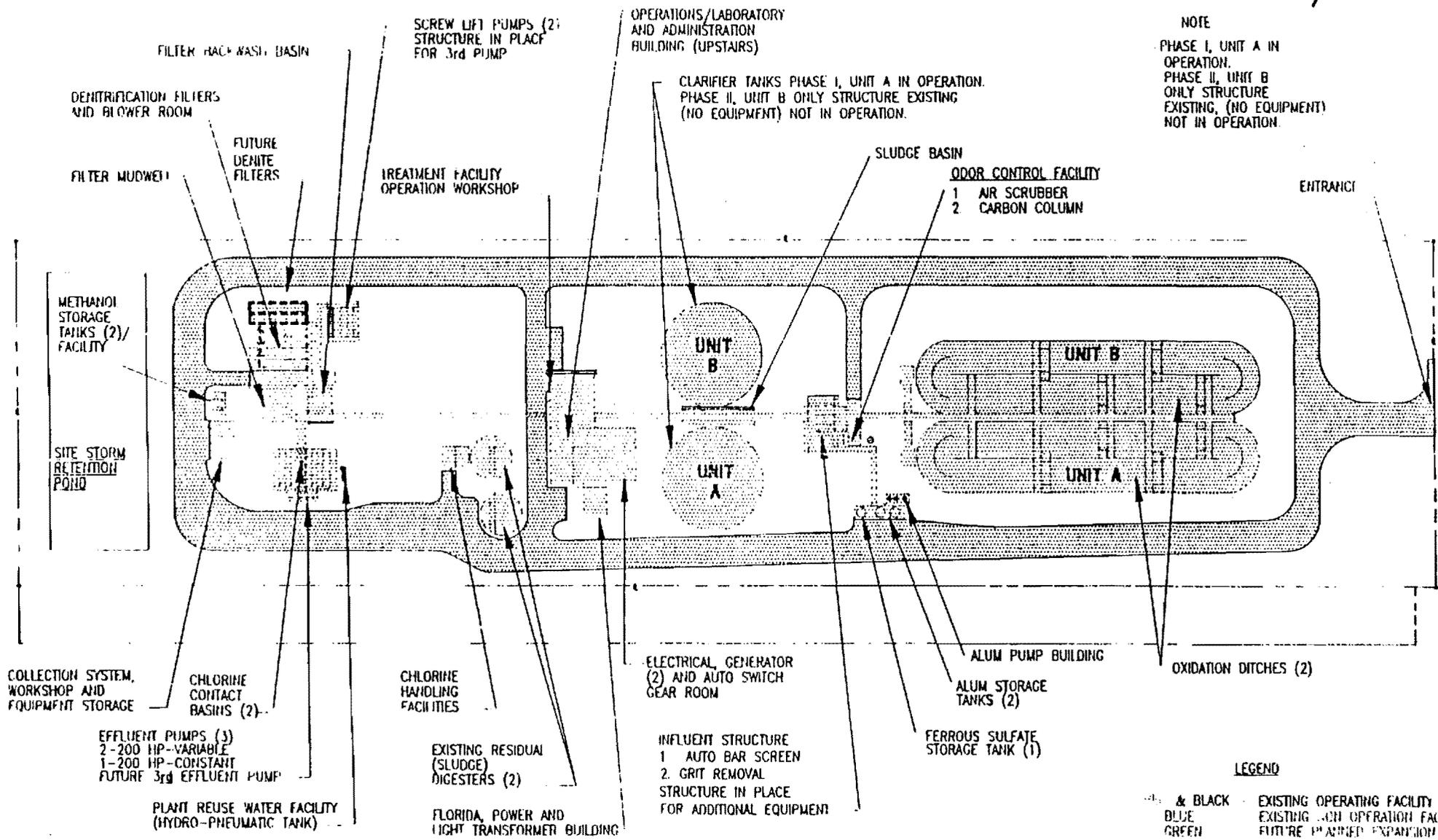
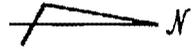
Obviously, feeding excess methanol potentially creates a need for greater chlorination and subsequent dechlorination. No attempt has been made to estimate the economic or waste minimization impact of these downstream operations, but more control and lesser use of the methanol feed should provide economic and operation advantages in those downstream operations.

In addition to the cost savings of reduced methanol feed, automated generation of operating statistics and waste minimization aspects, the ChemScan™ UV-6100 on-line process analyzer requires no reagents and has very low operation and maintenance requirements. Compared to analyzers that use reagents, the UV-6100 can provide additional savings in reagent cost

**alone of \$800-\$1,000 or more per month. The UV-6100 on-line analyzer saves in operations manpower requirements as well, by allowing nitrate values to be read and frequent adjustment of the metering pump more often than could be justified on a manpower basis.**

# **FIESTA VILLAGE AWT**

## **PLANT AND PROCESS DESCRIPTION**

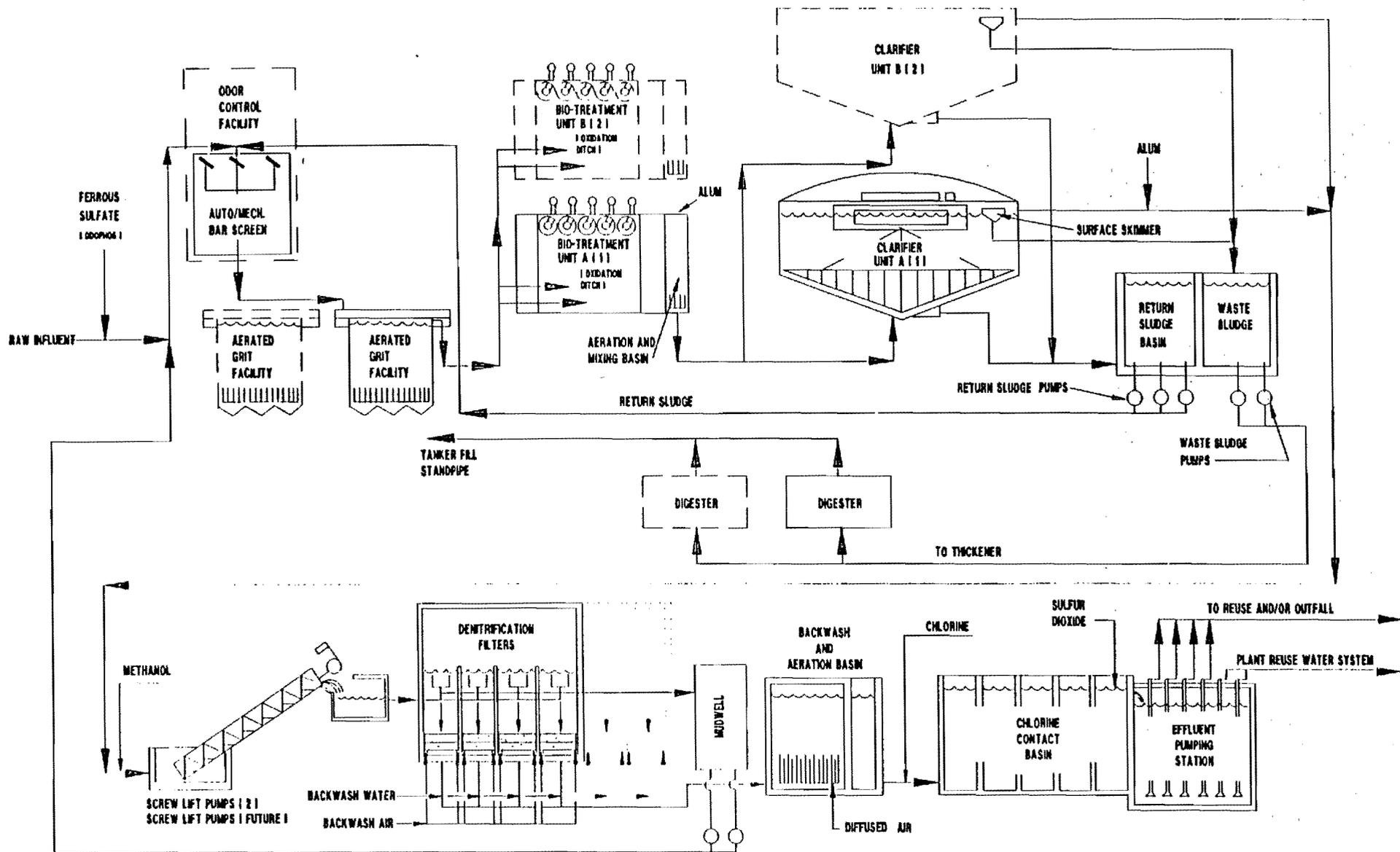


NOTE  
 PHASE I, UNIT A IN OPERATION.  
 PHASE II, UNIT B ONLY STRUCTURE EXISTING, (NO EQUIPMENT) NOT IN OPERATION.

### SITE PLAN

NTS  
 MAY 4, 1997

# FIESTA VILLAGE ADVANCED WASTEWATER TREATMENT PLANT 1992



TREATMENT PROCESS FLOW DIAGRAM

MAY 11, 1992

FIESTA VILLAGE ADVANCED WASTEWATER TREATMENT PLANT 1992

PHASE I

## **FIESTA VILLAGE ADVANCED WASTEWATER TREATMENT FACILITY**

The Fiesta Village Advanced Wastewater Treatment Plant (AWTP) is the most recent addition to the Florida Cities Water Company network of wastewater facilities. The Fiesta Village AWTP located in Fort Myers, Florida was placed in-service in January, 1986.

The Fiesta Village Wastewater Treatment Plant is 2.5 mgd advanced computer automated tertiary treatment facility utilizing biological treatment, chemical addition and filtration to achieve stringent organic, solids and nutrient removal requirements (5 mg/L BOD, 5 mg/l TSS, 3.0 mg/L TN and 0.5 mg/L TP). The wastewater treatment process flow schematic identifies the major treatment processes and flow pattern.

### PRETREATMENT

The initial pretreatment process includes a fully automatic bar screen and grit removal system. The bar screen removes all solids larger than 6 mm (0.25 inch) which could cause damage to the downstream equipment and pumps. The grit chamber provides initial settling for the removal of sand, stones, cinders and other inorganic material. The removal of grit protects against abrasive wear of downstream equipment and reduces inorganic deposits in downstream processes which would deplete treatment capacity. The grit is washed in a grit washer and the clean and odorless grit is disposed in the local landfill.

### OXIDATION DITCH

The oxidation ditch is a race track configuration tank 437 feet in length, 80 feet wide and 12 feet deep. The 3 million gallon volume provides 29 hours of retention time at the design average daily flow of 2.5 million gallons per day.

The oxidation ditch utilizes naturally occurring bacteria to remove organic matter and nitrogen. The bacteriological growth in the oxidation ditch is maintained through oxygen supplied by four (4) rotating brush rotors, each 42 inches in diameter and 40 feet long and powered by 60 HP motors, placed at strategic locations around the race-track shaped oxidation ditch; the recycle of bacteriological growth contained in return sludge from the downstream clarifier; and the organic matter in the incoming pretreated raw wastewater. The proper maintenance of the bacteriological growth, oxygen supply and incoming raw wastewater provides the required environment in different zones of the oxidation ditch for biological reduction of the organic matter and nitrification of the ammonia in the raw wastewater. The oxygen concentration in the oxidation ditch is automatically controlled by the computer. Special probes in the oxidation ditch detect the oxygen concentration and adjust the water level in the ditch to maintain the proper oxygen concentration.

## ALUM FEED

Alum addition to the oxidation ditch effluent initiates a chemical reaction that results in the chemical precipitation and removal of phosphorus with the settled sludge in the downstream secondary clarifier. The Alum feed is automatically paced by the computer and is maintained at the proportional rate of total wastewater flow.

## SECONDARY CLARIFICATION

The secondary clarification process removes and concentrates solids from the oxidation ditch effluent. Any residual traces of oil, grease and scum is also removed from the wastewater. The chemically bound and precipitated phosphorus is also removed with the sludge from the clarifier.

The secondary clarifier is a 90-foot diameter concrete tank with 12-foot side wall meter depth. The bottom of the tank slopes toward the center. A continuously rotating rake sweeps the settled sludge toward the center of the tank where it is removed. The solid free effluent overflows a V-notch weir that is continuous around the entire periphery of the clarifier. The clarifier is covered with an aluminum dome to block out sunlight and prevent the growth of algae.

A portion of the settled sludge removed from the clarifier is returned to the oxidation ditch to maintain the proper bacteriological growth in the oxidation ditch. Variable speed drive motors allow the operator to adjust the return sludge flow to the proper setting to maintain process control. The excess waste sludge is pumped to the sludge disposal process consisting of thickening and aerobic digestion. The stabilized sludge is applied to pasture land where it is an excellent fertilizer and soil conditioner.

## SCREW PUMP LIFT STATION

The secondary clarifier effluent is relatively free of organic material, solids and phosphorus. Two screw pumps, each capable of pumping up to 4,300 gpm each lift the clarifier effluent 20-feet up to the filters. Methanol is injected into the clarifier effluent at the screw pumps prior to the filter process. Methanol initiates a biological reaction in the filter process. This biological reaction is the final step in nutrient removal and any remaining nitrogen contained in the treated wastewater is stripped during the filter process. The computer automatically paces the methanol feed proportional to the wastewater flow.

## DENITRIFICATION FILTERS

The filter process provides the additional tertiary treatment required to meet the stringent State and EPA limitation imposed on the Fiesta Village facility. The filter system consists of 4 filtering cells, each 40 feet long by 10 feet wide and 18.5 feet deep. Each filter cell contains approximately three feet of sand. The sand provides a two-fold purpose. The sand provides a straining effect to remove any residual solids in the treated effluent and it provides a media to

promote bacteriological growth which utilizes the methanol feed and oxidized ammonia to biologically remove the residual nitrogen.

The filter system is fully automatic. The filtering, bumping and backwashing operations are controlled by a process controller and monitored by the computer.

### CHLORINATION/DISINFECTION

Chlorine is injected in the filter effluent to provide disinfection of any potentially remaining waste borne pathogens. The chlorine contact chamber provides contact time to insure that the disinfection chemical reaction has been completed prior to discharge.

### DECHLORINATION

Sulfur dioxides injected in the chlorine contact chamber effluent to reduce residual chlorine concentration below detectable levels.

### EFFLUENT PUMPING

The treated effluent is pumped to the Caloosahatchee River for discharge or utilized for irrigation at golf courses, parks and schools. The effluent pumping system consists of three 200 HP pumps. Two pumps are variable speed drive pumps which are controlled by the computer to pump at a rate equivalent to the treated effluent. The two variable speed pumps are capable of pumping up to 4,500 gallons per minute each. The third effluent pump is a constant speed pump is automatically placed on-line during peak flow periods during the day.

### COMPUTER CONTROL

The Fiesta Village facility process operations is controlled by a programmable Control System. The programmable controller system includes a microcomputer and color graphic touch screen CRT. The system provides for monitoring and control of the treatment processes. Normal operator control is by infrared touch screens which allow operators to touch CRT screen graphic images of pumps, valves and pushbuttons to control process equipment. The programmable controller system also is programmed to compile historical data and generate facility reports.

### LABORATORY

The laboratory is supplied with all equipment necessary to perform required routine analytical testing. All routine analytical testing, including specialized procedures for nutrient analyses, are performed in-house.

## EMERGENCY GENERATORS

Two diesel fueled emergency generators, each rated 600 kilowatts, provide back-up power supply during an electrical outage. The emergency generators are capable of maintaining all treatment processes and pumping operation indefinitely until normal power can be restored.