TASK 3.7 Final Report

Implementation Plan for Selected Technology

for the project entitled

Dairy Best Available Technologies in the Okeechobee Basin

(SFWMD Contract No. C-11652)

Submitted by

SWET, Inc.

Soil and Water Engineering Technology, Inc.

In Association With

MOCK•ROOS

CH2M HILL

ENTEL

March 3, 2003

The SWET Team

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Acronyms

ac-ft	acre-feet
BAT	best available technology
CMP	corrugated metal pipe
DACS	Department of Agriculture and Consumer Services
EOF	edge-of-farm
ERP	Environmental Resource Permit
FDEP	Florida Department of Environmental Protection
gpm	gallon per minute
HIA	high-intensity area
µg/L	micrograms per liter
mA	milliamps
mg/L	milligrams per liter
N/S	north/south
NGVD	National Geodetic Vertical Datum
O&M	operation and maintenance
P	phosphorus
ppb	parts per billion
R/D	retention/detention
SFWMD	South Florida Water Management District
SWET	Soil and Water Engineering Technology, Inc.
TMDL	total maximum daily load
TRT	Technical Review Team
USACE	U.S. Army Corps of Engineers

Introduction

This implementation plan addresses the selected technology for the Dairy Best Available Technologies (BATs) in the Okeechobee Basin. It provides the rationale and objectives for the selected technology, vendor information, applicable maps, and technical data for the proposed technology associated with each dairy; schedules and timelines for engineering and construction; and discussion of permitting issues. This plan requires approval from the Technical Review Team (TRT) prior to the start of construction.

Rationale and Objectives for Selected Technology

The rationale and objectives behind the project were to identify a technology or a combination of technologies that will provide the highest probability to achieve the goal of reducing phosphorus (P) discharge concentrations from the participating dairies to 40 micrograms per liter (µg/L). Once selected, the technology should be implemented to the maximum extent possible within the project budget to determine the actual P reduction that can be achieved per dollar spent. The previous task reports (2.6, 2.10, and 2.11) described the process of evaluating and selecting the technology in detail. In summary the selection criteria included the following:

1. Ability to reduce P to target levels
2. Capital costs
3. Operation and maintenance (O&M) costs
4. Compatibility with existing farm practices
5. Dairyman acceptance

The ultimate goal for the project is to reduce P exports from the participating dairies while determining the actual cost effectiveness of the technology, which is needed for determining its feasibility for future use across the region.

The literature review and evaluation of the various technologies (Tasks 1.3 and 2.10) determined that the edge-of-farm (EOF) treatment of stormwater by use of retention/ detention (R/D) and chemical treatment has the highest probability to achieve the project goal and objectives.

Description of Selected EOF Technology

Figure 1 provides a conceptual view of the EOF system. The system is designed to collect and divert as much surface and groundwater flow as possible from the high P source areas on a dairy to a stormwater R/D pond and chemical treatment. The system has the following four major components:

1. Land source areas needing runoff treatment
2. System of ditches and dikes to collect and divert runoff to the treatment system
3. R/D pond for storing water for treatment and reuse on farm
4. Chemical treatment system for discharge from the R/D pond

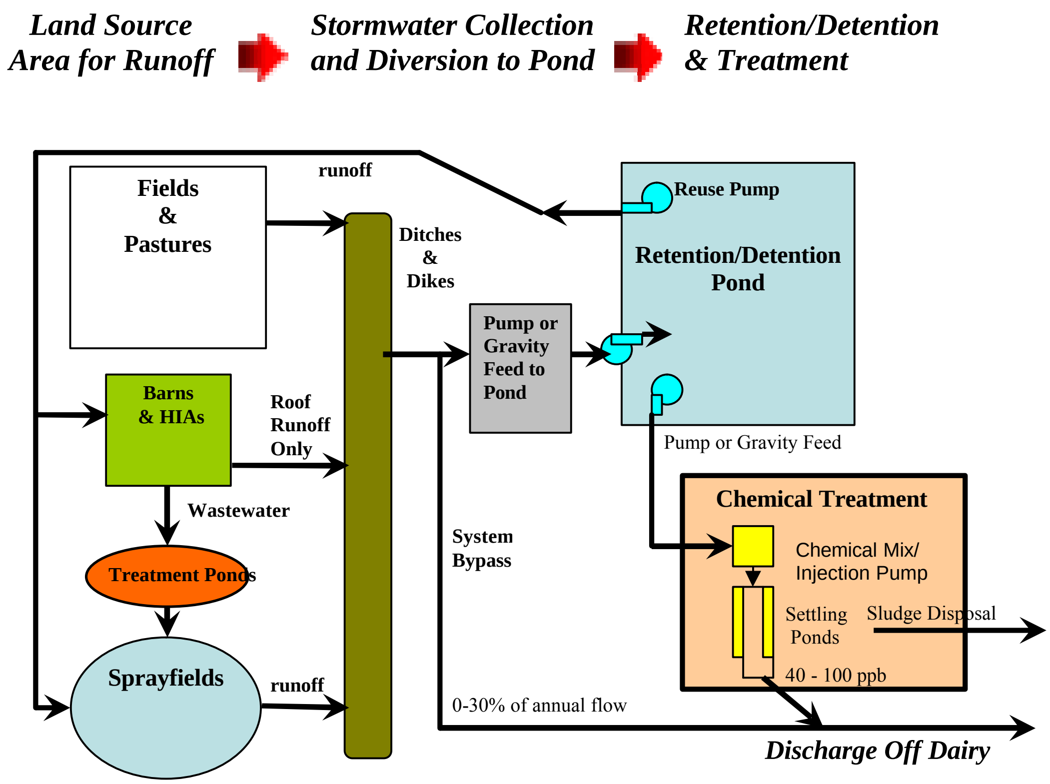

Figure 1. Conceptual Design of EOF System

The R/D pond will provide some wetland treatment, but will serve primarily as a surge buffer for chemical treatment of any offsite discharge and storage for water reuse on the farm. Chemical treatment (aluminum or iron flocculation) of the impoundment discharge will occur at the end of the R/D pond farthest from the inflow to reduce P concentrations as much as possible due to wetland interactions before a chemical treatment is applied. The impoundment discharge will be injected with an iron or aluminum salt as it flows, via pump or gravity, into a sump/basin sized to ensure complete flocculation and settling prior to final discharge from the property. The chemical treatment system will operate only when the storage capacity of the system is exceeded or to recover storage capacity prior to a subsequent storm event.

Preliminary Cost Analysis of EOF Technology

The economics of a conceptual design were evaluated by Soil and Water Engineering Technology, Inc. (SWET). This analysis indicated that an EOF system could achieve the P reduction goals, but at a cost that exceeded the available funds. The two factors that cause the system to exceed available funds are high retention volume requirements to ensure treatment of all runoff, and high chemical costs for achieving 40 μg/L of P in discharged water. The extensive dikes needed to capture and retain the infrequent large stormwater events cause the high costs. If these large storms are not captured, then any runoff greater than the R/D storage volume would have to be bypassed (i.e., not treated). The fraction of untreated runoff will dilute the treated water, raising the average P concentration in the discharge.

The second constraint mentioned above is the high chemical demand for reducing P concentrations to 40 μg/L of P. Chemical demand for P removal increases exponentially as P removal rate increases. Therefore, the amount of chemical required to remove the first 50 percent of P probably will be considerably less than that required to remove the last 10 percent (i.e., going from 90 to 100 percent removal). In relation to the anticipated P concentrations to be treated, this means that the last 50 μg/L of P reduction probably could require as much chemical as the first 1,000 μg/L of reduction. Preliminary estimates for chemical costs indicated that the dairymen might not be able to afford treatment to 40 μg/L of P, but that tremendous reductions could be achieved for an acceptable cost.

The preliminary design and cost estimates indicated that the EOF systems that could be built for the available funds ($575,000 for engineering and construction) and that would meet the dairymen's O&M requirements would achieve a P concentration reduction to about 120 to 380 μg/L (90 to 80 percent reduction) on a long-term average. For individual years, the P reductions could range from 70 to 100 percent of achieving the targeted goal of 40 μg/L. Although the current funds will only allow the original goal to be achieved for a few dry years, the overall P reduction, even for wet years, will be tremendous. This is particularly true when considering that the proposed systems will also be reducing net runoff in addition to P concentration; the P load reductions will be greater than the P concentration reductions indicated previously. If water reuse is implemented on the farm, then runoff could be reduced from 5 percent (wet years) to 50 percent (dry years). Due to limited funds, water reuse will be implemented only at Butler Oaks and Dry Lake Dairies. The proximity of the retention pond and the third stage ponds makes water reuse inexpensive at these two dairies. Water reuse will be considered in the future for Davie Dairy if funds are available.

The primary goal of this project will be to reduce P loads while determining the actual construction and O&M costs and P removal efficiencies for these EOF systems, so that true cost efficiency relationships can be developed. Such relationships are critical for determining the future applicability of these systems for P control in the Okeechobee Basin.

Vendor Selection for Engineering and Construction

Once the technology was selected, vendors were selected that could complete the engineering design and construct the EOF systems. Three vendors were selected based on their similar qualifications and unit cost proposals. One vendor was assigned to each of the three participating dairies based on their previous experience with the dairies. The vendor contacts for each of the participating dairies are as follows:

Butler Oaks Dairy
CDM Engineers & Construction, Inc.
Mr. Dean Carter, P.E., Project Manager
2301 Maitland Center Parkway, Suite 300
Maitland, FL 32751
Phone: 407-660-2552

Davie Dairy
Environmental Research & Design, Inc.
Mr. Jeffery L. Herr, P.E., Project Manager
3419 Trentwood Boulevard, Suite 102
Orlando, FL 32812
Phone: 407-855-9455

Dry Lake Dairy
Engineering & Water Resources, Inc.
Mr. Brian R. McMahon, P.E., Project Manager
851 Johnson Avenue, Suite 214
Stuart, FL 34994
Phone: 772-781-6408

Engineering and Design Vendor Reports for Participating Dairies

The EOF implementation vendors have completed their 100 percent design reports for their respective dairies (Appendices A, B, and C for Butler Oaks, Davie Dairy, and Dry Lake Dairy, respectively). These reports provide the conceptual design, final construction drawings, and estimates of the system's performance and costs. The designs presented have been reviewed by the dairymen and modified to meet their needs. Although conceptually similar, the three designed systems have a number of unique features specific to the layout and management requests of the respective dairies.

Butler Oaks Dairy EOF System

The Butler Oaks Dairy EOF system has been designed and will be constructed by CDM, Inc. CDM's detailed design report is provided in Appendix A. The EOF system is similar to the Davie Dairy system in that stormwater will gravity feed into the water storage areas, but the layout and runoff delivery to the R/D pond is different from Davie Dairy. The Butler Oaks Dairy requires significantly more diversion ditches upstream of the retention areas to allow for the separation of runoff from low nutrient lands and offsite areas from the dairy's more P-laden runoff that needs treatment. As seen in Figure 1.1

included in Appendix A, the dairy is divided into two separate tracts. The west tract (west of County Road 721) is low use hayland and beef pasture, which is anticipated based on low P soil tests to have low P runoff. The east tract (east of County Road 721) contains the main dairy activities, including the milk center, milk herd pastures, calf barn, and the sprayfield. The flow from the west tract is mixed with runoff from the neighboring B-4 dairy and wetlands west of the tract before coming onto the east tract. This on-flow does contain moderate P levels, but it is estimated that only about 20 percent or less of the P would be from Butler Oaks Dairy's west tract based on the land use and acreage of contributing areas. Initial design analyses considered including this inflow in the treatment system; however, the cost of the system would exceed the available budget. The system has therefore been designed to treat the water from just the east tract.

Because of the availability of a low-use land (woodland) on the lowest elevation portion of the dairy at its east end, the storage requirements can be met with a gravity inflow system. Shallow storage depths and quicker storage recovery in the R/D area are important for protecting the existing oak trees in the area. The more rapid drawdown after a storm event will decrease the water reuse potential for this system. The gradients are not sufficient to gravity feed the chemical treatment system; therefore, a pump will be required to lift water into the treatment system. This pump can also be used to pump water into the waste storage pond for water reuse.

Western Portion of the Butler Oaks Dairy Project Site (Appendix A: Figure 3-2):

Reshaping of the existing bypass will be done to allow the on-flow from the west tract to bypass the east tract and its treatment system. This bypassed water is being diverted because its P concentration is much lower than the east tract's P levels and only a fraction of the P in the on-flow originates from the dairy's west tract as explained previously. The bypass water will follow the existing canal running along the south side of the east tract.

Eastern Portion of the Butler Oaks Dairy Project Site (Appendix A: Figure 3-3)

To collect the east tract runoff and isolate it from the bypass water from the west tract, a new treatment system collection ditch will be constructed parallel to the existing south canal. This new ditch will connect to the existing north/south (N/S) sprayfield ditches to collect all runoff from the irrigated fields, which currently receive water from the waste storage pond. The new treatment system collection ditch will continue to flow east to the R/D area, which can then be pumped through the alum treatment system. A berm will be constructed around the perimeter of the R/D area . The berm will have a 2-foot freeboard over the control elevation of 31.0 feet National Geodetic Vertical Datum (NGVD). Stormwater from the pastures and road on the north side of the eastern tract will be diverted along the south side Boat Ramp Road in the improved road ditch to a point just east of the existing culvert under the road (monitoring site 41B, note culvert will be plugged). At this point, a new north/south ditch from the road ditch to the "center" ditch east of the milk barn will be constructed to transfer drainage water to the "center" ditch. A culvert and flapper gate from the "center" ditch to an internal drainage ditch within the

R/D area will allow water from the "center" ditch to drain into the R/D area when water levels in the "center" ditch exceeds the level in the R/D pond. The water that flows to the R/D internal ditch from the center ditch will be pumped the treatment system via lift pump located on the south side of the 3rd stage waste storage pond. This internal ditch is used to ensure adequate dewatering of the oaks in the R/D area.

The stormwater treatment system uses a single lift pump, alum chemical injection system, large flocculation/settling pond, and sludge de-watering area. Discharge from the settling pond is piped to the existing south boundary ditch just upstream of monitoring station 41A. An emergency overflow is located between the R/D storage area and the existing outfall canal at an elevation of 31.5 feet NGVD. Three independent models were used to simulate runoff and treatment for the Butler Oaks Dairy EOF treatment system. Each of the three model simulations indicated that for the project study area, a 90-percent treatment rate of all (average-year) runoff can be expected.

Also, because the dairyman initially preferred not to use alum as a chemical flocculent, the treatment system was initially designed using iron salts. There were concerns about land-spreading alum sludge; however, the dairyman has agreed to use alum as long as a reasonable land application or offsite disposal sludge program is provided.

The Butler Oaks Dairy was also the only dairy with threatened and endangered species issues. As part of the design effort, a species survey was conducted and a small family of gopher tortoises was found in the area of the proposed dike. These tortoises will be moved prior to construction. No wetland disturbance issues were found; therefore, no U.S. Army Corps of Engineers (USACE) permits are required.

Davie Dairy EOF System

The Davie Dairy EOF system has been designed and will be constructed by ERD, Inc. ERD's detailed design report is provided in Appendix B. The dairy has a unique topography that allows the stormwater R/D pond to be created by slightly increasing stages in the headwaters of Nubbin Slough. This feature allows the area to be filled by gravity with a minimum amount of diking. The steeper gradients in the lower section of Nubbin Slough near the property border allow for gravity delivery of water to the chemical treatment system. Although the topography allows for a gravity-fed system, the storage volume within the R/D pond could only hold about 0.3 inch of stormwater runoff. Therefore, ERD designed the chemical treatment system to handle a higher peak flow rate to allow the system to treat 100 percent of the runoff from storms up to 3.5 inches. A unique variable speed injection and mixing system will be used to provide a consistent concentration and mixing. The system was initially designed with three unique shallow, above water table, settling ponds to help dewater the chemical flocculent before disposal. However, costs for such a system were prohibitive and therefore the system was redesigned with a single deeper flocculation pond. Sludge in the flocculation/settling pond will be hydraulically pumped into above ground drying beds for sludge dewatering prior to land application.

The Davie Dairy EOF treatment system is located at the southwestern corner of the farm area used for the dairy. The contributing watershed area were initially estimated to include Basin 2 (687 acres) and Basin 3 (909 acres) for a total of 1,596 acres (Task 2.11 Final Report, Animal Nutrient Management Assessments for Three Selected Dairies for the Project entitled Dairy Best Available Technologies in the Okeechobee Basin South Florida Water Management District [SFWMD] Contract No. C-11652). According to the dairyman and the Department of Agriculture and Consumer Services (DACS), a culvert/ditch has been blocked by the neighbor just north of where historical flow entered Basin 3 from the north on the east side of Berman Road (see the Watershed Map in Appendix B). However, recent monitoring appears to indicate that additional flow is entering Basin 3. Therefore, the treatment system had to be increased at a late stage to handle this additional water. The design provided in Appendix B accounts for this additional water. Another offsite inflow coming from the west of Basin 3 will be diverted around the treatment system, if the budget allows. The diversion is a lower priority than the R/D pond and chemical treatment system.

An earthen berm and three corrugated metal pipe (CMP) culverts with flashboard risers will be constructed across the slough to create a small R/D area. This R/D area is simply used to divert water to the chemical treatment system, and not to retain water. A pipe extends from the slough upstream of the culvert structure to deliver water to the alum treatment system. The water flow rate would be measured by a flowmeter producing a 4-20 milliampere (mA) output. The 4-20 mA output would control the speed of the alum and buffer feed pumps to maintain constant chemical doses at different water flow rates. The system is expected to achieve treatment of most runoff (90% +) in an average annual rainfall year.

The alum-treated water would enter a large floc-settling cells designed with sufficient time to allow the floc to settle. The treated supernatant would discharge by gravity through a pipe into the slough downstream of the three culverts. The accumulated alum floc is approximately 95 to 99 percent water. Because there is no sanitary sewer system to receive the wet alum floc, the floc should be dewatered to the maximum extent possible in a neighboring dry bed. The dewatered solids will be land applied on the dairy. A front-end loader or other heavy equipment would be used to remove the dewatered floc from the drying cell. On the basis of a total annual water volume of 872 acre-feet (ac-ft) in an average year, 1.45 ac-ft of wet floc (5 percent moisture) or about 390 cubic yards of dry floc (30 percent moisture) will be generated once every 2 to 6 months.

The construction of the R/D pond dike and control structure requires a USACE wetland permit. The permit has obtained. No other permitting issues have been noted.

Dry Lake Dairy EOF System

The Dry Lake Dairy EOF system is being designed and constructed by EWR, Inc. EWR's detailed design report is provided in Appendix C. The Dry Lake Dairy system is a more conventional R/D pond storage type system. The R/D pond will have a perimeter dike around its entire perimeter and will require a large low-head lift pump to deliver runoff to the pond. The system requires a new diversion ditch to deliver stormwater from the eastern side of the milk center and high-intensity areas (HIAs) to the R/D pond (see Surface Water Runoff Collection figure in Appendix C). Some ditch blocks north of the farm's sprayfield are needed to divert runoff currently leaving the property to the east of the treatment system.

The Dry Lake Dairy property encompasses 1,241.5 acres. Core dairy operations including feed barns, milking parlor, HIAs, lagoons, and the waste storage pond account for approximately 30 acres. The remaining 1,211 acres consist of pastures, hayfields, land application areas, and farm worker houses. Several existing ditches located throughout the farm collect surface water runoff. The primary discharge point is located just north of the southwestern corner of the farm (SFWMD sampling point KREA 32B). Two other minor discharge points are located on the southeastern (SFWMD sampling point KREA 49A), and northeastern (SFWMD sampling point KREA 32C) corners. These locations are shown in Figure 6-1, Task 2.11 Final Report.

The EOF treatment system selected for this dairy consists generally of a traditional surface water management system followed by chemical treatment. It includes 2,600 feet of ditch, a 48-acre aboveground surface water impoundment, a 13,200-gallon-per-minute (gpm) drainage lift pump, a gravity based alum feed/mixing unit, and a final flocculation/settling pond. The system, located just upstream of KREA 32B, has been designed to capture on a long-term average about 82 percent of the surface water runoff from the remaining 1,163 acres (1,211 acres minus 48 acres for the R/D pond) of farm. To enhance runoff capture, the plan also proposes to stop the Dry Lake Dairy discharge through KREA 49A by installing a flashboard riser at the property line. The technical specifications of the system design and components of the system are shown in the construction drawings (Appendix C).

The Dry Lake Dairy system has a unique gravity based chemical injection system. An 18-inch culvert from the R/D pond delivers water to the chemical treatment system. The culvert flow is passed under a 4-foot gate (can also be used to stop flow) to create an orifice flow condition, which provides a near linear stage to flow relationship. The stage is then used to control alum injection rate. After alum is injected the flow is forced through a multi-vaned flow mixer before entering two flocculation/settling ponds. The bottom of these ponds have under-drains which allow dewatering of sludge in the ponds during dry periods. A track-hoe will be used to remove sludge material, which will then be land applied on the dairy.

The dike for the R/D pond goes through existing wetlands; therefore, a USACE wetland construction permit was required. The permit has been obtained. No other permitting issues have been noted.

EOF Permitting Issues

All permitting issues have been identified and addressed for the implementation phase of the project. Four permit issues were identified and have been addressed for the project. The first permit issue was how the project would be integrated into the existing Florida Department of Environmental Protection (FDEP) permits for the dairies. The second issue was whether the USACOE wetland impact permits would be required. The third issue concerned threatened and endangered species, and the last permit issue was whether a SFWMD Environmental Resource Permit (ERP) would be required.

After discussions with Tim Powell, FDEP West Palm Beach office, it was decided that the project will be handled on a notification basis until the EOF systems are installed and evaluated. The cost and performance data for the systems will be used at the end of the project to determine if the dairymen and FDEP will accept EOF systems into their permit permanently. This approach will be followed as long as the implemented systems do not interface with the existing operations that are covered by the dairies' current FDEP permits. FDEP will be provided with all design, construction, and as-built information regarding the technologies as they become available. As a member of the TRT, FDEP will automatically receive updates, but this will be verified periodically by phone calls.

An operational plan will be developed and mutually agreed upon, based on the reliable cost and performance information gained during the evaluation phase of the project. This operational plan will be incorporated into a modification of each dairy's FDEP permit after the evaluation period based upon findings. The EOF system will provide the dairymen with a facility to help meet potential future regulatory requirements.

A preapplication meeting was held with Irene Sadowski, USACE Merritt Island office, to verify the need for a USACE permit for construction activities in wetlands. Permit applications for both the Davie and Dry Lake Dairies were submitted in July 2002. Both permits have been received. The Butler Oaks Dairy system will not have any construction within a wetland; therefore, a USACE permit will not be required. Soil and Water Engineering Technology, Inc. will assist the dairies with USACE permits requirements including annual reports for the first two years of permit, after which no further reporting required should be needed.

Surveys of threatened and endangered species were done for the project areas on the three participating dairies. The only identified species of concern was gopher tortoises at Butler Oaks Dairy along where the R/D pond dike has to be improved. This permit has been applied for and approved. The transfer of the gopher tortoises will be completed before construction.

The Dairy BAT project activities will be covered as part of the FDEP dairy permits at the end of the two-year evaluation period if continued. Additionally, no Environmetal Reosource Permits will be necessary. In accordance with section 373.406 (9), F.S., the South Florida Water Management District (SFWMD) and the Florida Department of Environmental Protection (FDEP) are authorized to exempt, from Environmental Resource

Permitting, certain activities, conducted on agricultural lands, that are determined to be primarily for the purpose of environmental restoration or water quality improvement with only minimal or insignificant cumulative adverse impact. The Dairy BAT projects have been reviewed under the section 373.406(9) permit exemption guidelines, and it has been determined that these projects are exempt from Environmental Resource Permitting. However, during the construction of the Dairy BAT projects, appropriate pollution prevention practices must be utilized to minimize water quality impacts to the adjacent waterbodies.

Estimated EOF Systems' Performance

The estimated performance of the three EOF systems is provided in Table 1. These preliminary estimates provide only a rough estimate of the anticipated performance for the following reasons:

- Jar tests to date do not represent the variability of P and other constituents that are expected over time.
- Change in water quality and resulting flocculation efficiency caused by natural treatment in the R/D ponds is unknown, but is expected to improve treatment efficiency.
- P concentration of bypassed flow may be different from the assumed average inflow concentrations.
- Rainfall variability from season to season and year to year will significantly change treatment efficiency, particularly as related to the amount of bypassed runoff.

The first 2 years of operation will be monitored to better define the treatment performance of the three systems.

The alum sludge from the treatment systems will be land applied. Experts, including Drs. Mary Beth Hall, UF, Jesse Goff, USDA-ARS, George O'Conner, UF, Phil Moore, USDA-ARS, and Brian Haggard, USDA-ARS have been consulted as to possible impacts from animal ingestion and plant growth. These experts indicate that there are no indications of toxic impacts from animal consumption of alum or alum sludges and ruminate animals would have the lowest potential effects if there were any. The only concern stated was the potential for unused alum residuals to tie up P in the gut and limit P uptake by the animals. With proper treatment system dosing, very little if any alum residuals would be in the treatment sludges, so P binding would not be considered a problem. To limit ingestion of sludge materials it is recommended that animals be kept off application areas for two weeks after application.

The influence of the alum sludges on nutrient availability in soils is not well documented. However, Dayton and Basta 2001 and Basta et al 1999 have indicated that the P in the sludges might be plant available in spite of the fact that P mobility is greatly limited from the sludges. In general, it is believed that soil P test (Melich 1) will measure P in the alum sludge materials in the soils, but as indicated above this P might be available to the plants.

Table 1. Estimated Performance of EOF Treatment System for Three Project Dairies

ITEM	Butler Oaks			Davie			Dry Lake			All Dairies		
Year	Dry	Wet	Avg	Dry	Wet	Avg	Dry	Wet	Avg	Dry	Wet	Avg
System Information												
Inflow Volume (ac-ft/yr)	219	1093	437	596	1351	927	505	2523	1009	1319	4966	2373
Inflow P Concentration* (µg/L-P)	2000	2000	2000	800	800	800	2000	2000	2000	4800	4800	4800
% Treated (Less Bypassed Runoff)	100	80	90	100	85	90	100	75	85	100	80	88
% Water Reuse	10	5	7	5	0	3	25	5	15	13	3	8
P Concentration Reduction in Pond (%)	15	15	15	5	5	5	20	20	20	13	13	13
Total Outflow P Concentration (Bypass+Treated)												
With Chemical Treatment to 40ppb (µg/L-P)	40	432	236	40	154	116	40	530	334	40	372	229
With Chemical Treatment to 100ppb (µg/L-P)	100	480	290	100	205	170	100	575	385	100	420	282
With Chemical Treatment to 40ppb (% red.)	98%	78%	88%	95%	81%	86%	98%	74%	83%	97%	78%	86%
With Chemical Treatment to 100ppb (% red.)	95%	76%	86%	88%	74%	79%	95%	71%	81%	93%	74%	82%
Total P Removed												
With Chemical Treatment to 40ppb (lbs-P/yr)	1196	4781	2152	1266	2433	1770	2771	10350	4701	5234	17564	8624
With Chemical Treatment to 100ppb (lbs-P/yr)	1164	4642	2091	1171	2241	1635	2708	10049	4580	5043	16932	8306

* Based on District dairy monitoring data and limited data collected at the sites since May, 2002.

Cost and Performance Comparison

The estimated total engineering and construction costs for the three dairy projects are provided in Table 2. These costs are based on a total available budget of $575,000 (Engineering to Completion and Construction). The assessment and engineering averaged about 22 percent of total project costs at each dairy. Detailed breakdowns of these construction costs are provided in the individual design reports in Appendices A, B, and C.

Table 2. Costs for Engineering and Construction

Item	Costs per Dairy		
	Butler Oaks	**Davie**	**Dry Lake**
Engineering*			
To Date	$119,522	$100,357	$115,070
To Completion	$135,000	$115,000	$125,000
Construction	$ 409,723	$456,575	$448,357
Contingency	$30,277	$3,425	$643

* Includes surveying and environmental assessments

The O&M costs shown in Table 3 are higher than initially estimated, because they are based on the chemical and sludge disposal costs to meet a 40 part per billion (ppb) target in the treatment system discharge. Initially the Davie Dairy system had the lowest estimated annual O&M per costs because it is treating the lowest P concentration runoff, however the project monitoring data have indicated that additional offsite water appears to be entering Nubbin Slough from the east. This extra water has increased the estimated O&M costs by about 30 percent. Dry Lake Dairy has the second highest costs because its system is treating a high volume of water and has a higher estimated chemical dosing rate for the same level of treatment. The Butler Oaks Dairy O&M costs are the lowest because it has the lowest volume being treated even though its runoff P concentrations are relatively high. The data supporting these estimates differ among systems. The Davie Dairy design estimates an application rate of 15 milligrams per liter (mg/L) of alum to meet the project goals. The Dry Lake Dairy information uses a treatment of 30 mg/L alum. The Dry Lake Dairy stormwater was highly colored, and the jar tests results were not typical. The potential for interference with the floccing behavior from high levels of dissolved organic matter or other materials will be further explored in the final design and startup efforts. This effect should be minimized by the pretreatment of runoff in the R/D pond before chemical treatment.

The Butler Oaks Dairy chemical and sludge disposal costs were initially based on using ferric chloride because of a specific request by the dairyman. After further discussions the dairyman agreed to use alum and it is the chemical considered in the presented data. For consistency the chemical and sludge disposal costs for the Butler Oaks Dairy, as shown in Table 3, are for alum treatment based on unit costs developed for the other two dairies. Information supporting its use has developed and is being provided to the dairyman.

The floc-sludge disposal (see Note C in Table 3) is assumed to be by land-spreading on available dairy land. Land-spreading has been verified by FDEP as an acceptable disposal methodology (letter to SWET dated November 15, 2002, Appendix D). It is one of the least expensive methods for this nontoxic material. Two potential issues with this method will be evaluated during the first 2 years of operation:

1. Effectiveness of dewatering for improving land-spreading characteristics of the sludge
2. Convincing all parties that the P in the spread material will remain stable, i.e. future runoff of P or aluminum will not be a problem and excessive plant uptake of aluminum or plant toxicity will not occur.

Table 3. Cost Comparison of Edge of Field Treatment Systems for Minimum, Average and Maximum Rainfall Conditions.

Dairy	Rainfall Condition	Labor Cost[a]	Chemical Cost[b]	Power Cost	Renewal / Replacement Cost	Floc Removal & Disposal[c]	Total Cost
Butler Oaks	Minimum	$3,000	$35,000	$400	$2,000	$0	$40,400
Davie	Minimum	$3,120	$35,608	$600	$4,125	$9,036	$52,489
Dry Lake	Minimum	$3,500	$31,549	$600	$2,500	$3,629	$41,778
Butler Oaks	Average	$4,500	$55,000	$4,000	$4,000	$14,000	$81,500
Davie	Average	$6,240	$55,164	$1,800	$4,125	$13,872	$81,201
Dry Lake	Average	$5,000	$63,099	$1000	$3,051	$7,232	$79,382
Butler Oaks	Maximum	$8,500	$78,000	$6,000	$6,000	$22,000	$120,500
Davie	Maximum	$9,360	$80,325	$2,400	$4,125	$20,328	$116,538
Dry Lake	Maximum	$9,500	$94,648	$2000	$6,000	$10,867	$123,015

[a] Includes labor costs for road, dike, structure, and treatment system maintenance and operation.
[b] Chemical costs shown are for treatment to 40 µg/l P or less, and would therefore be about 50 percent less if treatment is to 100 µg/l P.
[c] Sludge disposal costs are based on the assumption that they will be land-spread onsite. If hauled to a landfill, the costs will increase by about 4 (Davie) to 8 (Butler Oaks) fold.

The existing literature provided in the Task 1.3 literature review report, and discussions with individuals experience in using these materials indicate that the dewatering of 20 to 30 percent solids after a few months would be typical and that these materials will be workable for land-spreading. Use of underdrains in the dewatering basins would shorten dewatering times, but would only be needed if cleanouts were required more often than every 3 months. As indicated in the Task 1.3 report, there have also been no indications that alum flocs become unstable or cause any excess aluminum uptake or toxicity effects in plants after spreading. The floc might bind additional P in the field after land-spreading; therefore, land-spreading is still the recommended disposal method. Two potential alternative methods of disposal include burying the sludge onsite or stockpiling. These alternatives eliminate unstable alum flocs and excess aluminum uptake, but have the drawbacks of limiting future construction activities on the burial site and future disposal issues for the stockpiled material. One future use for the stockpiled material would be to stabilize abandoned waste pond(s) during future closure procedures. FDEP will require site-specific information before providing approval for onsite burial of the sludge material. Disposal of sludge in landfills is very costly and not recommended, but would eliminate all of the previously mentioned concerns.

All of the systems are expected to treat 100 percent of the runoff during a dry year. During an average year, the systems will treat between 85 and 90 percent of the runoff. Wet years reduce treatment to as low as 75 percent. Estimated average-year weighted stormwater runoff from the farms (Table 1) ranged between 116 and 385 ppb because of the amount of water bypassing each system and the different levels of treatment.

Treating stormwater to 100 ppb rather than 40 ppb results in potentially a 50 percent reduction in chemical use and related sludge production, which can translate to an annual operating cost reduction of slightly less than 50 percent. Moving from a final P concentration target of 40 to 100-ppb target represents only a 5 percent reduction in overall treatment effectiveness (Table 1).

Implementation Schedule

The 100-percent plus design reports for each dairy are provided in Appendices A, B, and C. These reports contain an implementation schedule for each dairy. A summary of the proposed implementation schedule is provided in Table 4.

Table 4. EOF Implementation Schedule

Task	2002		2003								
	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
Conceptual Design Completion											
100% Construction Drawings											
Construction Approval											
Construction permits obtained											
Final Construction Drawings											
Construction											
Substantial Completion											
Monitoring Plan and Installation											
Monitoring Started											
Operation Startup											

References

Dayton, EA and NT Basta. 2001. Chemistry and Bioavailability of Waste Constituents in Soils. 2001. J. Environ. Qual. 30:1653-1658

Basta, NT, EA Dayton, and LE Gallimore. 1999. Nutrient adsorption capacity of water treatment residuals. Agron. Abstr. p. 345.

APPENDIX A – Butler Oaks Dairy EOF Design Documents

Contents

Appendices

Section 1
Introduction

1.1 Background

The Soil and Water Engineering Technology, Inc. (SWET) Team was selected in December 2000 to complete the Dairy Best Available Technologies project (C-11652) for the South Florida Water Management District (SFWMD). The primary goal of this study to provide an unbiased selection, implementation, and monitoring of the Best Available Technologies to significantly reduce dairy industry phosphorus exports to the Okeechobee Basin and bring about the most effective and substantial water quality improvements in the shortest possible time.

As part of this project the SWET Team completed a detailed literature review of available technologies, completed a ranking of Okeechobee dairies for participation, completed nutrient assessment for selected dairies, and ranked and selected the most appropriate technology for meeting the District's goal of a 40 parts per billion (ppb) phosphorus concentration in stormwater runoff at the edge-of-farm. Edge-of-farm treatment (impoundment, water reuse, and chemical flocculation) of runoff was found to be the highest ranked method to reduce phosphorus discharge from the farm to meet the project's goals. Based on these findings, the SFWMD Governing Board authorized SWET to contract one or more qualified design/build firms to complete the construction phase of the project. The team of CDM Engineers and Constructors, Inc. (CDM E&C) and Royal Consulting Services, Inc. (RCS) was selected as a qualified design/build firm to perform these services for Butler Oaks Farm, Inc (Butler Oaks Farm).

1.2 Project Objectives

The primary objectives for this project are the design and construction of an edge-of-farm treatment system capable of retaining as much of the Butler Oaks Farm's stormwater discharge as possible, and reduction of phosphorus discharge from the site to as close to 40 ppb as possible.

A conceptual design of the treatment system was provided by SWET as a basis for the final design of the treatment system. The primary components for an on-site multi-stage stormwater pond with a final chemical treatment-finishing pond, consist of the following:

- A large retention impoundment for reduction of offsite discharge, also serving as a buffer reservoir for a chemical treatment system.
- A chemical treatment system consisting of a discharge pump or gravity feed structure with flocculant injection/mixing, and two settling ponds.

It was proposed that the treated effluent from the settling ponds would sheet flow to the nearest stream leaving the property. The primary design tasks for this project were to locate and size the above described system to the site specific conditions present at Butler Oaks Farm. The conceptual design as defined by SWET consisted of the following components:

- Interception ditches or diversion dikes for directing farm field runoff and seepage to the stormwater impoundment.
- A bypass structure for stormwater in excess of the design capacity of the system.
- Pump station(s) to lift stormwater into impoundment(s) (5,000 to 30,000 gpm capacity range anticipated).
- Impoundment, including dikes and emergency discharge structure.
- Pump or gravity flow structure that will provide chemical mixing before delivery to the two settling ponds (0.5 to 2 ac).
- A roofed coagulant storage facility with chemical injection pump and controls.
- A settling pond for collection of flocculant prior to final discharge.
- Piping to provide reuse water from the stormwater pond to the dairies' existing waste storage ponds for sprayfield application, barn flush water systems and cooling ponds.
- Total project budget including engineering services, surveying, permitting, construction and startup not to exceed $575,000.

1.3 Site Location and Description

The Butler Oaks Farm, Inc. encompasses approximately 1,838-acres of land, and is located in Sections 3, 4, and 5 in TS37S and R33E, Section 31 in TS36S and R33E, and Section 36 in TS36S and R32E, approximately 14 miles to the northwest of Okeechobee, Florida. The property is accessed from County Road 721 (see **Figure 1-1**).

Table 1-1 describes the land use, cover type (where applicable), and size for each delineated area on the farm. **Figure 1-2** shows the layout of the entire farm, including the western forage production/solids application area, location of each field, and land uses for each area. **Figure 1-3** shows the layout of the eastern portion of the farm. Hay is the only crop that is harvested on the farm. In a typical year, approximately 5,350 tons are harvested. All of the hay that is harvested is used on site.

The predominant breed of dairy cattle on the farm is Holstein. Over the past twelve months, the farm's total head count has averaged 1,060, with a lactating population of 750 head. The remaining 310 head consists of approximately 50 dry cows, 80 springers, 30 cows in the hospital herd, and approximately 150 head that are culled each year. The high production lactating population is divided into two herds of 165 head each; the low producers are divided into three herds of 140 head each.

Design/Build Phase of the Dairy Best Available Technologies Project for Butler Oaks Farm, Inc.

SFWMD Contract C-11652

February 2003

Design Report

Royal Consulting Services, Inc.

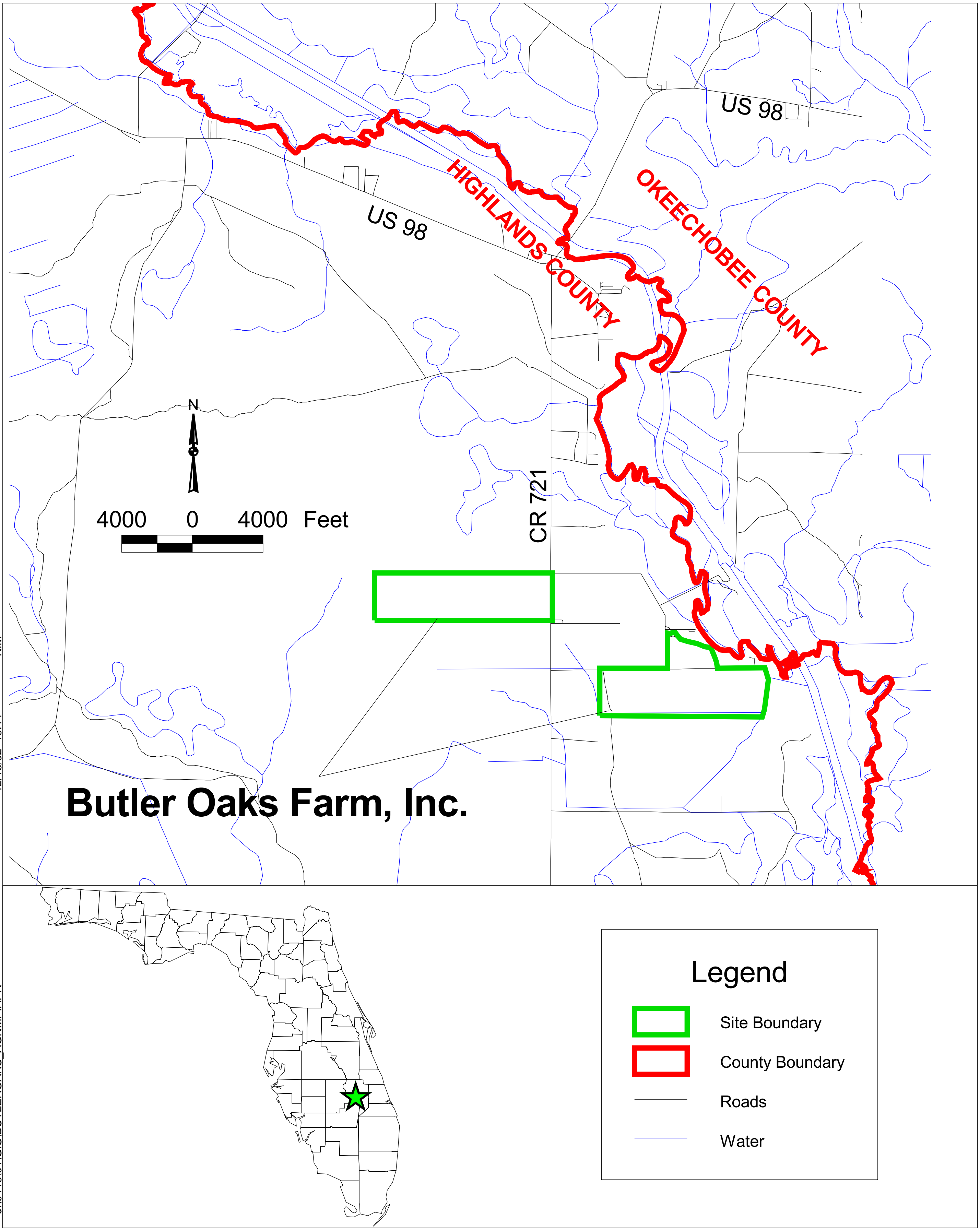

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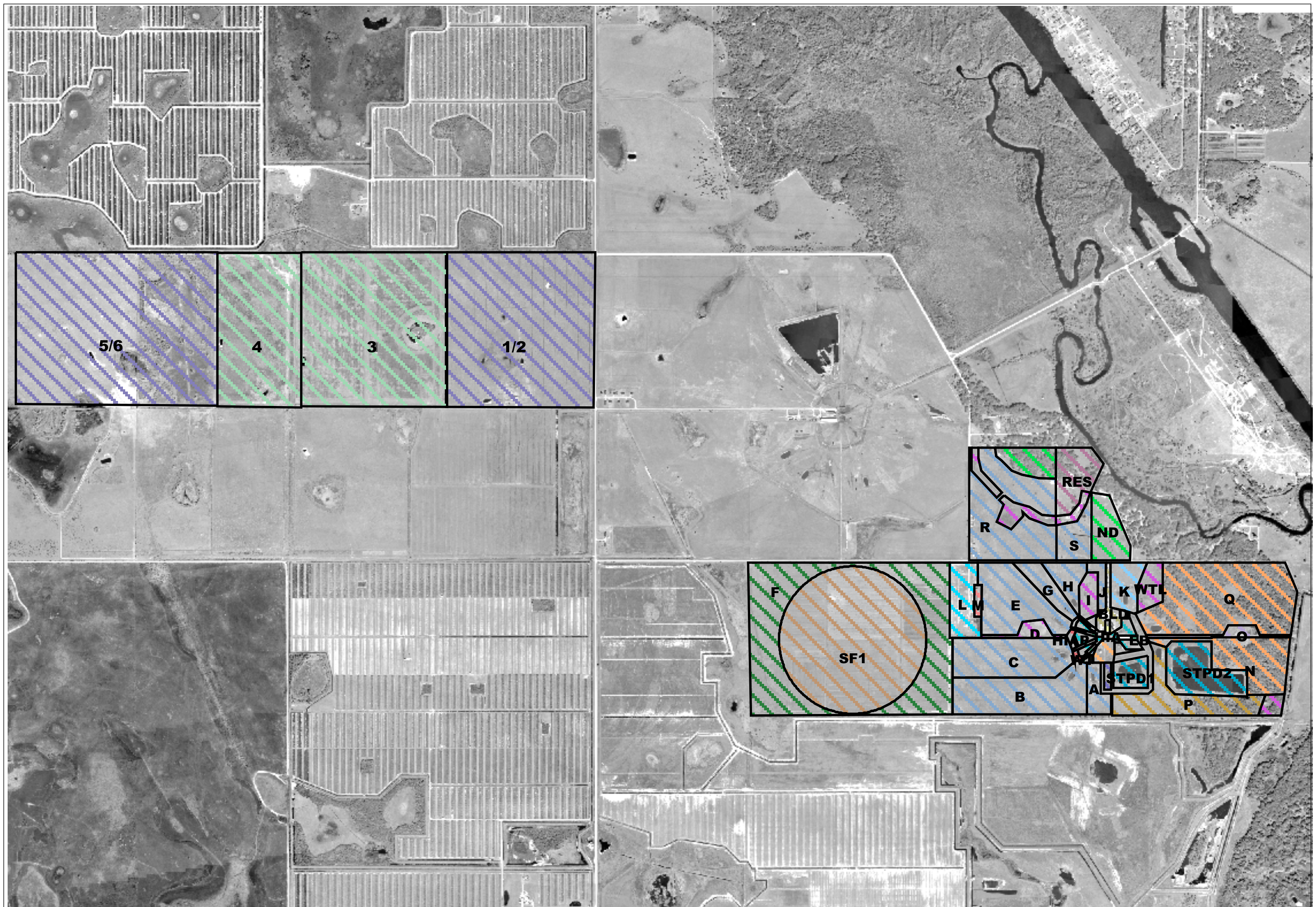
Figure 1-1
Site Location Map

Table 1-1
Farm Land Use and Acreage
Butler Oaks Farm, Inc.

Field Designation	Description/ Land Use	Animal Type	Vegetative Cover (If Applicable) *	Acres
A	Field	Hobbled Herd	S	6.7
B	Field	Heifers	B, S	37.2
BP	Beef Pasture	Beef Herd	B, S, P	506.7
C	Field	Heifers	B, S	32.5
D	Field			4.6
E	Field	Heifers	B, S	30.6
EB	East Barn			0.6
F	Hay		S	95.4
Facilities/Commodities	Facilities/Commodities			5.0
Forage Prod./Solids App.	Forage Prod./Solids App.		B, S	617.7
G	Field	Fresh Cows	B, S	8.6
HIA	HIA			7.0
HIA Perimeter	HIA Perimeter			1.5
I	Field		S	5.6
J	Field	Assorted Head	B	4.1
K	Springers	Calving Herd	S	10.0
L	Field	Not in Use	B	14.5
Lagoon	Lagoon			1.3
M	Calf Barn	Not in Use		1.5
MH	Manure Handling			1.0
MP	Milking Parlor			0.4
N	Field	Not in Use	partially wooded	8.4
N	Pasture	Not in Use		26.0
O	Field			4.9
P	Historical Sprayfield	Lactating Herd	S	26.5
Q	Pasture	Lactating Herd	wooded	67.6
R	Pasture	Dry Cows	B	48.8
Residential	Residential		B	16.1
S	Pasture	Horses/ Cow Staging	B	24.7
SF1	Sprayfield		B, S	118.5
Solids Area	Solids Area			3.0
STPD1	Waste Storage Pond			6.9
STPD2	Waste Storage Pond			23.0
W1	Feed Barn			0.6
W2	Feed Barn			0.2
W3	Feed Barn			0.2
W4	Feed Barn			0.2
Water	Water			38.5
Wetland	Wetland			21.6

* S = stargrass, B = bahia, P = pangola



Legend

Land Use Type

- Calf Barn
- East Barn
- Facilities/Commodities
- Feed Barn
- Field
- Forage Production
- Forested Pasture
- HIA
- HIA Perimeter
- Hay
- Historical Sprayfield
- Lagoon
- Manure Handling
- Milking Parlor
- Non Dairy
- Pasture
- Residential
- Solids Application
- Solids Area
- Sprayfield
- Springers
- Storage Pond
- Travel Lane
- Wetland

N

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Figure 1-2
Land Use Map for Butler Oaks Farm, Inc.

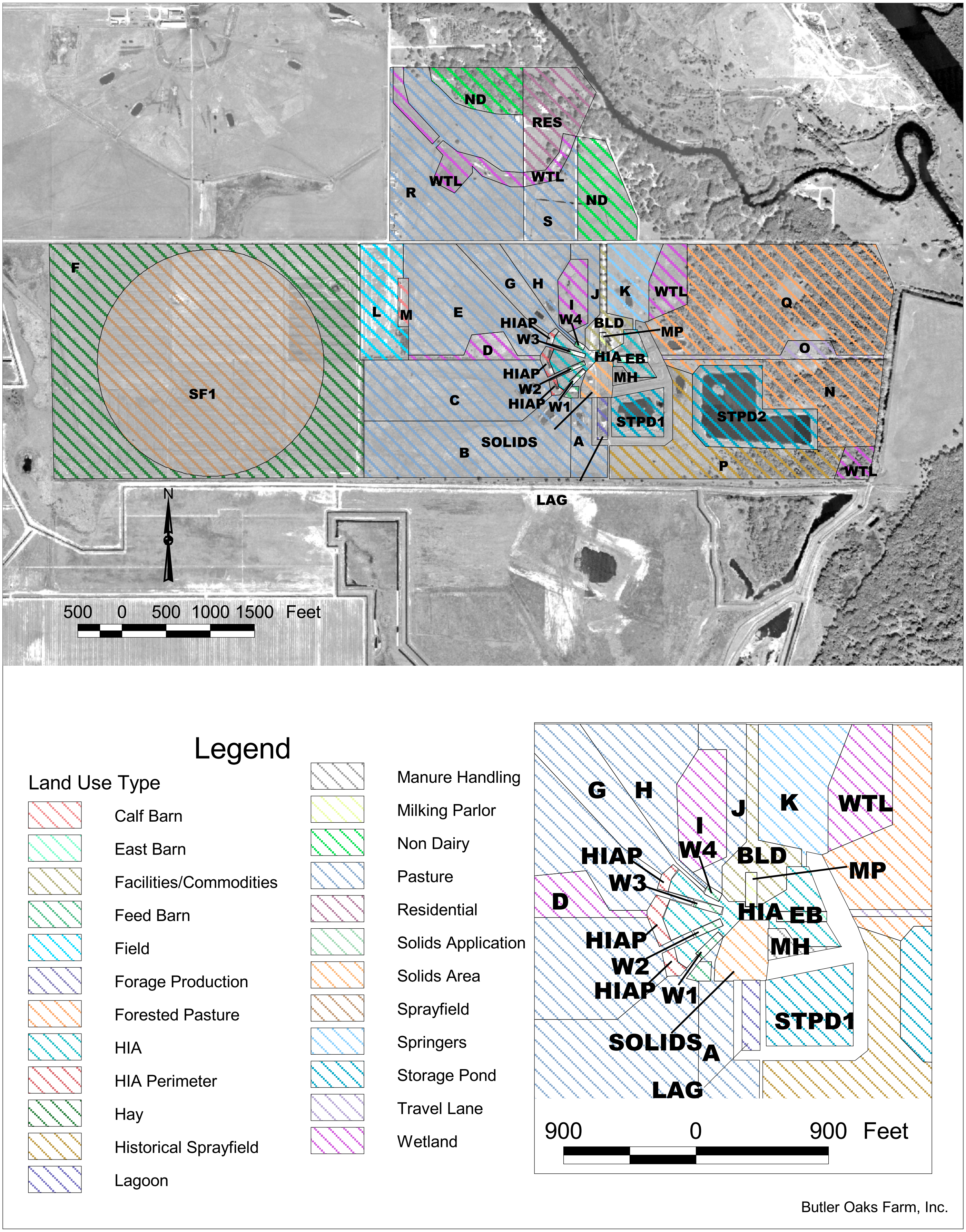

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Figure 1-3
Land Use Map for the Study Area

Manure is collected in and around the barns and stored in the high intensity area for drying. It is spread, as needed, on the irrigated field, hay field, or low use pastures. The farm's records for 2000 indicate that 1008 tons of manure was spread on a total land area of 225-acres. Solids are not removed from the farm. Approximately 8.6 million gallons of wastewater were pumped from the waste storage pond to the irrigated field in 2000. The waste storage pond sediment trap is typically cleaned out once every 10 years. The end of the solids trap was last cleaned out in April 1999. The sludge is placed in the manure dry storage area and is spread in hayfields or non-lactating and minimum-use pastures, when needed.

The Natural Resources and Conservation Service (NRCS) waste management system operation and maintenance plan for the Butler Oaks Farm was constructed in the early 1990s. The system was designed for a population of 990 milking cows, assuming a live weight of 1,200 pounds. The design storm selected to size system components was a 24-hour 25-year storm event (8.2-inches of rainfall). Additionally, a barn wash flow of 55,000 gallons per day was assumed. System components included the following:

- A 17.5-acre high intensity area (HIA) and ditch that surrounds the barn. Barn wash water and runoff from the HIA drains via the HIA ditch to a solids separation lagoon (solids trap).
- Two waste storage ponds (a 7-acre STPD 1 and a 23-acre STPD 2) designed to contain barn wash water and runoff from the high intensity area after it passes through the solids separation lagoon.
- A 214-acre hay and greenchop area within which a center-pivot irrigation system is located. Water from the waste storage pond is pumped to the 118-acre irrigated field via a 1,090-gpm pump. The design maximum application rate to the irrigated field was 0.28-inch over a 24-hour period.
- Subsurface drains in the high intensity area to convey water to the high intensity ditch.

Section 2
Existing Site Conditions

2.1 Hydrology and Topography

The area within which the Butler Oaks Farm is located, the Lower Kissimmee River Basin, generally drains to the south towards Lake Okeechobee. The region is particularly flat, with elevation changes typically on the order of two to three feet per mile. There are no identified karst features on the site. Based on a review of applicable USGS quad maps:

- Approximately 15-acres drain internally to the high intensity area lagoon (from which water is pumped into Waste Storage Pond 1).
- Approximately 110-acres of Butler Oaks Farm drains to the east.
- Approximately 2196-acres of land drains to a ditch along the southern boundary of the farm including land on B-4 Dairy and citrus land to the west of property.
- Approximately 81-acres of Butler Oaks Farm drains to the northeast.

Figure 2-1 shows the estimated surface water flow pattern onto and off the eastern portion of the farm, as well as within the farm's boundaries.

Hydrologic unit boundaries were delineated by assessing additional information obtained from four sources: (1) a digital aerial photograph of the region encompassing the farm, (2) topographic survey completed for the project, (3) information provided by Soil and Water Engineering Technologies, Inc. (SWET), and (4) conversations with the farm owner. In general, natural physical features or constructed stormwater conveyance systems that control and direct stormwater runoff to a common outfall define hydrologic units. For the purpose of this study, the Butler Oaks Farm was subdivided into four hydrologic units, ranging in size from 67.81 acres to 304.96 acres, as is shown on **Figure 2-2**.

2.2 Soils

A soils map of the Butler Oaks Farm is provided as **Figure 2-3**. The soil map units occurring within the farm boundaries fall into two general groups: (1) soils of the flatwoods, hammocks, and sloughs, and (2) soils of the swamps, marshes, and flood plains. Both groups of soils are nearly level, poorly drained, sandy soils with high runoff potential if not ditched. These soils typically have a low phosphorus retention potential and can therefore leach phosphorus if phosphorus loading exceeds crop phosphorus uptake. An organically coated subsoil is present in some locations and some areas are subject to ponding or flooding. Specific soil types located on the Butler Oaks Farm include: Basinger and Placid depressional; Basinger fine sand; Immokalee fine sand; Valkaria fine sand; Felda

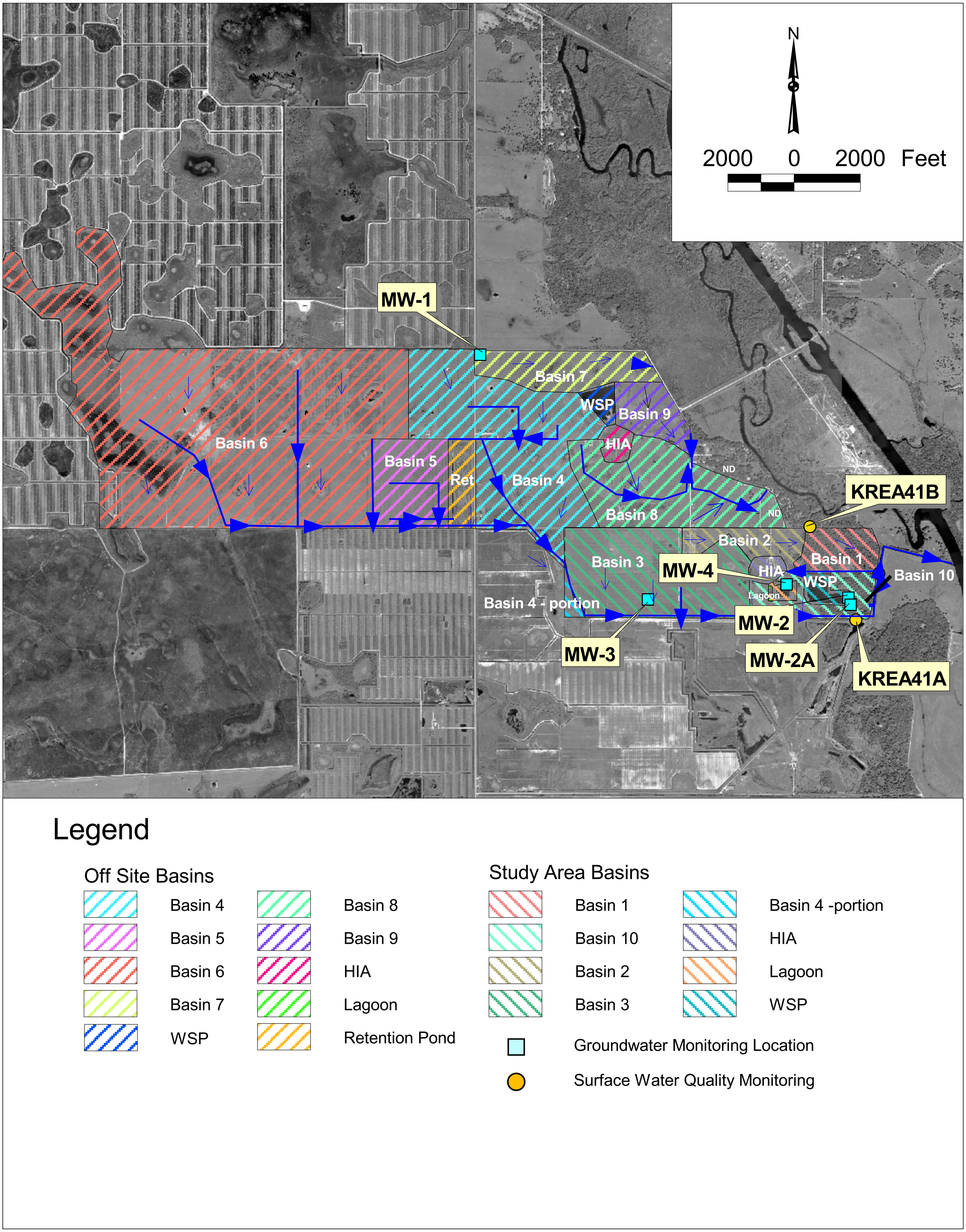

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Figure 2-1
Surface Water Basins

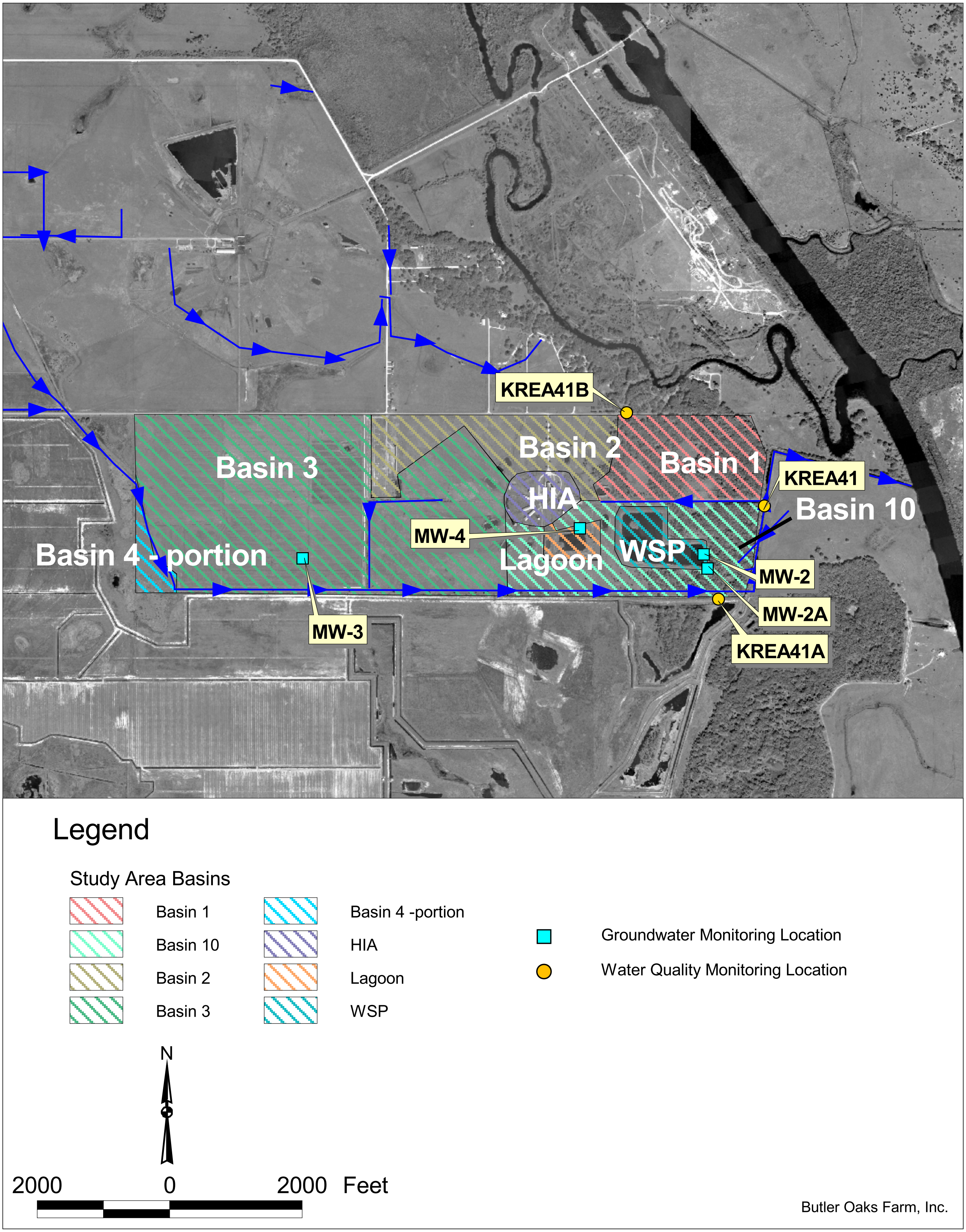

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Figure 2-2
Study Area Surface Water Basins

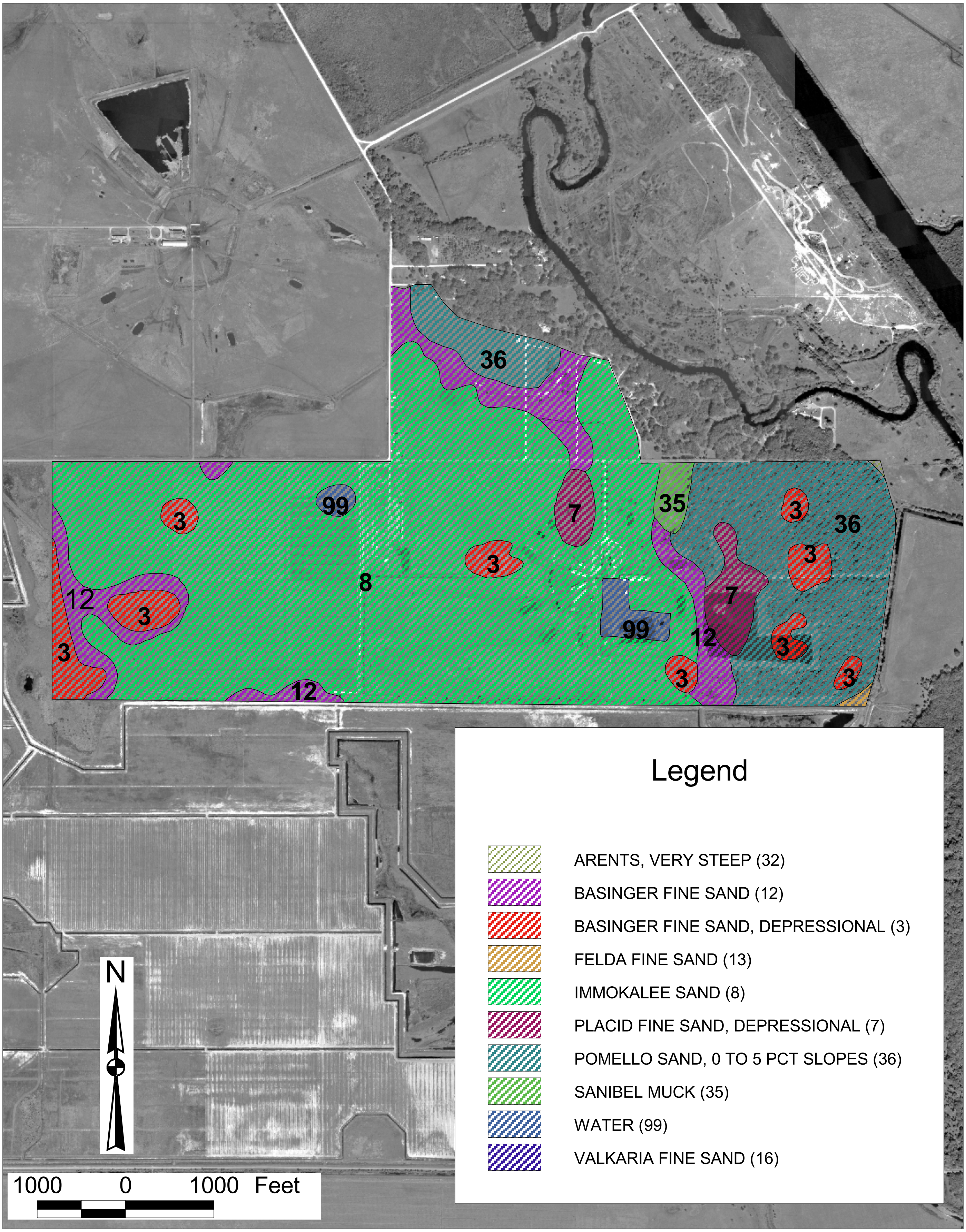

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Figure 2-3
Study Area Soil Types

fine sand; Tequesta muck; Sanibel muck; Avents, very steep; Pomello sand, 0-5% slope; Manatee, Delray, and Okeelantana soils.

The soil data was used to evaluate stormwater runoff, infiltration, and recharge potential for pervious areas. Information on soil types was obtained from the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) Soil Survey of Highlands County, Florida. Based on its research, the NRCS has developed soil series and "hydrologic soil groups", which characterize soil types according to their drainage potential. The hydrologic soil group categories are commonly used to evaluate runoff potential from a given soil type. Soils having very high infiltration potential and low runoff potential have been assigned to Hydrologic Soil Group A. Soils with very low infiltration potential and a high runoff potential have been assigned to Hydrologic Soil Group D. Soils included in Hydrologic Soil Groups B and C have infiltration and runoff characteristics that fall somewhere between these two extremes. For the purposes of this study, dual class soil groups were conservatively assigned to the Hydrologic Soil Group with the lowest infiltration potential. For example, soils that were classified within Group A/D were assigned to Hydrologic Soil Group D. The percentage of each Hydrologic Soil Group within the four hydrologic units delineated for the Butler Oaks Farm is listed in **Table 2-1**.

Table 2-1 Percentage of Hydrologic Soil Group within Hydrologic Units

Hydrologic Unit ID	Percent By Hydrologic Unit				
	Group A	Group B	Group C	Group D	Total
Basin 1	0%	0%	11%	2%	13%
Basin 2	0%	0%	0%	13%	13%
Basin 3	0%	0%	0%	58%	58%
Basin 10	0%	0%	7%	9%	16%
Grand Total	0%	0%	18%	82%	100%

2.3 Phosphorus Concentration in Soils

In July 2002, the Florida Department of Agriculture on Consumer Services (FDACS) provided phosphorus concentrations of onsite soil samples collected at Butler Oaks Farm. The samples were analyzed at the University of Florida, IFAS laboratory using the Mehlich 1 and water soluble phosphorus extraction methods. Other miscellaneous parameters, such as pH, potassium and lime requirement were also measured. Soil samples were collected with the following frequencies:

- High Intensity Areas (HIAs) - one sample per acre
- Pasture areas - one sample per five acres, and
- Forage areas - one sample per 20 acres

The soil samples collected were logged in the field using a global positions system (GPS) to accurately identify the sample location. **Figure 2-4** summarizes the results of the phosphorus concentrations found in the field samples.

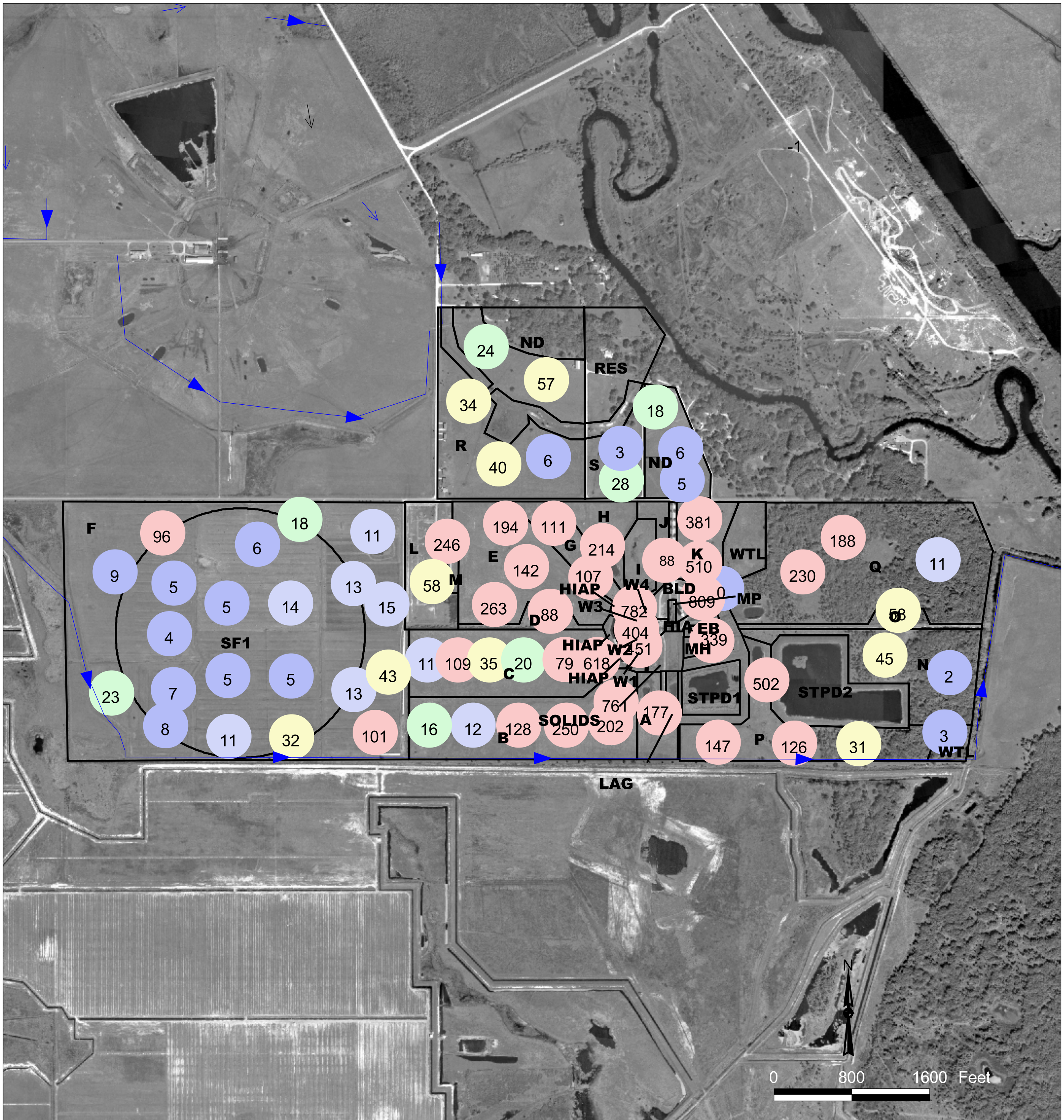
2.4 Wetland Assessment and Preliminary T&E

In May 2002, a wetland assessment and preliminary T&E study was conducted by C&N Environmental Consultants, Inc. on Butler Oaks Farm. This study concluded that five wetlands, comprising approximately 5.16 acres exist on the site, including approximately 0.49 acres of maidencane marsh and 4.67 acres of wet prairie. Preliminary wetland boundaries, delineated using federal and state criteria by C&N are identified on **Figure 2-5**. Exotic and nuisance species have invaded these wetland systems and have reduced the number and diversity of native species (C&N, 2002).

On December 12, 2002 the wetland determination performed by C&N was re-evaluated by the Highlands County NRCS wetlands specialist to the NRCS standards. Additional wetlands were identified from the wetland delineation previously prepared for this study by a certified wetland specialist. A complete wetland determination was completed in February 2003 by the NRCS. The preliminary results of the NRCS wetland determination are currently under review by the Army Corp of Engineers. The results of this draft report are also presented on Figure 2-5.

The threatened and endangered species random survey identified five listed species, including crested caracara (Caracara plancus), sandhill cranes, burrowing owl, gopher tortoise, and butterfly orchids (Encyclia tampensis). Figure 2-5 also identifies the location of species spotted.

Each of the plants and animals identified in the study were flagged in the field, the immediate habitat was then identified by state certified biologists. The proposed design encroaches on an area in which gopher tortoises were identified. In an effort to protect the gopher tortoises found in this designated construction area a Gopher Tortoise Relocation Permit was obtained from the Florida Fish and Wildlife Conservation Commission. A copy of this permit is provided in **Appendix A**. This permit recently expired and a new permit application, along with a reevaluation of the gopher tortoise survey required before the gopher tortoise relocation can commence. The gopher tortoise survey reevaluation was completed in February 18, 2003 and showed less tortoise activity. The permit application is currently being updated



Legend

Mehlich-P Concentrations

- VLOW < 9 ppm
- LOW (10 - 15 ppm)
- MED (16 - 30 ppm)
- HIGH (31 - 60 ppm)
- VHIGH (> 60 ppm)

- Land Use Boundary
- General Flow Direction

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Figure 2-4
Phosphorus Concentration in Soil

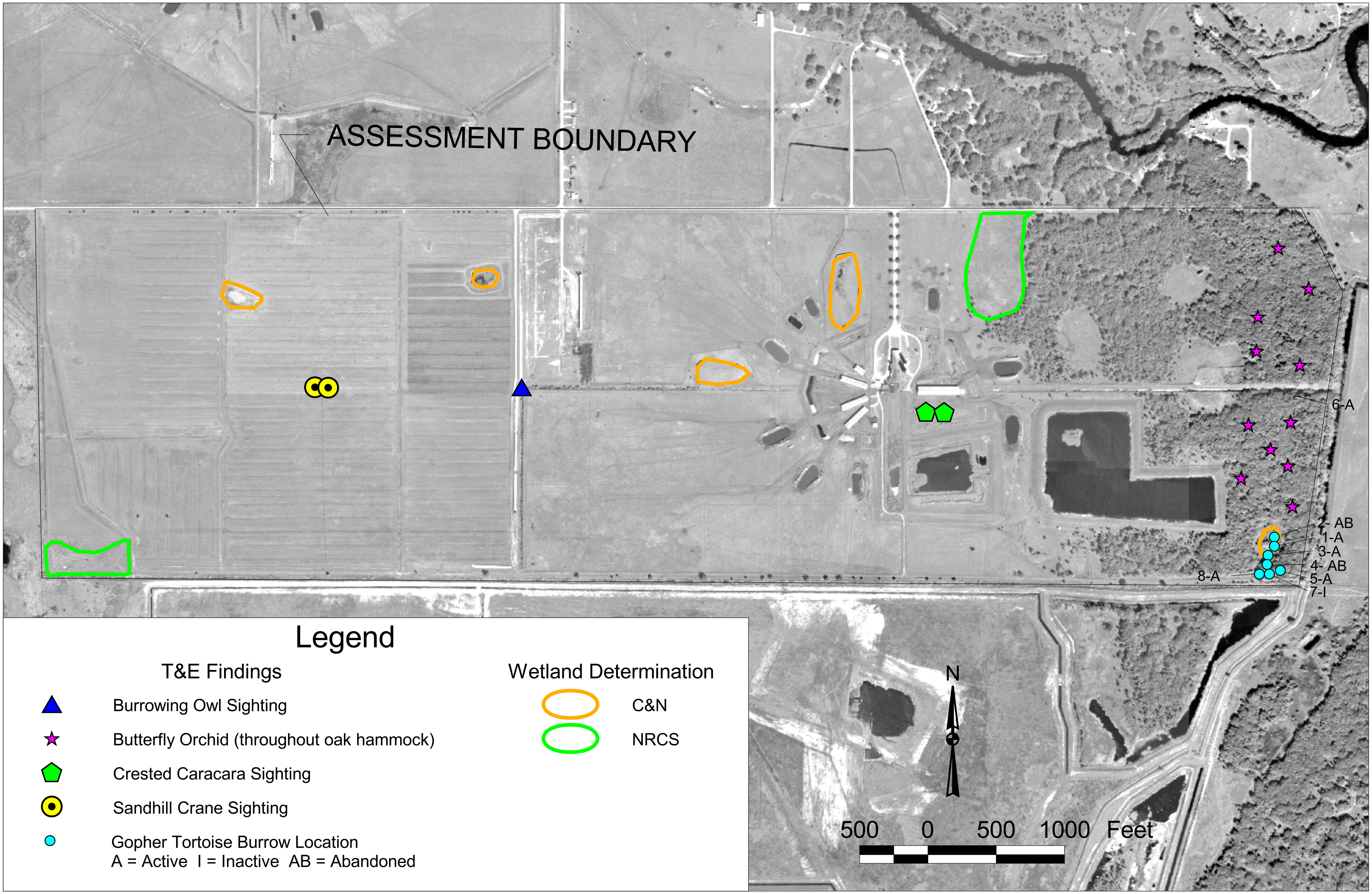

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Figure 2-5
Results of Wetland and T&E Study

Section 3
Surface Water Modeling

3.1 Introduction

Three different modeling approaches were used to estimate the quantity of surface water runoff to be managed as part of the proposed edge-of-farm treatment system for the Butler Oaks Farm. These models included Win TR-55, Hydrologic Model Version 1.2 (HM), and TRTSTORM. Win TR-55, a single-event, rainfall-runoff small watershed model is a public domain model developed by the Natural Resources Conservation Service (NRCS). Based on the same principles of TR-55, HM, developed by Engineering & Water Resources, Inc., is a spreadsheet based water balance model. TRTSTORM, developed by CDM in 1993, provides a method of simulating the operation of wet weather storage facilities. The general principles on which these models are developed on are summarized below.

3.2 Model Selection

The use of the three different models provides for a range of anticipated results based on various modeling parameters. Various model input and output from the simulations is presented in **Appendix B**.

3.2.1 Win TR-55

Win TR-55 generates hydrographs from sub-areas by means of the NRCS hydrograph generation technique using the appropriate rainfall depth (for a specific frequency), rainfall distribution, sub-area drainage area, time of concentration (Tc), and curve number. The program uses a Muskingum-Cunge method of channel routing, and the storage-indication is then used to route structure hydrographs (NRCS, 2002).

3.2.2 HM

In a similar fashion to the Win TR-55, HM spreadsheet uses the daily rainfall to calculate available soil storage to generate a Curve Number. Runoff quantities can then be generated using the simple SCS Method. Quantities of runoff are added to the water budget for the storage basin to evaluate the percent capture of runoff.

3.2.3 TRTSTORM

TRTSTORM uses the same general algorithms used in HEC-STORM. Based on the Rational Method, a single C coefficient and depression storage are used by the model to compute runoff. The model also allows for the simulation of treated overflow and decanting from storage facilities in the model.

3.3 Model Development

3.3.1 Win TR-55

Rainfall Intensities and Quantities

Specified rainfall data were used to generate stormwater runoff hydrographs for each hydrologic unit in the hydrologic model. Observed rainfall data are generally characterized by an amount (depth, measured in inches), intensity (inches per hour), frequency or occurrence (return period, in years), event duration (hours), spatial distribution (local variance), and temporal distribution (time variance). Design storm events are typically named by the return period of the rainfall depth and by the event duration. For example, a 25-year/8-hour design storm event describes a rainfall depth over an 8-hour period that has a 4-percent (1 in 25) chance of occurring at a particular location in any given year.

For this study, the 2-, 3-, 5- 10-, 25-, and 100-year design storm events using durations of 24-hours under existing land use and existing hydraulic conditions were simulated. If available, design storm event depths were derived from rainfall curves included in the "Surface Water Design Aids" section of Volume IV of the South Florida Water Management District (SFWMD) *Environmental Resource Permit Information Manual* (2000). Storm event depths for storm durations that had no rainfall curves available were estimated from the trend shown by available SFWMD curves. Rainfall depths selected for simulations were as follows:

- 2-year return period/24-hour event duration = 3.5-inches of rainfall (trend-based estimate)
- 3-year return period/24-hour event duration = 4.0 inches of rainfall (SFWMD curve)
- 5-year return period/24-hour event duration = 4.5 inches of rainfall (SFWMD curve)
- 10-year return period/24-hour event duration = 5.0 inches of rainfall (SFWMD curve)
- 25-year return period/24-hour event duration = 6.5 inches of rainfall (SFWMD curve)
- 100-year return period/24-hour event duration = 8.0 inches of rainfall (SFWMD curve)

Overland Flow Parameters

WinTR-55 uses overland flow data in the form of hydrologic unit widths and average surface slopes to create a physically based overland flow plane that generates the stormwater runoff. The overland flow path length was calculated as the average slope over the flow path length and is calculated by dividing the difference in elevation by the hydraulic length. The length and slope data that were estimated from the topographic survey that was performed for the project are shown in **Table 3-1**.

Existing Land Use and Impervious Areas

Existing land use on the Butler Oaks Farm study area is almost entirely pasture (improved and unimproved), grassland, or wooded area. Impervious areas within the study area constitute a very small percentage of the total land use and consist primarily of the farm's limerock access road off of Boat Ramp Road, the milking parlor, grain silos, various feed barns, etc. Of the land use category options WinTR-55 offers, all basin areas were described as "fair pasture, grassland or range". The

Table 3-1
Butler Oaks Edge of Farm Treatment System

Overland Flow Parameters

Basin	Identifier	Flow Length (ft)	Slope (ft/ft)	Manning's n	Travel Time (hr)	Time of Concentration (hr)
B1	Sheet	100	0.0060	0.24	0.925	
	Shallow	1,100	0.0034	3.50	0.325	
	Channel	730	0.0011	--		
						1.25
B2	Sheet	100	0.0010	0.24	0.754	
	Shallow	3,600	0.0024	3.50	1.265	
						2.02
B3	Sheet	100	0.0020	0.24	0.571	
	Shallow	1,440	0.0020	3.50	0.554	
	Channel	7,895	0.0010			
						1.13
B10	Sheet	100	0.0030	0.24	0.486	
	Shallow	3,900	0.0026	0.05	1.317	
						1.80

curve numbers generated by the selected land use descriptions for the farm are presented in **Table 3-2**.

Model Results

System storage was considered to be relatively small, and to be conservative was excluded from the model representation of the farm. The hydrograph peak flows, times to peak, runoff amount and runoff volumes for each of the basin areas are presented in **Table 3-3**. The 10-yr/24-hr storm was selected for design of the proposed edge-of-farm treatment system. As is indicated in Table 4-3, the model estimates that the following peak flows will result from a 10-yr/24-hour design storm:

- 78 cubic feet per second (cfs) at the outlet of basin B1,
- 66 cfs at outlet of basin B2,
- 415 cfs at the outlet of basin B3, and
- 81 cfs at the outlet of basin B10.

If all of the runoff from the farm resulting from a 10-yr/24-hr storm were to be impounded, approximately 139 acre-feet of storage volume would be required. The proposed edge-of-farm treatment system will include a wet detention storage volume of approximately 50 acre-feet. As a comparison, according to Section 5.2.1, "Volume Requirements" of the *Basis of Review for Environmental Resource Permit Applications Within the South Florida Water Management District* (August 2000):

> "Wet detention volume shall be provided for the first inch of runoff from the (entire) developed project, or the total runoff of 2.5 inches times the percentage of imperviousness, whichever is greater."

If this requirement were applied to the 524.42-acre project area, the required wet detention volume would be 43.7 acre-feet.

The results of the model show 93 percent of the runoff generated on the project site from a 10-yr/24-hr design storm can be detained and treated within the 51.6 acre-ft onsite stormwater detention system.

3.3.2 HM

HM is a simple mass balance model with very few input parameters. Input for the conceptual design includes:

- Soil holding capacity based on the soils hydrologic group
- Storage pond depth, area, volume, and pump down time

Table 3-2
Butler Oaks Edge of Farm Treatment System

Basin Land Use and Curve Number Details

Basin	Land Use *Basin Summary*	Hydrologic Soil Group	Basin Area (ac)	Curve No.
B1	Pasture, grassland or range (fair)	A	0.05	49
	Pasture, grassland or range (fair)	C	56.94	79
	Pasture, grassland or range (fair)	D	11.72	84
	Total Area / Weighted Curve Number		*68.71*	*80*
B2	Pasture, grassland or range (fair)	C	1.89	79
	Pasture, grassland or range (fair)	D	65.92	84
	Total Area / Weighted Curve Number		*67.81*	*84*
B3	Pasture, grassland or range (fair)	D	304.96	84
	Total Area / Weighted Curve Number		*304.96*	*84*
B10	Pasture, grassland or range (fair)	C	35.63	79
	Pasture, grassland or range (fair)	D	47.31	84
	Total Area / Weighted Curve Number		*82.94*	*82*

Table 3-3
Butler Oaks Edge of Farm Treatment System

Win TR-55 Model Results

ID	B1	B2	B3	B10
Basin Area (ac)	68.71	67.81	304.96	82.94
2 Year 24 Hour Storm				
Peak Flow (cfs)	43.7	38.8	245.6	46.8
Time of Peak (hrs)	12.7	13.2	12.6	13.1
Runoff (in)	1.6	1.9	1.9	1.8
Runoff Vol (ac-ft)	9.3	10.9	49.2	12.3
Impoundment Area Needed [1] (ac-ft)				81.7
3 Year 24 Hour Storm				
Peak Flow (cfs)	54.9	47.6	302.1	57.9
Time of Peak (hrs)	12.7	13.2	12.6	13.0
Runoff (in)	2.0	2.4	2.4	2.0
Runoff Vol (ac-ft)	11.7	13.4	60.2	14.1
Impoundment Area Needed [1] (ac-ft)				99.3
5 Year 24 Hour Storm				
Peak Flow (cfs)	66.5	56.6	359.1	69.6
Time of Peak (hrs)	12.7	13.2	12.6	13.0
Runoff (in)	2.5	2.8	2.8	2.6
Runoff Vol (ac-ft)	14.1	15.9	71.6	18.2
Impoundment Area Needed [1] (ac-ft)				119.7
10 Year 24 Hour Storm				
Peak Flow (cfs)	78.4	65.6	415.4	81.2
Time of Peak (hrs)	12.7	13.2	12.6	13.0
Runoff (in)	2.9	3.3	3.3	3.1
Runoff Vol (ac-ft)	16.5	18.4	83.1	21.2
Impoundment Area Needed [1] (ac-ft)				139.3
25 Year 24 Hour Storm				
Peak Flow (cfs)	115.0	93.0	590.1	117.2
Time of Peak (hrs)	12.7	13.2	12.5	13.0
Runoff (in)	4.2	4.7	4.7	4.4
Runoff Vol (ac-ft)	24.2	26.3	118.6	30.7
Impoundment Area Needed [1] (ac-ft)				199.8
100 Year 24 Hour Storm				
Peak Flow (cfs)	152.1	121.0	767.3	153.5
Time of Peak (hrs)	12.7	13.2	12.6	13.1
Runoff (in)	5.6	6.1	6.1	5.9
Runoff Vol (ac-ft)	32.2	34.4	154.9	40.5
Impoundment Area Needed [1] (ac-ft)				261.9

[1] To completely contain runoff from project area

- Runoff area, runoff reduction factor
- Monthly evaporation rates
- Daily rainfall totals
- Pumping capacity

A complete listing of the model input and results is presented in Appendix B. The results of the model show 96 percent of the runoff generated on the project site receives treatment.

3.3.3 TRTSTORM

TRTSTORM is also a simple model with very few input parameters. Input for the conceptual design includes:

- Runoff area and composite rational "C" coefficient
- Depressional storage
- Monthly evaporation rates
- Treatment volumes and treatment rates
- Hourly rainfall totals

A complete listing of the model input and results is presented in Appendix B. The results of the model show a 97 percent of the runoff generated on the project site receives treatment.

3.4 Summary of Results

The results of the model were as follows:

1. Each of the three model simulations indicated that for the project study area, a 90 percent treatment rate of all runoff can be expected.

2. Only 17 untreated discharge events were predicted over the 30 years of recorded rainfall data used in the modeling analysis. This results in approximately one discharge event occurring in every two years, or less than one discharge event per year.

3. Additional modeling is recommended to verify the dynamic response of the increase in stage in the canals and ditches on the drainage of the pastures.

Section 4
Conceptual Design

4.1 Permitting Considerations

Butler Farms Inc. currently operates under Florida Department of Environmental Protection (FDEP) wastewater permit (No. FLA013655-001-IW4A). According to conversations held with FDEP, the South Florida Water Management District, and Dr. Del Bottcher, the proposed improvements to the project site outlined in the preliminary design will fall under this existing permit, with the exception of a required wetland assessment and threatened and endangered species assessment (T&E). All other permit issues associated with the construction of this project will be addressed in future permit modifications.

4.2 Conceptual Design

To cost-effectively meet the project objectives stated in Section 1, several versions of the conceptual stormwater plans were evaluated. Anticipated limitations on capital costs, operations and management costs, landowner preferences, etc. were all considered in the development of the preliminary design. Multiple conceptual designs evaluated by SWET, SFWMD, CDM and the landowner. During the review process of these various versions of the conceptual design several additional design limitations were imposed by the project team. These limitations included:

- The landowner indicated that the removal of trees located along the eastern edge of the property should be avoided. (May 2002)
- SFWMD/SWET mandated 3:1 side slopes for all containment berms. (September 2002)
- SFWMD/SWET indicated that due to cost restraints all backup systems, automated controls, and sludge distribution equipment were considered optional and would only be included if there were remaining funds available. (December 2002)
- SFWMD/SWET mandated that the chemical treatment system use alum as its coagulant. (December 2002)
- SFMWD/SWET indicated that in sizing the settling basin a 4-hour settling time must be used.(November 2002)

Stormwater flows were evaluated for both portions of the farm, (both east and west of CR 721). However, due to the relatively low phosphorus levels on the forage lands west of CR 721, these areas were not included as part of this study. Therefore, the focus of this conceptual design is on the main farm located east of CR 721, and is herein referred to as the project site. **Figures 4-1** and **4-2** show the proposed conceptual design for the project site. Major components of the conceptual design include:

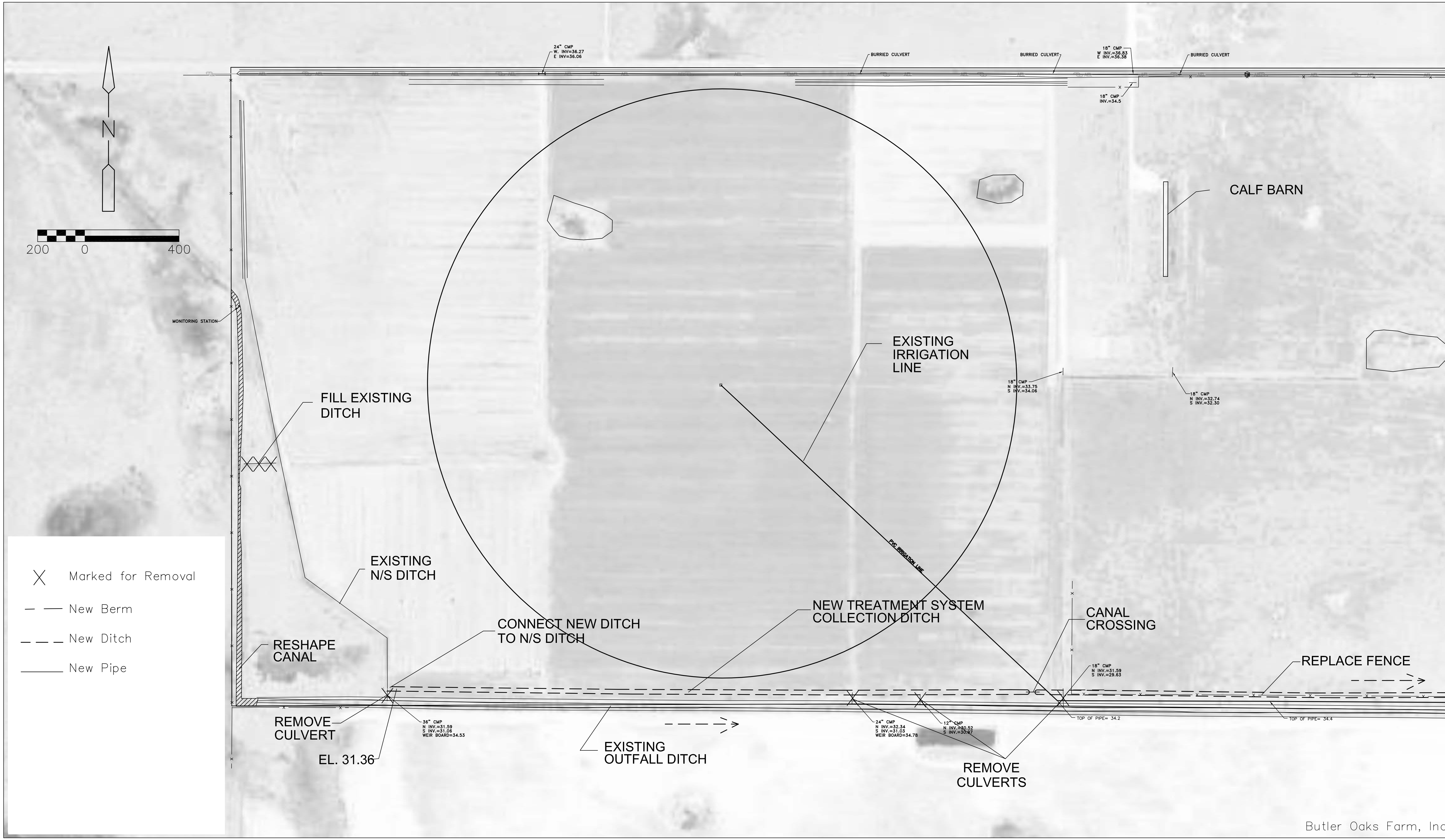

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Figure No. 4-1
Conceptual Design Western Portion of Site

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Figure No. 4-2
Conceptual Design Eastern Portion of Site

Western Portion of the Project Site (Figure 4-1):

- Reshaping of the existing bypass - water with low phosphorus concentration originating west of CR721 from the portion of the farm outside of the study area, will be allowed to bypass the proposed treatment system by following the existing outfall canal to the east to be discharged into the Kissimmee River.

- A new treatment system collection ditch will be constructed parallel to the existing outfall canal to collect runoff from the study area. It will connect to the existing north/south (N/S) ditch to collect all runoff from the irrigated fields, which currently receive water from the water storage pond.

- In the western portion of the site the water within the collection ditch flows east to the treatment system located south of the waste storage pond.

- Several culverts need to be removed.

- The existing pasture fence will need to be relocated.

- A canal crossing will be constructed.

Eastern Portion of the Project Site (Figure 4-2):

- A berm will be constructed around the perimeter of stormwater detention area. The berm will have 2 foot freeboard over the control elevation of 31.0 feet NGVD.

- To the north, stormwater from the pastures and road will be diverted into a north transmission ditch which conveys water south to the existing central ditch. The north transmission ditch will have a bottom of channel elevation of 26.0 feet NGVD. The water will then flow east to the south transmission ditch.

- The south transmission ditch will also have a bottom elevation of 26.0 feet NGVD. Water in the ditch will flow south to the new treatment system collection ditch, were it will then flow west to the treatment system.

- Stormwater is treated at the treatment system using two parallel coagulant injection systems with a 1.0 acre settling pond. Treated discharges from the settling ponds are sent to the existing outfall canal.

- Two emergency overflows are located between the stormwater detention area and the existing outfall canal at an elevation of 31.0 feet NGVD.

- The pump from the treatment system ditch will also have the ability to send untreated water to the existing waste storage ponds to be used for irrigation through the existing system.
- A sludge drying bed adjacent to the treatment system will be used to dewater sludge manually pumped from the bottom of the settling pond.

4.3 Water Attenuation and the Probable Affect on Existing Vegetation

The affect of re-directing water into the existing oak hammock located in the southeast corner of the Butler Oaks Farm parcel during storm events was evaluated. C&N Environmental Consultants, Inc. was requested to provide an opinion regarding the ability of the oaks to maintain their present health, based on the following criteria:

- Following a storm event, the maximum depth of water held in the hammock will be 18 inches, with an overflow structure to remove water in excess of this 18-inch depth.
- The water will be held at 18 inches for one day, and will then be lowered to 12 inches via a pump system.
- By the third day, the water will be at 6 inches.
- By the end of the third day, the water will be gone.

The professional opinion of C&N Environmental Consultants, Inc. regarding this issue follows:

"Under normal circumstances, the water level within the oak hammock would sit 24 to 40 inches below the surface during the rainy season. During a storm event, this type of community might have a few inches of water sitting on the surface for a short period of time, after which it would percolate into the ground until it again reached equilibrium. In the event of consecutive storm events within this design system, if the water was held in the hammock for more than three days, the health of the oaks might suffer.

There is really no way to ascertain what the exact effect of long-term or repeated inundation will be on these trees. It is safe to say that two or more storm events that cause the water depths to be maintained at 18 inches within a week would have adverse effects on the hammock vegetation. The vegetation would need at least 5-7 days to recover from the inundation after a single storm event. These adverse effects can range from being unnoticeable to tree mortality. Please be advised that these effects may not be immediately evident. While it is certain that the vegetation will be effected, the exact effects cannot be determined definitively."

Section 5
Surface Water Treatment System Design

5.1 Introduction

The development of the surface water treatment system was an iterative process of trying to balance the project objectives (see Section 1), while living with the limitations of the physical system and budgetary constraints. The physical system shown in Section 2 provided the foundation for the Surface Water Modeling Analysis presented in Section 3 and the Conceptual Design presented in Section 4. The information gathered for this study and the surface water modeling results provided the rates, volume and anticipated water quality parameters required to design the surface water treatment system.

The surface water quality (nutrient concentrations) for post-construction is difficult to predict. Therefore, water quality from the existing discharges from the site was used to estimate and size the proposed surface water treatment system. Actual variations in water quality, coagulant feed rates, etc. will be addressed in the operationally flexible system proposed as described in the following sections.

5.2 Summary of Design Criteria and Assumptions

The design criteria and assumptions used for the design of the surface water treatment systems are listed below:

- The stormwater storage area and treatment capacity were sized based on the portion of the farm located east of CR-721, which is approximately 525 acres.
- Stormwater storage area = 34.4 acres
- Maximum depth of water above average land surface = 1.5 feet
- Maximum stage elevation = 31.0 feet NGVD
- Maximum duration of inundation
    - 1 day at 1.5 feet deep
    - 2 days at 1.0 feet deep
    - 3 days at 0.5 feet deep
- Frequency of maximum duration events = 1 event per 7 days
- The treatment system must have redundancy of critical components, emergency structures and draining capacities in case of electrical failures or catastrophic events.

- The treatment system must allow for drying the flocculent sludge.
- The chemical treatment system must use alum as its coagulant.
- The settling basin shall be sized for a 4-hour settling time.

5.3 Treatment Design

5.3.1 Pump Sizing and Selection

Pump sizes were determined by taking the inundation volume of the stormwater storage area divided by the duration of inundation. Therefore, a single pump would have to pump 3892 gallons of water per minute (GPM). In order to meet the redundancy requirement, two 4000 GPM pumps were selected.

The head requirements for the pump are low, approximately 15 feet. As a result, a 12 inch axial flow pump was selected. These pumps are inexpensive and require little to no maintenance. The electric motor for each pump was sized at 20 horsepower (HP). To decrease the startup electrical requirements, a multi-stage starter will be added to each pump. Having two pumps in the system provides for redundancy as well as twice the treatment rate under extreme events.

The pumps will be activated by float level switches. The first pump will activate on the (low on) control set point. The second pump will activate on a second higher (high on) control set point. A third even higher set point (high alarm) will activate a flashing light and alarm. The alarm system will be provided with a battery backup system that will automatically turn on during electrical failure. When both pumps shut off, the pumps will cycle between being the first and second pump. The two features, 1) rotating pumps to the first pump, and 2) allowing for two pumps to run at the same time, can be manually turned off as desired by the operator.

The initial control set points are:

Low On	=	27.5 feet NGVD
High On	=	29.0 feet NGVD
High Alarm	=	31.0 feet NGVD
Off	=	27.0 feet NGVD

The electrical service to the motors shall also have a double disconnect switch to provide the future placement of a permanent backup generator (automatic disconnect switch) or a temporary (manual disconnect switch). If funds allow a permanent backup generator will be provided.

5.3.2 Flocculent Evaluation and Selection

Previous studies provided to the project team by Dr. Del Bottcher, P.E. of Soil and Water Engineering Technology, Inc., indicated that the two most cost effective flocculants were aluminum sulfate or ferric chloride. Aluminum sulfate (alum) is the most common aluminum salt used for precipitation of phosphorus. Phosphorus is removed from aluminum treated water by three primary mechanisms: (1) forming insoluble $AlPO_4$, (2) by adsorption on the surface of $Al(OH)_3$ floc and (3) by entrapment of phosphorus containing particulate matter. Nitrogen associated with particulate matter is also removed with the $Al(OH)_3$ floc. In general, aluminum salts produce more sludge (precipitate) than do iron salts.

One mole (594 grams) of alum will react with 2 moles (190 grams) of phosphate containing 62 grams of phosphorus to form 2 moles (244 grams) of $AlPO_4$ sludge. Thus, the weight ratio of alum to phosphorus is 594 to 62 or (9.6:1) (RCS, 2000).

Several factors were involved in choosing which coagulant to use on this project. The advantages and disadvantages of alum and ferric chloride were evaluated against each other and a final decision was made to go with alum based on a mandate from SWET and SFWMD in December 2002. Both alum and ferric chloride are relatively inexpensive and efficient. The main factors, which lead to this decision are the following (RCS, 2000):

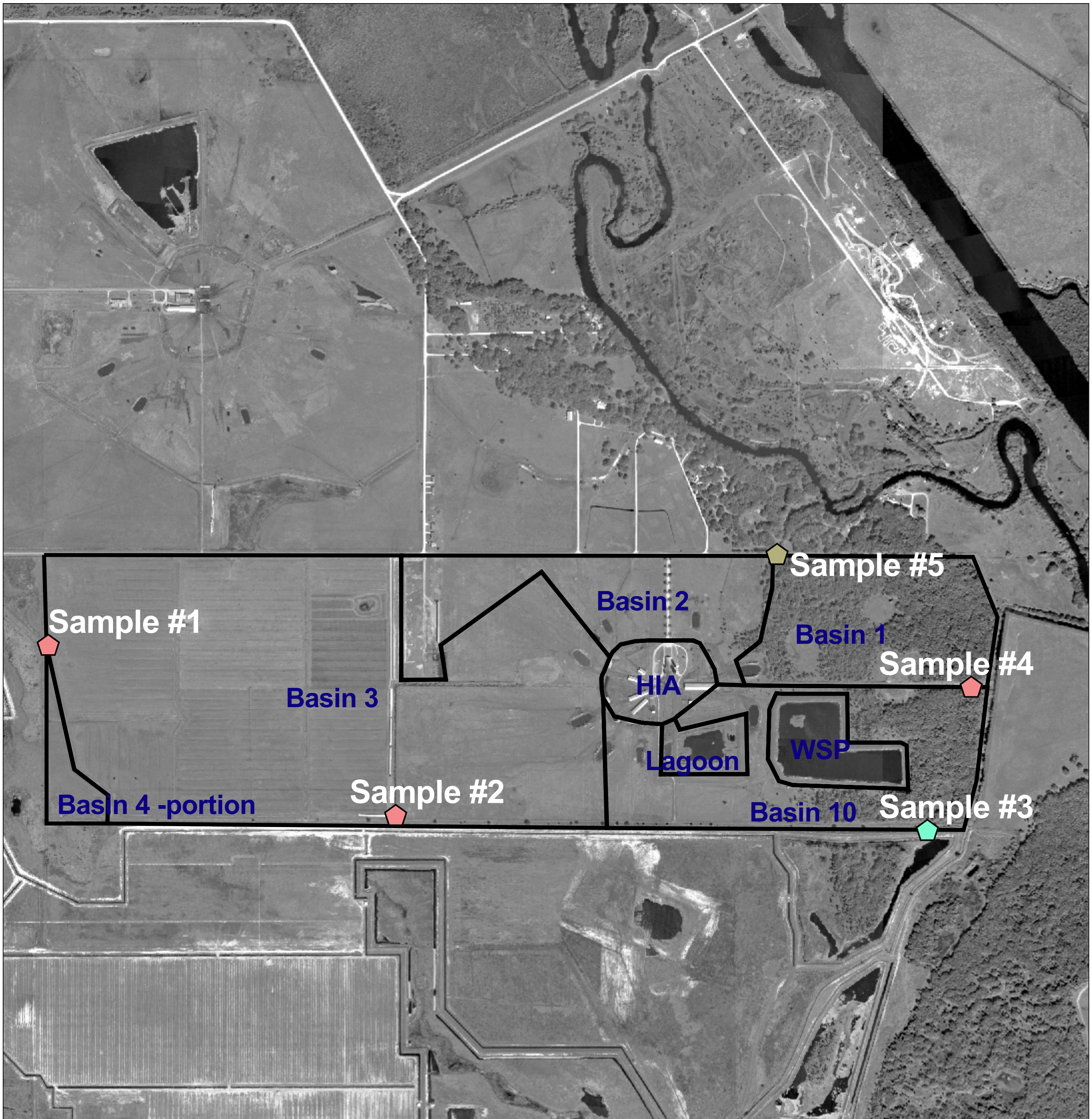
- Efficient & relatively inexpensive.
- Easy to store & handle.
- Dry alum is not corrosive.
- Liquid alum only moderately corrosive

In practice, the quantities of coagulant required are higher than the stoichiometry would predict. This is due to the competing reactions, which vary with the treatment water. The addition of other chemicals or polymers may be optimized by in-situ testing.

5.3.3 Flocculent Feed Rates and Storage

Water samples were collected August 28, 2002 at four of the five sample locations identified on **Figure 5-1** for jar testing**.** Three of the samples were collected from stagnant water pools, one from low flowing water, and one sample location was dry. As a result, these water samples are not necessarily representative of site conditions that will be treated. Do to the lack of suitable onsite water for testing; more representative water samples will be collected after a larger storm event for jar testing. These future samples should be more representative of the water to be treated. The jar testing was conducted using ferric chloride as the coagulant. At the time of that the jar testing took place it was thought that ferric chloride was to be used in the design. While the jar test results are specific to ferric chloride dosing, the results for alum are similar. Results of the jar testing indicate that the lowest ferric chloride dosing (at 40% concentration) capable of producing a good floc and yielding a clear sample was 120 PPM. For the purpose of this design 120 PPM of alum will be used. This value is subject to change depending upon the results of the additional jar testing to be completed. Other assumptions are as follows:

- Phosphorus concentration of runoff = 10 mg/l (RCS, 2001).



LEGEND

Study Area Basins

Jar Test Sample Locations
Dry
Low Flow
No Flow

N

1000 0 1000 Feet

Butler Oaks Farm, Inc.

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Figure 5-1
Jar Testing Sample Locations

- Efficiency of chemical reaction = 90%
- Total annual runoff equals 161.04 million gallons (from stormwater modeling results)
- Alum will be purchased in liquid bulk at a delivered cost of $0.13 per pound to be delivered in 4000 gallon tanker trucks
- Alum density = approximately 11.7 pounds per gallon
- At 120 PPM, the flocculent feed rate equals 0.48 gallons per minute for each 4000 gallon per minute treatment pump.

The sizing of the storage facility (tanks) for the chemicals was based on a typical seasonal storage of approximately 8000 gallons. For a redundant system, two tanks are to be placed under the pole barn adjacent to the pumps. This minimum size would provide ample storage until a delivery truck could refill the tanks. Bulk storage will be used to allow for less material handling and a lower chemical cost. Also, bulk storage will reduce operator exposure to the chemicals.

5.3.4 Sizing of Settling Ponds

The sizing of the settling ponds was based on several limiting factors:

- The width of the pond could not exceed 75 feet from the tops of the banks. This would allow a long-arm excavator to easily remove the settled material.
- A tractor and spreader and semi-truck access to load the precipitated waste sludge limited the turning radius of the berms.
- The average velocity of the flow through the pond must be slow enough to allow for a 4 hour detention time throughout the flow profile.
- The ground elevation on the berms and treatment area is 33.0 feet NGVD. Therefore a maximum operational elevation of 30.5 feet NGVD was selected. The resulting operational depth of the pond under 8000 gpm will maintain a 1 foot freeboard.
- The operational depth of the settling pond was only limited by the 2 to 1 side slopes. Approximately half of the pond will remain inundated with groundwater during normal operation. The groundwater will aid in reducing the re-suspension of flocculants during high flow events.

The settling pond was sized as indicated on the design plans to meet the horizontal velocity (detention time) and settling velocity of 0.3 feet per hour, resulting in a pond length of 500 feet, and a total volume of 196,000 ft^3. The dimensions of the settling ponds will allow for the theoretical complete settling of alum before being discharged. Extra freeboard was added to account for the direct application of rainwater to the settling pond during operation.

5.3.5 Flocculent Accumulation Volumes

An estimated total annual runoff of 161.04 million gallons will be treated in the settling pond, based on the stormwater modeling presented in Section 3. By taking the estimated alum usage of 120 PPM and multiplying it by the total annual runoff times the density of alum (approximately 11.7 lbs/gallon) yields 226,100 pounds of alum per year. While there is no absolute correlation between the mass of sludge generated and other water quality measurements, a typical settling ratio of solids to coagulant used is 3 (Lindeburg, 2001). Therefore, the total dry weight of precipitated sludge is approximately 339 tons. Accounting for water in the sludge, at a ratio of 50 to 100 percent, the total wet sludge weight is estimated at 509 to 678 tons. The actual weight will depend on the percent moisture of the precipitated sludge. The wet density of the precipitated sludge is approximately 65 pounds per cubic foot (RCS, 2000). Thus the annual accumulation depth of sludge in each pond, assuming both ponds were used, could be as high as 1.2 feet in each settling pond, based on the 9000 square feet of bottom surface area per pond.

The coagulant feed pumps were sized to meet the anticipated injection rate of 0.48 gallons per minute. A safety factor of 10 was used to select and size the variable speed pump required for this task. The feed pumps will inject the liquid coagulant directly into the suction side of the propeller of the pump. The pump rotation will provide for excellent mixing of the coagulant.

5.3.6 Structures

A permanent pole barn structure is shown to cover the coagulant storage tanks and electrical panel while providing a covered area for the future placement of a generator. The pad and building size is 40 feet by 32 feet. The simple 16 foot high structure will follow typical non-occupied agricultural specifications.

5.4 Operations and Maintenance Considerations

5.4.1 Operation of the Treatment System

Coagulant Tanks – The coagulant tanks will need to be filled as the chemicals are used. Multiple chemical supply companies will be identified for competitive bid for the flocculent. Alum is a common chemical and is readily available from multiple locations and vendors.

Reuse System – The two valves associated with the reuses system are simple gate valves that direct the flow from the northernmost pump to the waste storage pond instead of the settling pond. It is important to note that coagulant should only be used when discharging to the settling pond. No coagulant should be directed to the waste storage pond.

Treatment Center Inspection – Weekly inspections of the stormwater storage area and treatment pumps should be done.

5.4.2 Maintenance of the Treatment System

Since there is only one settling pond, it can not be taken out of service without affecting the design treatment capacity of the overall system. Transfer of the sludge from the bottom of the settling pond to the drying bed should take place annually as the sludge accumulates. This may be accomplished using a wet agitated PTO pump operating between the settling pond and the drying bed. A less efficient approach is to use a long-arm excavator to scrape the sludge and stockpile within the drying bed. The land owner or custom hauler will then load and spread the material, at approved agronomic rates, to his fields. The spreading of the material could be as simple as a pull-behind manure spreader, or a commercial auger-fed truck.

Based on the anticipated accumulation rates of the alum, the ponds will need to be cleaned maybe 1 time per year. The actual cleaning schedule will also depend on how dry the material is in the pond bottom, or if land is available to apply slurry/cake. The cleaned material from the bottom of the pond will provide an excellent, low cost, nutritional supplement to many agronomic crops.

5.4.3 Estimated Annual O&M Costs

In order to procure the alum at the best possible cost, it will be purchased in 4000-gallon lots to be delivered by a chemical tanker truck. Dual 4000-gallon bulk chemical storage tank will be required for this operation. The 4000-gallon tank will require replenishment approximately once in 10 weeks.

Chemical costs are estimated at \$35,000, \$55,000 and \$78,000 for minimum, average and maximum rainfall years, respectively. Typical annual electrical costs for the operation of two 20 HP pumps, at an electrical cost of \$0.10 per kilowatt hour, are estimated at \$250, \$2,500, and \$6,000 for minimum, average and maximum rainfall years, respectively.

The total operation and maintenance costs associated with this design are as follows:

- Labor/machine costs for mowing containment berms = \$5400/year (6 hours/month at \$75/hour).
- Labor costs for regular maintenance of the chemical injection system = \$2600/year (1 hour/week at \$50/hour).
- Disposal costs assuming sludge transported offsite to a local landfill = \$20,360 (cost includes excavation, hauling and tipping fees at \$40/ton for 509 tons of sludge).

- Disposal costs assuming land spreading to onsite cropland = $5,090 (cost includes excavation, hauling and spreading using farmer's spreader at $10/ton for 509 tons of sludge).

5.5 Additional Considerations

The design of the surface water treatment system presented in this section of the report was based on information gathered from previous studies and data collected for this project. Additional data and investigations (jar testing) should be gathered to more accurately estimate the coagulant requirements of the system during actual storm events. This task is currently being planned and the results will be incorporated before construction commences.

An operations and maintenance manual should be prepared to assist the land owner with the operation of the system. The proposed surface water treatment system was design specifically with low maintenance in mind. However, successful operation of the system will require regular monitoring and maintenance.

5.6 References

Royal Consulting Services, Inc., 2000. *Review of Nutrient Removal Technologies December 2000*. Prepared for Soil and Water Engineering Technologies, Inc.

Royal Consulting Services, Inc., 2001. *October 2001 Agriculture Nutrient Management Assessment (ANMA) for Butler Oaks Farm, Inc*. Prepared in association with Soil and Water Engineering Technologies, Inc., for the South Florida Water Management District.

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Appendix A
Florida Fish and Wildlife Conservation Commission
Gopher Tortoise Relocation Permit

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

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DIVISION OF WILDLIFE
SOUTHWEST REGION
Phone: (863) 648-3205
Fax: (863) 701-1248

Dear permit holder:

Enclosed is your on-site relocation permit for 5 or fewer tortoises. ***Please be sure to read the permit provisions and conditions carefully and sign the permit on the blank with the asterisk in the upper right hand corner. Keep this permit with you at all times while working on the property in question.***

Tortoises may be trapped by excavation or captured using the bucket trapping method. If tortoises are trapped by excavation, the burrow must be dug in incremental stages to minimize the potential for harming the tortoises involved. To bucket trap tortoises at the burrow, dig a hole directly in front of the tortoise burrow and place a 5 gallon bucket in the hole. The bucket should have at least 5 holes in the bottom for drainage in case of rain during the trapping period. Once the bucket has been placed in the hole, cover the top of the hole with newspaper, wax paper, or cheese cloth and then camouflage it with the surrounding soil. As the tortoise leaves or returns to the burrow, it will be caught in this pit-fall trap. As stipulated on your permit, traps must be checked at least once a day for 25 consecutive days or until the tortoise is captured. On hot summer days, burrows should be checked around 2:00 PM to prevent tortoises from being exposed to direct sunlight for the entire day. As specified on your permit, tortoises should not be relocated on days when the weather is forecasted to be below 50°F for the next 3 consecutive days.

Once tortoises are captured, they must be relocated on-site, outside the construction area. Starter burrows should be dug at a 45 degree angle within the relocation area. Temporary fencing should be used to prevent tortoises from entering the construction area and returning to their original burrow locations. Tortoises may be penned for up to 10 days under this permit in areas with partial shade (see enclosed pen specifications). To keep tortoises out of the construction area for longer periods, the construction area itself should be fenced in allowing tortoises to move freely within the remaining property on-site.

Thank you for your consideration of these matters. If you have questions about permit guidelines or trapping tortoises, please call me at (863) 648-3205 for assistance.

Sincerely,

Alex Kropp

Alex Kropp
Assistant Regional Biologist
Florida Fish and Wildlife Cons. Comm.
E-mail: Kroppa@fwc.state.fl.us

W1067/ANK
WLD 4

Enclosures

PERMIT

Issued Under Authority of the Wildlife Code of the State of Florida
(Title 68A, Florida Administrative Code) by the

SOUTHWEST REGION
STATE OF FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
Division of Wildlife, 620 South Meridian Street, Tallahassee, FL 32399-1600, (850) 488-3831

Permit Type: Gopher Tortoise Relocation--Special

Permit No.: GTRS-02-R1-ANK-0061

Issuance Date: **July 23, 2002**

Expiration date: 90 days subsequent to issuance

Permittee: **Cheryl M. Carpenter**

Permittee Signature*: ______________________

Address: **C & N Environmental Consultants**
612 N. Orange Ave. Suite A-10
Jupiter, FL 33458

* Signature indicates acceptance of all permit conditions. This original should be signed and retained.

Phone: **(561) 744-7420**
Fax: **(561) 744-2887**

Affected Site

Title (if applicable): **Butler Oaks Farm**   County: **Highlands**

Owner: **Robert Butler**

Address or Township/Range/Section: **172 Shady Oaks Lane, Lorida, FL 33857.**

Provisions/Conditions:

1. Up to five gopher tortoises may be live-captured by excavation or bucket-trapping, or by hand and relocated and released to preclude their harm due to imminent construction or land clearing activities. If excavation is used, burrows are to be excavated in incremental stages to minimize the potential of harming the tortoises involved. If bucket-trapping is used, traps must be checked at least once per day and remain in place for at least 25 consecutive days or until a tortoise is captured, whichever is precedent. Captures must be effected immediately prior to land clearing/construction activities to preclude tortoises returning to their burrows. Alternatively, temporary fencing may be used to exclude relocated tortoises from construction sites, but if such fencing necessitates confining tortoises, shade must be available therein, the confinement is to comply with the attached guidelines, and confinement is not to exceed 10 days. Any mortality associated with the permitted work must be reported to this office within five days.

2. Tortoises shall not be captured/relocated on days for which the overnight low temperature for that day and the two consecutive days thereafter is forecasted by the U.S. National Weather Service to be below 50°F. This 3-day window of milder overnight temperatures is to allow the relocated tortoises to settle into the recipient site.

3. This permit must be readily available for inspection at all times while engaging in the permitted activities, and is effective only to all reasonable alternatives having been exhausted to accommodate the affected tortoises in situ, and only subsequent to all necessary local, state and/or federal permits for the construction/land clearing having been issued.

Kenneth D. Haddad
Executive Director

By: Alexander N. Kropp

W1067/ANK
gtrs2002_0061.wpd
Attachment
cc: Regional Law Enforcement Commander
Angela Williams, Tallahassee

MAINTENANCE OF THE GOPHER TORTOISE IN CAPTIVITY

The environment of a captive gopher tortoise is the most important factor affecting its health. Air and ground temperatures, exposure to sun and shade, shelters for security, and a clean enclosure must be considered. Indoor enclosures may be best for hatchlings and small individuals, whereas outdoor pens serve the needs of medium to adult-sized tortoises.

Indoor Enclosures: Aquaria, terrariums and other suitable containers should be easily cleanable. The floor of the enclosure should be at least 10 times the size of the tortoise. Avoid sand (which can cause intestinal impaction if eaten) and cat litter products or pine and cedar shavings, which can be harmful to reptiles.

Household temperatures of 70-80 degrees Fahrenheit are adequate. During the day, a low wattage light bulb placed at one end of the enclosure can provide additional heat (not to exceed 95 degrees Fahrenheit). This "basking" site facilitates body temperature regulation.

Ultraviolet light is also needed to assure proper bone and shell growth. Provide access to natural sunlight or artificial lights which are designed to emit ultraviolet rays. Never set the enclosure in full sunlight as tortoises can overheat rapidly. Always provide some shade. Ultraviolet light should be offered three times a week during daylight hours.

Clean water should always be available. A shallow container or pan which the tortoise can climb in and out of easily is best. Also, provide a small hide box for security and sleeping.

Outdoor Pens: Pens are best constructed on sandy, well-drained soils to promote a dry environment. Pens may be constructed of wood, galvanized sheet metal (flashing) or welded wire fencing. Walls should be at least 2 feet high and buried 6 inches into the ground. Enclosure size should be based on tortoise size:

	1-2 Tortoises	3-5 Tortoises	6-10 Tortoises
Juveniles	4 x 4 feet	4 x 8 feet	8 x 8 feet
Subadults	4 x 8 feet	8 x 8 feet	Need 2 enclosures
Adults	8 x 8 feet	12 x 12 feet	Need 2 enclosures

Flooding by rainwater can be avoided in wooden enclosures by slightly parting horizontally-positioned boards at ground level. Holes may be drilled in flashing. Avoid exposed concrete in pen construction as it can result in shell abrasions. Outdoor pens should also provide shade and a clean water source.

Burrows: Burrows offer escape from heat, cold, droughts, fires, and predators. In captivity they are important in temperature regulation and security. In outdoor pens, you can assist the tortoise by digging a "starter burrow." It should be dug at a 45-degree angle and should be slightly wider than the length of the tortoise to allow enough space to turn around. Usually only one tortoise will occupy a burrow so one should be provided for each possessed tortoise. Avoid walking near the mouth of the burrow as it can cave in.

Bucket Trapping Tortoises

Once you have received your permit, you are authorized to bucket trap five or fewer tortoises and relocate them within the boundaries of your property. To bucket trap tortoises, dig a hole directly in front of the tortoise burrow and place a 5-gallon bucket in the hole. The bucket should have at least 5 holes in the bottom for drainage in case of rain during the trapping period. Once the bucket has been placed in the hole, cover the top of the hole with newspaper, wax paper, or cheese cloth and then camouflage it with the surrounding soil. As the tortoise leaves or returns to the burrow, it will be caught in this pit-fall trap. As stipulated on your permit, traps must be checked at least once a day for 25 consecutive days or until the tortoise is captured. On hot summer days, burrows should be checked around 2:00 PM to prevent tortoises from being exposed to direct sunlight for the entire day (or you can check burrows multiple times per day). As specified on your permit, tortoises should not be relocated on days when the weather is forecasted to drop below 50°F for the next 3 consecutive days.

Excavating Tortoise Burrows

This method poses a higher risk of injury to tortoises than bucket trapping. Burrows should be excavated slowly by an experienced backhoe operator or using hand shovels. Use a garden hose or a similar flexible material to measure the depth of the burrow to the nearest obstruction. This obstruction could be the tortoise, a sharp turn in the burrow, or the end of the burrow (burrows are known to reach a length of 25 feet in some cases). When you are three feet from the obstruction, use hand shovels to excavate this final portion. Continue this method until you reach the end of the burrow or the tortoise. Great care must be taken to avoid injuring or killing tortoises when heavy equipment is used to perform the excavation. If an accident occurs, call this office immediately.

Relocating Tortoises

Once tortoises are captured, they must be relocated on-site (inside your property boundaries), outside the construction area. Make sure the construction area is surrounded by temporary fencing before tortoises are relocated. This will prevent released tortoises from accessing their old burrows or getting into harm's way during construction. Starter burrows should be dug at least 2 feet deep at a 45 degree angle within the release area. Tortoises may be penned for up to 10 days under this permit when this is absolutely necessary for their safety. Pens must have partial shade, water, forage, and starter burrows (see Maintenance of the Gopher Tortoise in Captivity). If little grass or other forage is available within the pen, you can supply food to the tortoises, but <u>only</u> for the 10-day penning period (refer to Maintenance of the Gopher Tortoise in Captivity). Feeding tortoises regularly can permanently alter their behavior so that they no longer forage for themselves.

If you have questions about trapping or relocating tortoises, please call **Alexander Kropp at (863) 648-3205.**

Diet: Outdoor pens should contain native grasses and broad-leafed plants for grazing. Pens can also be seeded with Bahia, rye, and clover. Mowing the pen will stimulate new plant growth which is more nutritious and is preferred by the tortoise.

In addition to providing natural forage (which should be cut and offered to tortoises kept indoors), a prepared diet should be given at least three times a week. All items in the diet should be cut up, mixed, and offered on a flat dish or tray. A standard diet comprised of a variety of fruits and vegetables may include apple, carrot, melon, squash, banana, beets, sprouts, broccoli, spinach, kale, endive, and Romaine lettuce. Dog kibble soaked in water or a multi-vitamin/calcium powder can be added once a week. Variety is the key to a well-balanced diet.

Some tortoises are initially reluctant to feed in captivity. During this period of acclimation avoid handling, provide proper temperatures and hiding areas, and offer diets which include aromatic and colorful (tortoises are attracted to red) food items.

Winter Accommodations: Gopher tortoises become inactive during cold periods and remain in their burrows. They may emerge during warm spells to bask. Tortoises that have dug burrows in outdoor pens should do well during winter months. Heat must be provided to tortoises without burrows as temperatures below 50-55 degrees Fahrenheit can result in metabolic and respiratory illness. A small shelter can be constructed with heat strips underlying a 1/4 inch plywood floor and fitted with leaves and straw. Other methods and designs may be employed but always test temperature first. Tortoises may also be brought indoors during cold weather.

Behavior: Tortoises are highly social animals and react to the presence of other tortoises. Social hierarchies or "pecking orders" may develop which result in dominant and subordinate individuals. If this social stress interferes with normal behavior and feeding, separation may be required.

Evaluating Health: Signs of health problems include inactivity, lethargic behavior, labored breathing, discharge from the eyes, nose or mouth, and abnormal feces. A veterinarian should be consulted when these symptoms first occur.

Appendix B
Selected Model Input and Output Files

WinTR-55 Current Data Description

--- Identification Data ---

User:	CLG	Date:	7/17/2002
Project:	Butler Oaks	Units:	English
SubTitle:	Dairy BAT Edge of Farm Treatment	Areal Units:	Acres
State:	Florida		
County:	Highlands		
Filename:	J:\0110\01\model\TR55\TR55_02Jul17.dat		

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
B3	Basin 3	Reach A	304.96	84	1.125
B2	Basin 2	Outlet	67.81	84	2.019
B1	Basin 1	Reach B	68.71	80	1.250
B10	Basin 10	Outlet	82.94	82	1.803

Total area: 524.42 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

3-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	2-Yr (in)	100-Yr (in)	-Yr (in)
4.0	4.5	5.0	6.5	3.5	8.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Florida Type II
Dimensionless Unit Hydrograph: <standard>

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Storm Data

Rainfall Depth by Rainfall Return Period

3-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	2-Yr (in)	100-Yr (in)	-Yr (in)
4.0	4.5	5.0	6.5	3.5	8.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Florida Type II
Dimensionless Unit Hydrograph: <standard>

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
B3	304.96	1.125	84	Reach A	Basin 3
B2	67.81	2.019	84	Outlet	Basin 2
B1	68.71	1.250	80	Reach B	Basin 1
B10	82.94	1.803	82	Outlet	Basin 10

Total Area: 524.42 (ac)

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
Reach A	Outlet	2010	CHANNEL
Reach B	Outlet	840	CHANNEL

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
B3							
SHEET	100	0.0020	0.240				0.571
SHALLOW	1440	0.0020	3.5				0.554
CHANNEL	7895	0.0010					
					Time of Concentration		1.125
B2							
SHEET	100	0.0010	0.240				0.754
SHALLOW	3600	0.0024	3.5				1.265
					Time of Concentration		2.019
B1							
SHEET	100	0.0006	0.240				0.925
SHALLOW	1100	0.0034	3.5				0.325
CHANNEL	730	0.0011					
					Time of Concentration		1.250
B10							
SHEET	100	0.0030	0.240				0.486
SHALLOW	3900	0.0026	0.050				1.317
					Time of Concentration		1.803

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
B3	Pasture, grassland or range	(fair)	D	304.96	84
	Total Area / Weighted Curve Number			304.96	84
				======	==
B2	Pasture, grassland or range	(fair)	C	1.89	79
	Pasture, grassland or range	(fair)	D	65.92	84
	Total Area / Weighted Curve Number			67.81	84
				=====	==
B1	Pasture, grassland or range	(fair)	A	.05	49
	Pasture, grassland or range	(fair)	C	56.94	79
	Pasture, grassland or range	(fair)	D	11.72	84
	Total Area / Weighted Curve Number			68.71	80
				=====	==
B10	Pasture, grassland or range	(fair)	C	35.63	79
	Pasture, grassland or range	(fair)	D	47.31	84
	Total Area / Weighted Curve Number			82.94	82
				=====	==

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach A	2010	0.25	0.002	10	2 :1
Reach B	840	0.25	0.002	8	2 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach A	0.0	0.000	0	10	0.002
	0.5	0.858	5.5	12	
	1.0	2.815	12	14	
	2.0	9.658	28	18	
	5.0	56.396	100	30	
	10.0	247.946	300	50	
	20.0	1238.450	1000	90	
Reach B	0.0	0.000	0	8	0.002
	0.5	0.692	4.5	10	
	1.0	2.294	10	12	
	2.0	8.046	24	16	
	5.0	49.369	90	28	
	10.0	226.568	280	48	
	20.0	1172.770	960	88	

Butler Oaks
Dairy BAT Edge of Farm Treatment
Highlands County, Florida

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 3-Yr (cfs) (hr)	5-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	2-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS						
B3	302.14	359.12	415.38	590.06	245.61	767.25
	12.56	12.58	12.61	12.53	12.56	12.55
B2	47.58	56.62	65.63	92.96	38.76	121.03
	13.20	13.15	13.19	13.21	13.20	13.16
B1	54.90	66.45	78.38	114.96	43.69	152.09
	12.67	12.65	12.70	12.67	12.70	12.66
B10	57.92	69.56	81.17	117.22	46.76	153.51
	13.02	13.03	12.99	13.01	13.10	13.05
REACHES						
Reach A	302.14	359.12	415.38	590.06	245.61	767.25
	12.56	12.58	12.61	12.53	12.56	12.55
Down	230.99	278.08	326.54	469.47	186.60	613.37
	12.99	12.93	12.89	12.89	12.99	12.84
Reach B	54.90	66.45	78.38	114.96	43.69	152.09
	12.67	12.65	12.70	12.67	12.70	12.66
Down	47.48	57.92	68.58	101.16	37.72	134.35
	12.98	12.97	12.94	12.83	13.02	12.82
OUTLET	381.09	458.54	537.78	771.77	308.66	1009.56

Butler Oaks Farm, Inc.
Hydrologic Model Version 1.2

			Start Discharge at	0.250	of Max Volume	Runoff Area	585.4	acres	Pond Volume	600.0	ac-inches
Soil Hold Cap	0.6	inches/foot	Pump Capacity	6.00	inches/day	Runoff Factor	0.60		Treat Time	3.0	days
Start Depth	0	feet									
Start Volume	0	ac-in	Design Pond Depth	1.5	feet	Pond Area	34.4	acres			

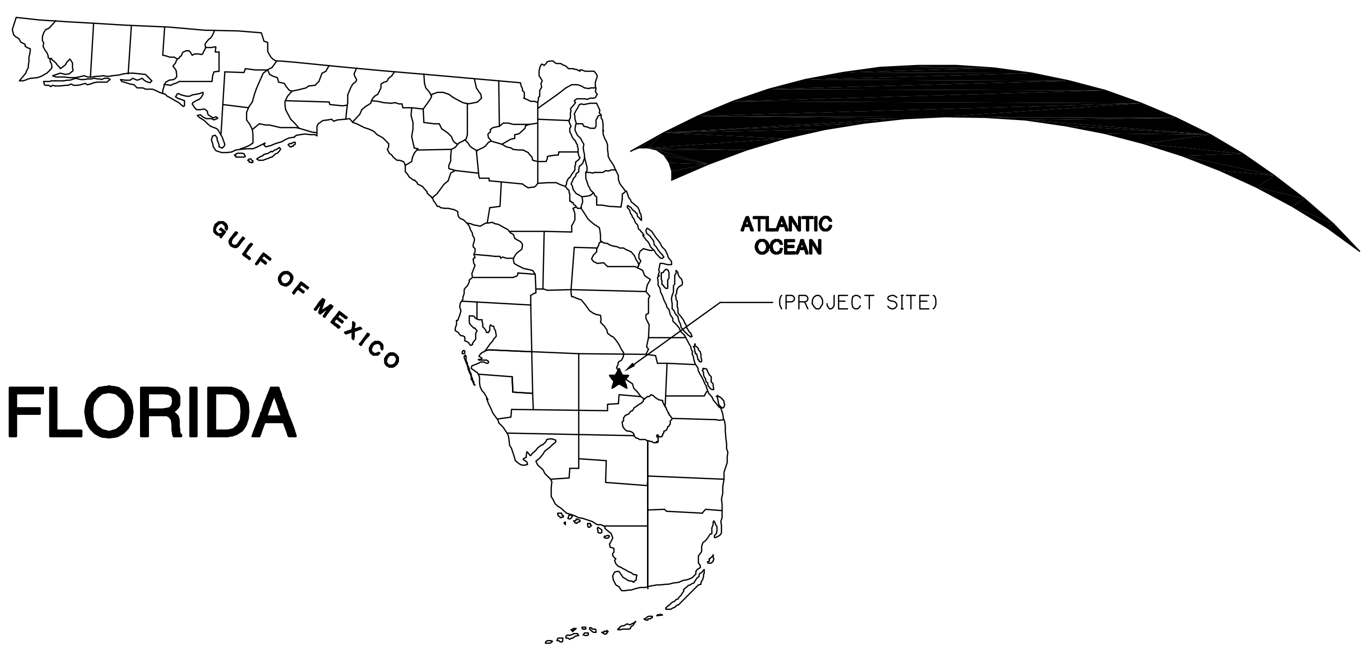
Date	Rainfall, in	ET, in.	Avail Soil Store(S), in.	Curve No. CN	Runoff (Q) inches	Adjusted Q inches	Pumped to Storage inches	Water Bypassed inches	Water In Basin ac-in	Water Treated inches	Treat? y=1 n=0	logic test
Record Sum:	**1899.77**	**2128.27**			**542.598**	**325.559**	**295.09**	**30.47**		**311.92**	% Treated	**95.8**
10/1/60		0.13	0.0	100.0	0.000	0.000	0.00	0.00	0.0	0.00	1	FALSE
10/2/60		0.13	0.9	91.7	0.000	0.000	0.00	0.00	0.0	0.00	0	FALSE
10/3/60	0.5	0.13	1.0	90.7	0.065	0.039	0.04	0.00	0.4	0.00	0	FALSE
10/4/60	0	0.13	0.9	91.7	0.000	0.000	0.00	0.00	23.2	0.00	0	FALSE
10/5/60	0	0.13	1.0	90.7	0.000	0.000	0.00	0.00	23.0	0.00	0	FALSE
10/6/60	0	0.13	1.2	89.6	0.000	0.000	0.00	0.00	22.9	0.00	0	FALSE
10/7/60	0.1	0.13	1.3	88.6	0.022	0.013	0.01	0.00	22.9	0.00	0	FALSE
10/8/60		0.13	1.3	88.2	0.000	0.000	0.00	0.00	30.5	0.00	0	FALSE
10/9/60		0.13	1.5	87.2	0.000	0.000	0.00	0.00	30.4	0.00	0	FALSE
10/10/60	0.61	0.13	1.6	86.3	0.045	0.027	0.03	0.00	30.8	0.00	0	FALSE
10/11/60	0.1	0.13	1.1	89.8	0.016	0.010	0.01	0.00	46.7	0.00	0	FALSE
10/12/60	0.1	0.13	1.2	89.5	0.018	0.011	0.01	0.00	52.3	0.00	0	FALSE
10/13/60	0	0.13	1.2	89.1	0.000	0.000	0.00	0.00	58.4	0.00	0	FALSE
10/14/60	0	0.13	1.3	88.1	0.000	0.000	0.00	0.00	58.3	0.00	0	FALSE
10/15/60		0.13	1.5	87.1	0.000	0.000	0.00	0.00	58.1	0.00	0	FALSE
10/16/60		0.13	1.6	86.1	0.000	0.000	0.00	0.00	58.0	0.00	0	FALSE
10/17/60	0.22	0.13	1.7	85.2	0.010	0.006	0.01	0.00	58.1	0.00	0	FALSE
10/18/60	0	0.13	1.7	85.8	0.000	0.000	0.00	0.00	61.5	0.00	0	FALSE
10/19/60	0.17	0.13	1.8	84.8	0.022	0.013	0.01	0.00	61.6	0.00	0	FALSE

```
 Sewered Area                = 585.410000 ACRES
 Rainfall Division Factor    =   1.000000 Rainfall values are divided by this integer value
 C Coefficient               =   0.350000
 Maximum Depression Storage =       0.25 (Inches)
 Monthly Evaporation rates (Inches/DAY)
       JAN       FEB       MAR       APR       MAY       JUN
    0.0900    0.1200    0.1500    0.1900    0.2000    0.2000
       JUL       AUG       SEP       OCT       NOV       DEC
    0.1900    0.1700    0.1500    0.1300    0.1000    0.0800

 First Flush Storage Volume =   0.000000 MG   =    0.000000 Inches
 Treatment Storage Volume   =  16.300000 MG   =    1.025324 Inches
 Inline Storage Volume      =   1.000000 MG   =    0.062903 Inches

 Dry Weather Flow Rate      =   0.000000 MGD  =    0.000000 Inches per Hour
 Interceptor Treatment Rate =   5.600000 MGD  =    0.014677 Inches per Hour
 Basin Treatment Rate       =   0.000000 MGD  =    0.000000 Inches per Hour
 Excess flows are shunted past treatment basin

 Decant Rate                =   0.000000 MGD  =    0.000000 inches per hour

 Number of Dry Hours        =       6.00

 NUMBER OF YEARS      =      29.83 years
--------------------EVENT SUMMARIES----------------------------
                                NUMBER      NUMBER/YEAR
 STORAGE EVENTS      =           1108          37.14
 EVENTS WITH DECANT  =              0           0.00
 TREATED OVERFLOWS   =              0           0.00
 UNTREATED OVERFLOWS =             17           0.57
 -------------------TOTAL DURATION SUMMARIES--------------------
                          HOURS  HOURS/YR
 RAINFALL            =     10784    361.50
 RUNOFF              =      5560    186.38
 STORAGE             =  19946.80    668.65
 TREATED OVERFLOW    =      0.00      0.00
 DECANT              =      0.00      0.00
 UNTREATED OVERFLOW  =     76.00      2.55
--------------------VOLUME SUMMARIES---------------------------
                           INCHES INCHES/YR        MG     MG/YR
 TOTAL RAINFALL       =    1286.67     43.13  20454.72    685.68
 TOTAL RUNOFF         =     302.19     10.13   4804.09    161.04
 TREATED OVERFLOW     =       0.00      0.00      0.00      0.00
 DECANT VOLUME        =       0.00      0.00      0.00      0.00
 UNTREATED OVERFLOW   =       9.36      0.31    148.80      4.99

-------------------PERCENT CAPTURE CALCULATION------------------------

 TOTAL VOLUME OF UNTREATED OVERFLOW                =      9.360 INCHES

 TOTAL VOLUME OF RUNOFF                            =    302.193 INCHES
 DRY WEATHER FLOW DURING RUNOFF
 COMPUTED AS HOURS OF RUNOFF X DRY WEATHER FLOW
      5560 HOURS X      0.000 IN/HR                =      0.000 INCHES

 PERCENT CAPTURE                                   =     96.903 PERCENT
```

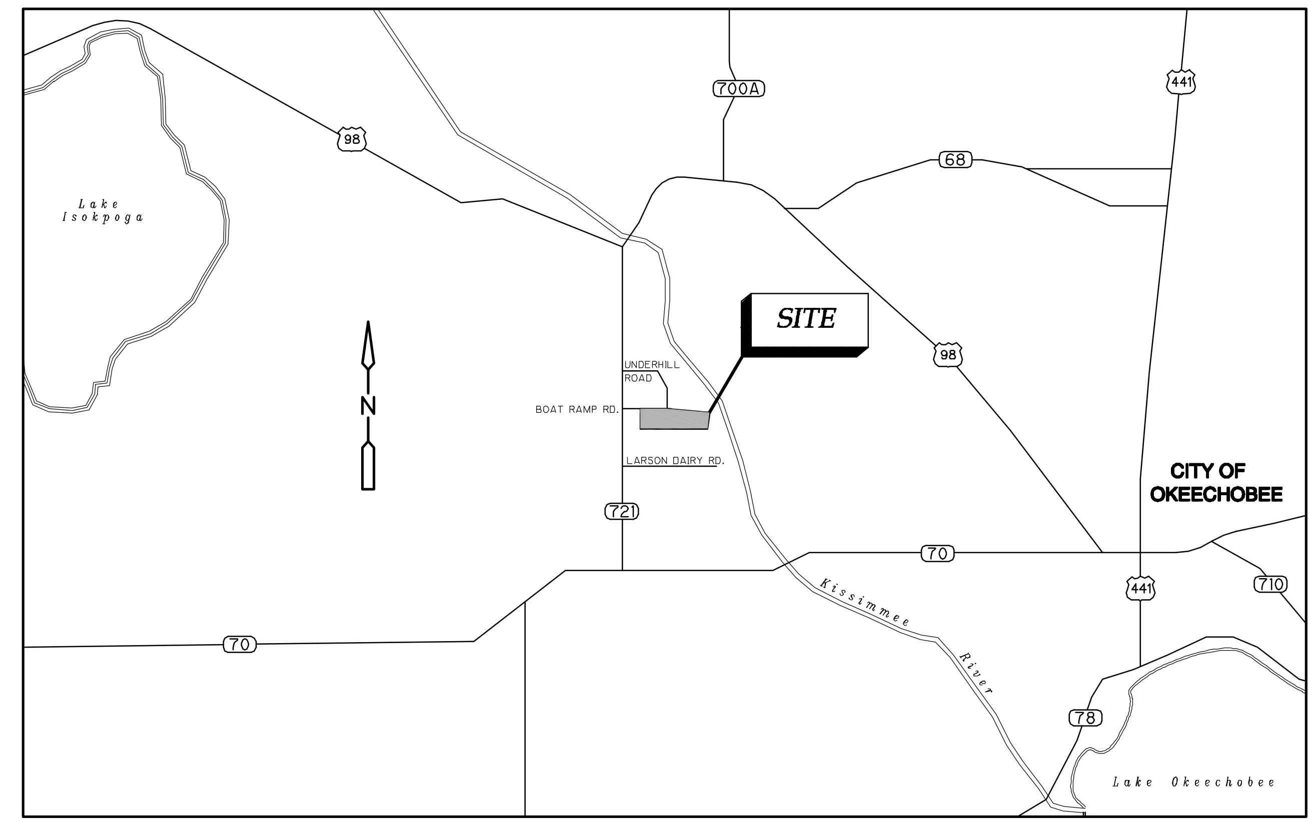
Appendix C
Design Drawings

DESIGN/BUILD PHASE OF THE DAIRY BEST AVAILABLE TECHNOLOGIES PROJECT - SFWMD CONTRACT C-11652

BUTLER OAKS FARM, INC.



VICINITY PLAN
NTS



SECTIONS 3, 4, 5, TOWNSHIP 37 SOUTH, RANGE 33 EAST
SECTIONS 31 & 33, TOWNSHIP 36 SOUTH, RANGE 33 EAST
SECTION 36, TOWNSHIP 36 SOUTH, RANGE 32 EAST

LOCATION MAP
NTS

FEBRUARY 2003

ROYAL CONSULTING SERVICES, INC.

RCS PROJECT NO. 0110-01

PROFESSIONAL ENGINEER STATE OF FLORIDA

GENERAL
CIVIL
MECHANICAL

Brian L. Roy, P.E.
No. 45366

ELECTRICAL
INSTRUMENTATION

Larry M. Smith, P.E.
No. 45997

PRELIMINARY
NOT FOR CONSTRUCTION

Royal Consulting Services, Inc.
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(561) 616-3911 fax (561) 616-3912

LEGEND

	STORM SEWER
M.H. SAN. S.	EXISTING SANITARY SEWER W/ MANHOLE
IRR	EXISTING IRRIGATION LINE
T	EXISTING BURIED TELEPHONE
P	EXISTING POWER DUCTS OR CABLES
E	OVERHEAD ELECTRIC
C.B. 15" S.S.	EXISTING STORM SEWER W/CATCH BASIN
or P.P.	EXISTING POWER POLE
or L.P.	EXISTING LIGHT POLE
	R/W - RIGHT OF WAY
	℘ - PROPERTY LINE
	JURISDICTIONAL BOUNDARY
	LIMITS OF CONSTRUCTION
	EASEMENTS
	WATER ELEVATION
	BASE LINE
	PROPOSED SILT FENCE
	STORMSEWER TO BE CONST. UNDER EXISTING UTILITY
	STORMSEWER TO BE CONST. OVER EXISTING UTILITY
	BENCH MARK
	EXISTING BARBED WIRE FENCE
	NEW BARBED WIRE FENCE
12.00	EXISTING CONTOUR
12.00	PROPOSED CONTOUR
× 12.00	EXISTING SPOT ELEVATION
51.32	PROPOSED SPOT ELEVATION
X-8	DRAINAGE STRUCTURE ID
	DITCH BOTTOM INLET
	STORMWATER MANHOLE

ABBREVIATIONS

ADJUSTABLE	ADJ	NOT TO SCALE	NTS
AHEAD OF STATION	AH	NUMBER	NO
ALUMINUM	AL, ALUM	ON CENTER	OC
ANGLE	<	OPPOSITE	OPP
BACK OF STATION	BK	OPTION	OPT
BALL VALVE	BAV	OPENING	OPNG
BASELINE OF SURVEY	℄	OR EQUAL	O/E
BELOW	BEL	PAVEMENT	PVMT, PAVT
BENCHMARK	BM	PERFORATED	PERF
BETWEEN	BTWN	POINT OF CURVATURE	POC
BITUMINOUS COATED CORRUGATED METAL PIPE	BCCMP	POINT OF TANGENCY	POT
BURIED TELEPHONE	BT	POINT	PT
CENTER LINE OF CONSTRUCTION	℄	POLYETHYLENE PIPE	PP
CENTER TO CENTER	CC	POLYVINYL CHLORIDE	PVC
CONCRETE	CONC	POUND(S)	LB(S)
CONCRETE BOX CULVERT	CBC	PLATE	PL
CONSTRUCT	CONST	PRECAST	PRCST
CORRUGATED METAL PIPE	CMP	PROFILE GRADE LINE	PGL
CENTER (ED)	CTR	RADIUS	RAD, R
CROSS SECTION	X-SEC	REINFORCED CONCRETE PIPE	RCP
DEMOLITION	DEMO	REQUIRED	REQ'D
DIAMETER	DIA, DIAM	RESTRAINED JOINT	RJ
DIAGONAL	DIAG	RIGHT	RT, R
DIMENSION	DIM	RIGHT OF WAY	R/W, ROW
DOWNSTREAM	D/S	SANITARY SEWER	SAN, S
DISCHARGE	DISCH	SECTION	SEC
DITCH BOTTOM INLET	DBI	SHEET	SH, SHT
DRAWING	DWG	SIDEWALK	SDWK, S/W
DUCTILE IRON PIPE	DIP	SLIP-ON JOINT	SJ
DUCTILE IRON	DI	SQUARE FEET	SQ. FT., SF
EACH	EA	STAINLESS STEEL	SS
ELEVATION	EL, ELEV	STANDARD	ST'D
EDGE OF PAVEMENT	EOP, EP	STATION	STA
EXISTING	EXIST	STEEL	STL
FIBERGLASS REINFORCED PIPE	FRP	STEEL PIPE	SP
FINISH	FIN	STORM SEWER	SS, STORM
FLANGE	FLG	SYMMETRICAL	SYMM
FLARED END SECTION	FES	TANGENT TO CURVE	TC
FLOOR	FL	TEMPORARY CONSTRUCTION EASEMENT	TCE
FURNISHED BY OTHERS	FBO	THICK	THK
FEET/FOOT	FT	TIED JOINT	TJ
GALVANIZED STEEL PIPE	GSP	TOP OF CURB	TOC
HEIGHT	HT	TYPICAL	TYP
HIGH POINT	HP	TEMPORARY	TEMP
INSTALL	INST	UPSTREAM	U/S
LEFT	L, LT	UTILITY EASEMENT	UE
LOW POINT	LP	VERIFIED VERTICAL ELEVATION AND HORIZONTAL LOCATION	Vvh, VVH
MATERIAL	MTL	VERTICAL	VERT
MANHOLE	MH	VERTICAL CURVE	VC
MAXIMUM	MAX	WATER	WTR
MECHANICAL	MECH	WATER LEVEL	WL
METAL	MET	WATER MAIN	WM
MINIMUM	MIN	WEATHERPROOF	WPF
MITERED END SECTION	MES	WEST	W
MOUNTED	MTD	WITH	W/
NOMINAL	NOM		
NOT IN CONTRACT	NIC		

EROSION CONTROL NOTES

IT IS THE CONTRACTORS RESPONSIBILITY TO IMPLEMENT THE EROSION AND TURBIDITY CONTROLS AS SHOWN ON THE EROSION AND TURBIDITY CONTROL PLAN. IT IS ALSO THE CONTRACTORS RESPONSIBILITY TO ENSURE THESE CONTROLS ARE PROPERLY INSTALLED, MAINTAINED AND FUNCTIONING PROPERLY TO PREVENT TURBID OR POLLUTED WATER FROM LEAVING THE PROJECT SITE. THE CONTRACTOR WILL ADJUST THE EROSION AND TURBIDITY CONTROLS SHOWN ON THE EROSION AND TURBIDITY CONTROL PLAN AND ADD ADDITIONAL CONTROL MEASURES, AS REQUIRED,TO ENSURE THE SITE MEETS ALL FEDERAL, STATE AND LOCAL EROSION AND TURBIDITY CONTROL REQUIREMENTS. THE FOLLOWING BEST MANAGEMENT PRACTICES WILL BE IMPLEMENTED BY THE CONTRACTOR AS REQUIRED BY THE EROSION AND TURBIDITY CONTROL PLAN AND AS REQUIRED SITE BY THE REGULATORY AGENCIES.

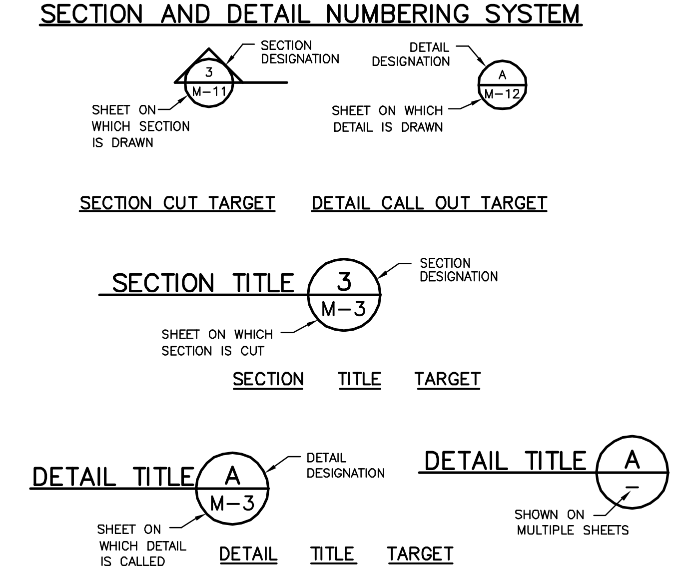
1. SEDIMENT BASINS AND TRAPS, PERIMETER DITCHES, SEDIMENT BARRIERS AND OTHER MEASURES INTENDED TO TRAP SEDIMENT SHALL BE CONSTRUCTED AS A FIRST STEP BEFORE ANY LAND-DISTURBING TAKES PLACE TO MEET THE EROSION AND TURBIDITY REQUIREMENTS IMPOSED ON THE PROJECT.
2. ALL SEDIMENT CONTROL MEASURES ARE TO BE ADJUSTED TO MEET FIELD CONDITIONS AT THE TIME OF CONSTRUCTION AND BE CONSTRUCTED PRIOR TO ANY GRADING OR DISTURBANCE OF EXISTING SURFACE MATERIAL ON BALANCE OF SITE. PERIMETER SEDIMENT BARRIERS SHALL BE CONSTRUCTED TO PREVENT SEDIMENT OR TRASH FROM FLOWING OR FLOATING ON TO ADJACENT PROPERTIES.
3. DURING CONSTRUCTION OF THE PROJECT. SOIL STOCK PILES SHALL BE STABILIZED OR PROTECTED WITH SEDIMENT TRAPPING MEASURES. THE CONTRACTOR IS RESPONSIBLE FOR THE TEMPORARY PROTECTIONS AND PERMANENT STABILIZATION OF ALL SOIL STOCKPILES ON SITE AS WELL AS SOIL INTENTIONALLY TRANSPORTED FROM THE PROJECT SITE.
4. AFTER ANY SIGNIFICANT RAINFALL SEDIMENT CONTROL STRUCTURES WILL BE INSPECTED FOR INTEGRITY. ANY DAMAGED DEVICES SHALL BE REPAIRED IMMEDIATELY.
5. CONCENTRATED RUNOFF SHALL NOT FLOW DOWN CUT OR FILL SLOPES UNLESS CONTAINED WITHIN AN ADEQUATE TEMPORARY OR PERMANENT CHANNEL, FLUME OR SLOPE DRAIN STRUCTURE.
6. WHENEVER WATER SEEPS FROM A SLOPE FACE ADEQUATE DRAINAGE OR OTHER PROTECTION SHALL BE PROVIDED.
7. SEDIMENT WILL BE PREVENTED FROM ENTERING ANY STORM DRAIN SYSTEM, DITCH, OR CHANNEL. ALL STORM SEWER INLETS THAT ARE MADE OPERABLE DURING CONSTRUCTION SHALL BE PROTECTED SO THAT SEDIMENT-LADEN WATER CANNOT ENTER THE CONVEYANCE SYSTEM WITHOUT FIRST BEING FILTERED OR OTHERWISE TREATED TO REMOVE SEDIMENT. GRATE INLETS AND CURB INLETS SHALL BE PROTECTED WITH GRATE INLET PROTECTION PCD-1000 AND CURB INLET PROTECTION PRODUCED BY SUNTREE ISLES, INC., OR APPROVED EQUAL.
8. BEFORE TEMPORARY OR NEWLY CONSTRUCTED STORMWATER CONVEYANCE CHANNELS ARE MADE OPERATIONAL ADEQUATE OUTLET PROTECTION AND ANY REQUIRED TEMPORARY OR PERMANENT CHANNEL LINING SHALL BE INSTALLED IN BOTH THE CONVEYANCE CHANNEL AND RECEIVING CHANNEL.
9. WHEN WORK IN A LIVE WATERCOURSE IS PERFORMED, PRECAUTIONS SHALL BE TAKEN TO MINIMIZE ENRICHMENT. CONTROL SEDIMENT TRANSPORT AND STABILIZE THE WORK AREA TO THE GREATEST EXTENT POSSIBLE DURING CONSTRUCTION. NONERODIBLE MATERIAL SHALL BE USED FOR THE CONSTRUCTION OF CAUSEWAYS AND COFFERDAMS. EARTHEN FILL MAY BE USED FOR THESE STRUCTURES IF ARMORED BY NONERODIBLE COVER MATERIALS.
10. STOCKPILING MATERIAL: NO EXCAVATED MATERIAL SHALL BE STOCKPILED IN SUCH A MANNER AS TO DIRECT RUNOFF DIRECTLY OFF THE PROJECT SITE INTO ANY ADJACENT WATER BODY OR STORM WATER COLLECTION FACILITY.
11. EXPOSED AREA LIMITATION: THE SURFACE AREA OF OPEN, RAW ERODIBLE SOIL EXPOSED BY CLEARING AND GRUBBING OPERATIONS OR EXCAVATION AND FILLING OPERATIONS SHALL NOT EXCEED 5 ACRES. IF THE TOTAL AREA TO BE CLEARED IS EQUAL TO, OR EXCEEDS FIVE (5) ACRES, THEN THE CONTRACTOR WILL BE RESPONSIBLE FOR PREPARING A STORMWATER POLLUTION PREVENTION PLAN (SWPPP) IN ACCORDANCE WITH EPA'S NPDES REGULATIONS. THE CONTRACTOR WILL BE RESPONSIBLE FOR SUBMITTING FDEP'S NOTICE ON INTENT (NOI) TO EPA FORTH-EIGHT (48) HOURS PRIOR TO COMMENCING CONSTRUCTION.
12. TEMPORARY SEEDING: AREAS OPENED BY CONSTRUCTION OPERATIONS AND THAT ARE NOT ANTICIPATED TO BE RE-EXCAVATED OR DRESSED AND RECEIVE FINAL GRASSING TREATMENT WITHIN 30 DAYS SHALL BE SEEDED WITH A QUICK GROWING GRASS SPECIES WHICH WILL PROVIDE AN EARLY COVER DURING THE SEASON IN WHICH IT IS PLANTED AND WILL NOT LATER COMPETE WITH THE PERMANENT GRASSING.
13. TEMPORARY SEEDING AND MULCHING: SLOPES STEEPER THAN 6:1 THAT FALL WITHIN THE CATEGORY ESTABLISHED IN PARAGRAPH 12 ABOVE, A SUFFICIENT AMOUNT OF MULCH MATERIAL SHALL BE CUT INTO THE SOIL OF THE SEEDED AREA ADEQUATE TO PREVENT MOVEMENT OF SEED AND MULCH.
14. TEMPORARY GRASSING: THE SEEDED OR SEEDED AND MULCHED AREA(S) SHALL BE ROLLED AND WATERED OR HYDROMULCHED OR OTHER SUITABLE METHODS IF REQUIRED TO ASSURE OPTIMUM GROWING CONDITIONS FOR THE ESTABLISHMENT OF A GOOD GRASS COVER. TEMPORARY GRASSING SHALL BE THE SAME MIX & AMOUNT REQUIRED FOR PERMANENT GRASSING IN THE CONTRACT SPECIFICATIONS.
15. TEMPORARY REGRASSING : IF, AFTER 14 DAYS FROM SEEDING, THE TEMPORARY GRASSED AREAS HAVE NOT ATTAINED A MINIMUM OF 75 PERCENT GOOD GRASS COVER, THE AREA WILL BE REWORKED AND ADDITIONAL SEED APPLIED SUFFICIENT TO ESTABLISH THE DESIRED VEGETATIVE COVER.
16. MAINTENANCE: ALL FEATURES OF THE PROJECT DESIGNED AND CONSTRUCTED TO PREVENT EROSION AND SEDIMENT SHALL BE MAINTAINED DURING THE LIFE OF THE CONSTRUCTION SO AS TO FUNCTION AS THEY WERE ORIGINALLY DESIGNED AND CONSTRUCTED.
17. PERMANENT EROSION CONTROL: THE EROSION CONTROL FACILITIES OF THE PROJECT SHOULD BE DESIGNED TO MINIMIZE THE IMPACT ON THE OFFSITE FACILITIES.
18. PERMANENT SEEDING: ALL AREAS WHICH HAVE BEEN DISTURBED BY CONSTRUCTION WILL, AS A MINIMUM, BE SEEDED. THE SEEDING MIX MUST PROVIDE BOTH LONG-TERM VEGETATION AND RAPID GROWTH SEASONAL VEGETATION. SLOPES STEEPER THAN 4:1 SHALL BE SEEDED AND MULCHED OR SODDED.

INDEX OF SHEETS

GENERAL NOTES

1. ALL ELEVATIONS ARE REFERRED TO NATIONAL GEODETIC VERTICAL DATUM OF 1929.
   HORIZONTAL CONTROL/COORDINATES SHOWN HEREON REFER TO STATE PLANE COORDINATE SYSTEM OF 1983 WITH THE 1990 ADJUSTMENT FOR FLORIDA EAST ZONE
2. LOCATIONS, ELEVATIONS, AND DIMENSIONS OF EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES ARE SHOWN ACCORDING TO THE BEST INFORMATION AVAILABLE AT THE TIME OF PREPARATION OF THESE PLANS, BUT DO NOT PURPORT TO BE ABSOLUTELY CORRECT. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL VERIFY AND AGREE TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES AFFECTING HIS WORK.
3. THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE UTILITY COMPANY SEVENTY-TWO (72) HOURS IN ADVANCE OF ANY EXCAVATION INVOLVING ITS UTILITIES SO THAT A COMPANY REPRESENTATIVE CAN BE PRESENT. THE LOCATION OF THE UTILITIES SHOWN IN THE PLANS ARE APPROXIMATE ONLY. THE EXACT LOCATION SHALL BE DETERMINED BY THE CONTRACTOR DURING CONSTRUCTION.
4. THE CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY IF OTHER UTILITIES (NOT SHOWN IN THE PLANS) EXIST WITHIN THE AREA OF CONSTRUCTION. SHOULD THERE BE OTHER UTILITIES, THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE UTILITY OWNERS TO RESOLVE UTILITY CONFLICTS AND UTILITY ADJUSTMENTS, AS REQUIRED. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTION OF ALL UTILITIES TO REMAIN IN PLACE.
5. TOPOGRAPHIC SURVEY WAS PERFORMED BY:
   F.R.S. & ASSOCIATES, INC.
   GARY P. WILLIAMS, R.L.S.
   901 NORTHOINT PARKWAY, SUITE 301
   WEST PALM BEACH, FLORIDA 33407
   PHONE: 561-478-7178
   FAX: 561-478-7922
6. THE CONTRACTOR SHALL CONTACT THE ENGINEER'S OFFICE IMMEDIATELY UPON FINDING ANY CONFLICTS DURING CONSTRUCTION ON ANY IMPROVEMENTS SHOWN ON THE DRAWINGS.
7. EROSION CONTROL AND SEDIMENTATION CONTROL DEVICES SHALL BE IN PLACE PRIOR TO BEGINNING OF ANY CLEARING, GRUBBING, DEMOLITION OR CONSTRUCTION. THEY SHALL BE INSTALLED TO THE LIMITS SHOWN IN THE DRAWING, AS REQUIRED IN THE SPECIFICATIONS AND IN ACCORDANCE WITH ALL REGULATORY AGENCY REQUIREMENTS (SEE EROSION CONTROL NOTES)
8. THE CONTRACTOR SHALL REPLACE ANY MONUMENTS, FENCES, ETC. WITH THE SAME TYPE OF MATERIAL THAT WAS REMOVED DURING CONSTRUCTION.
9. ALL STATIONING AND OFFSET REFERS TO CONSTRUCTION BASELINE UNLESS OTHERWISE NOTED ON PLANS.
10. EXISTING UTILITIES AND FACILITIES SHOWN ON THE DRAWINGS WERE LOCATED FROM THE UTILITY OWNER'S RECORDS OF UNDERGROUND FACILITIES. GUARANTEE IS NOT MADE THAT ALL EXISTING FACILITIES ARE SHOWN NOR THAT THOSE FACILITIES SHOWN ARE ENTIRELY ACCURATE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COORDINATION / RELOCATION OF THE EXISTING UTILITIES.
11. THE LIMITS OF CONSTRUCTION SHOWN ON THE PLANS SHALL BE STRICTLY OBSERVED BY THE CONTRACTOR. ALL INGRESS, EGRESS AND TRAFFIC PATTERNS ON THE SITE SHALL BE WITHIN THE LIMITS OF CONSTRUCTION SHOWN ON THE DRAWINGS.
12. DURING CONSTRUCTION OF THE IMPROVEMENTS, THE CONTRACTOR IS RESPONSIBLE FOR REMOVAL, PROTECTION, AND REPLACEMENT OF ITEMS ON PRIVATE PROPERTY AND PUBLIC RIGHTS OF WAY SUCH AS SPRINKLERS, FENCES, SOD, SHRUBS, TREES, SURVEYING MARKERS, ETC.
13. PRIOR TO EXCAVATING , THE CONTRACTOR SHALL NOTIFY THE EXISTING UTILITIES COMPANIES OWNERS IN ACCORDANCE WITH THE REQUIREMENTS OF FLORIDA STATUTES, PROTECTION OF UNDERGROUND PIPELINES F.S. 553.851, CH 17-143.
14. INSTALLATION OF ALL STORM SEWERS, INLETS, MANHOLES, BOX CULVERTS AND APPURTENANCES SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE APPLICABLE SECTIONS OF FLORIDA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS, OR AS INDICATED ON THE DRAWINGS.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL UTILITIES THAT MAY EXIST, ABOVE OR BELOW GROUND.
16. ALL BRUSH, STRIPPINGS OR UNSUITABLE MATERIAL SHALL BE DISPOSED OF ON-SITE AT THE CONTRACTOR'S EXPENSE.
17. STATION OFFSETS SHOWN ON PLANS ARE FROM CENTERLINE TO CENTERLINE OF STRUCTURE.
18. ALL PRIVATE AND PUBLIC PROPERTY AFFECTED BY THIS WORK SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN THE CONDITION EXISTING PRIOR TO COMMENCING CONSTRUCTION UNLESS SPECIFICALLY EXEMPTED BY THE PLANS. COSTS TO BE INCIDENTAL TO OTHER CONSTRUCTION AND NO EXTRA COMPENSATION TO BE ALLOWED.
19. SITE PREPARATION:
    A. DEWATERING MAY BE NEEDED PRIOR TO ANY EARTHWORK OPERATIONS.
    B. THE CONTRACTOR SHALL SUBMIT ANY MODIFICATIONS TO THE MAINTENANCE OF TRAFFIC FOR APPROVAL BY HIGHLANDS COUNTY BEFORE CONSTRUCTION BEGINS.
    C. EXISTING TRAFFIC CONTROL SIGNS SHALL BE MAINTAINED OPERATIONAL AT ALL TIMES.
20. REMOVE & REPLACE EXISTING FENCING PER DIRECTION OF ENGINEER. ALL FENCES SHALL MEET N.R.C.S. STANDARDS AND SPECIFICATIONS FOR FENCING CODE 382 FOR 5 STRANDED BARB WIRE. LINE POSTS SHALL BE 4" DIAMETER OR LARGER.
21. CONTRACTOR SHALL COMPLY AND MEET ALL STANDARD PRACTICES DEFINED BY N.R.C.S. AT CONTRACTOR'S EXPENSE.
22. THE CONTRACTOR IS REQUIRED TO PREPARE AND SUBMIT A POLLUTION PREVENTION PLAN PER F.D.E.P. AT THE CONTRACTOR'S EXPENSE.

SECTION AND DETAIL NUMBERING SYSTEM



BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

REVISION
NO. DATE

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

INDEX, ABBREVATIONS
GENERAL NOTES & LEGEND

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SHEET
G-1

JOB NO.	0110-01
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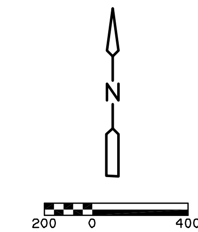
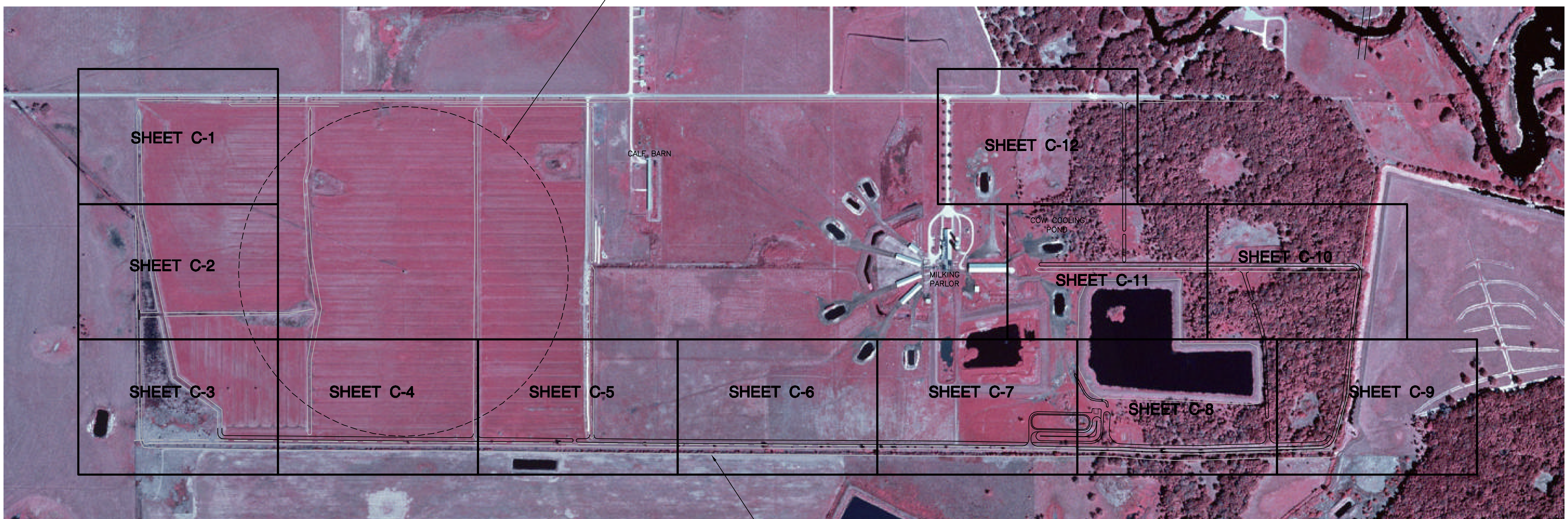


EXISTING CENTER PIVOT
IRRIGATION SYSTEM



NOTE:
CONTRACTOR SHALL CONSTRUCT 2 ADDITIONAL CANAL CROSSINGS LOCATIONS TO BE DETERMINED BY OWNER/ENGINEER (A / CD-1)

BUTLER OAKS FARM, INC.
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KEY PLAN

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BRIAN L. ROY
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SHEET
G-2

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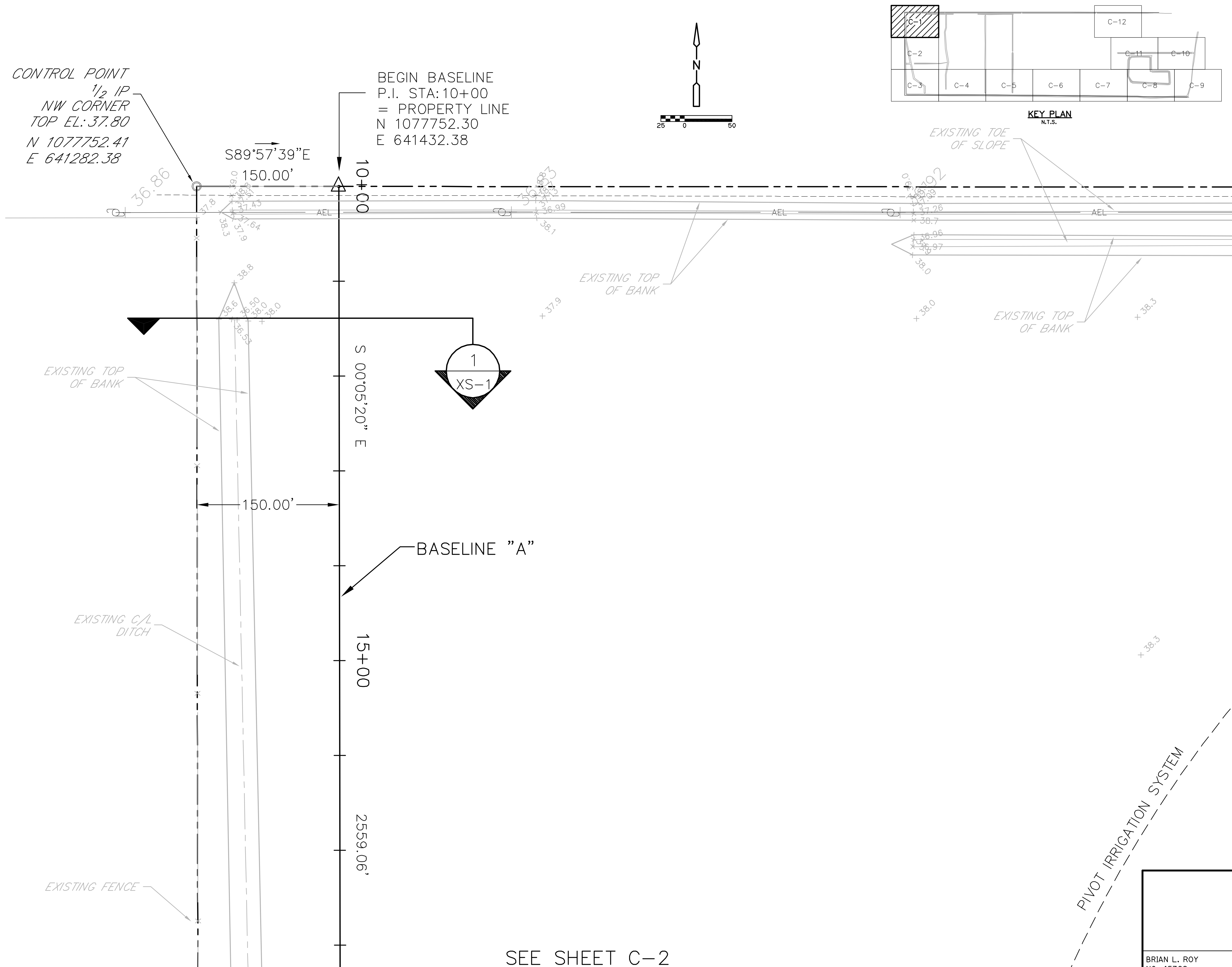

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SHEET
C-1

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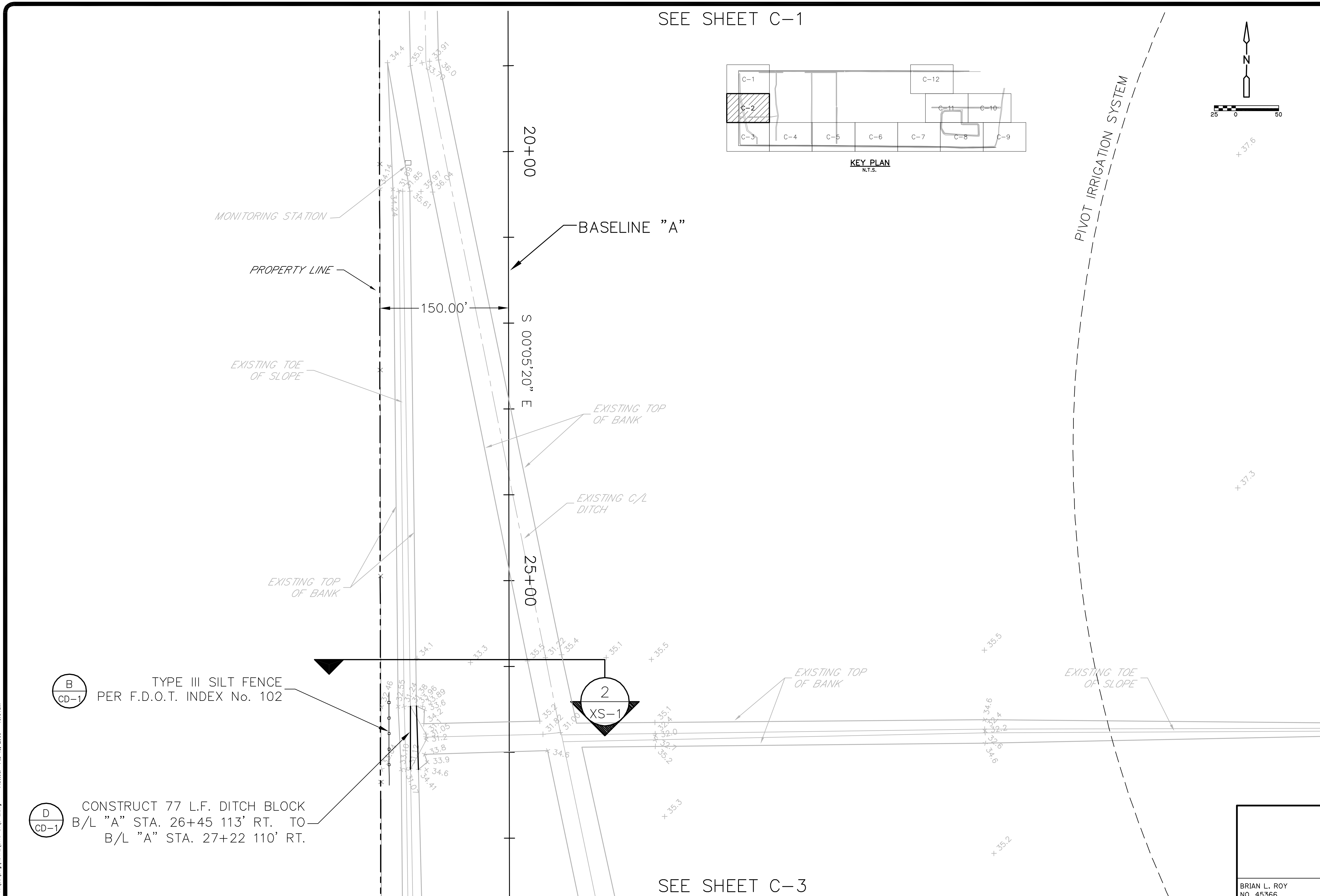

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SHEET C-2

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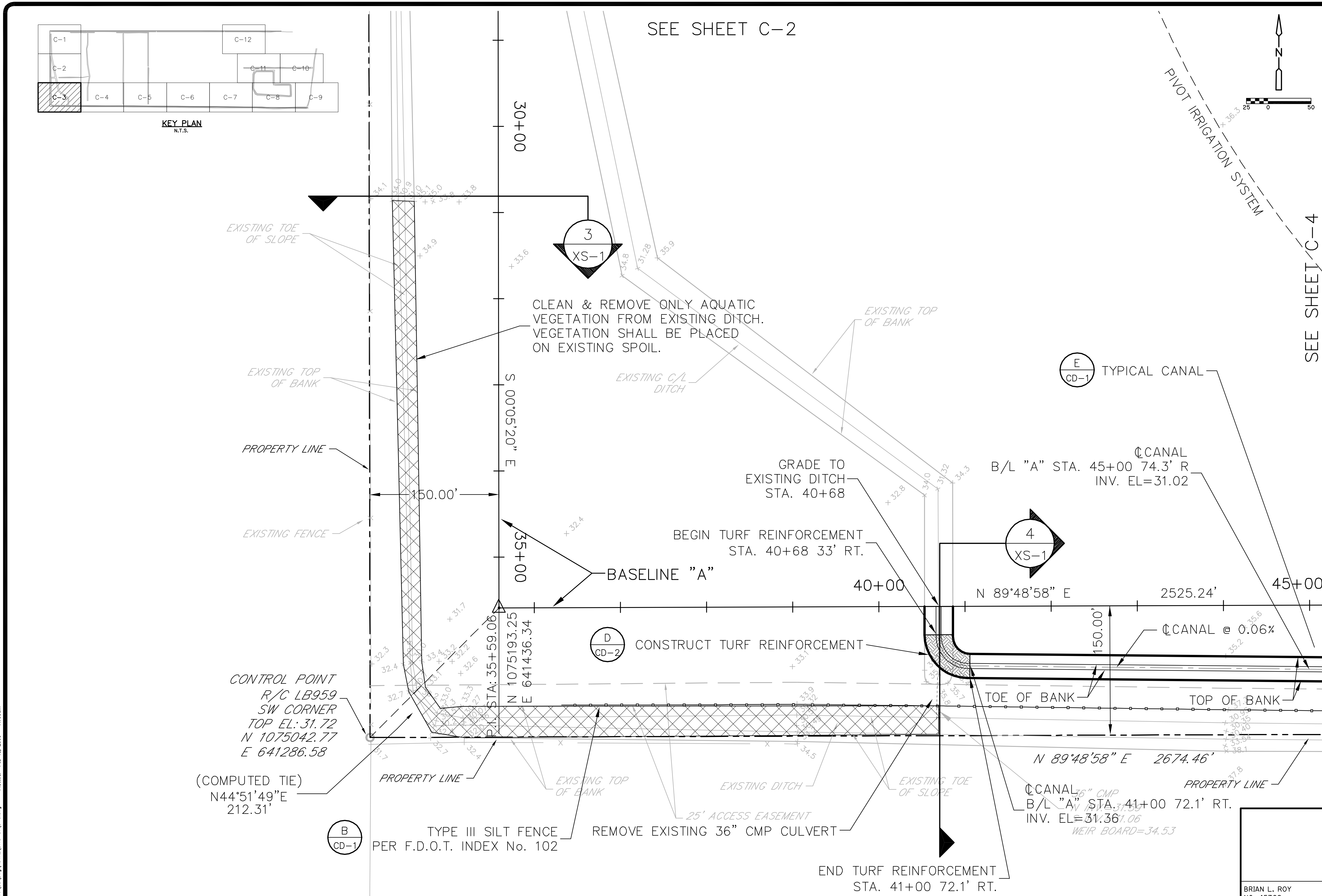

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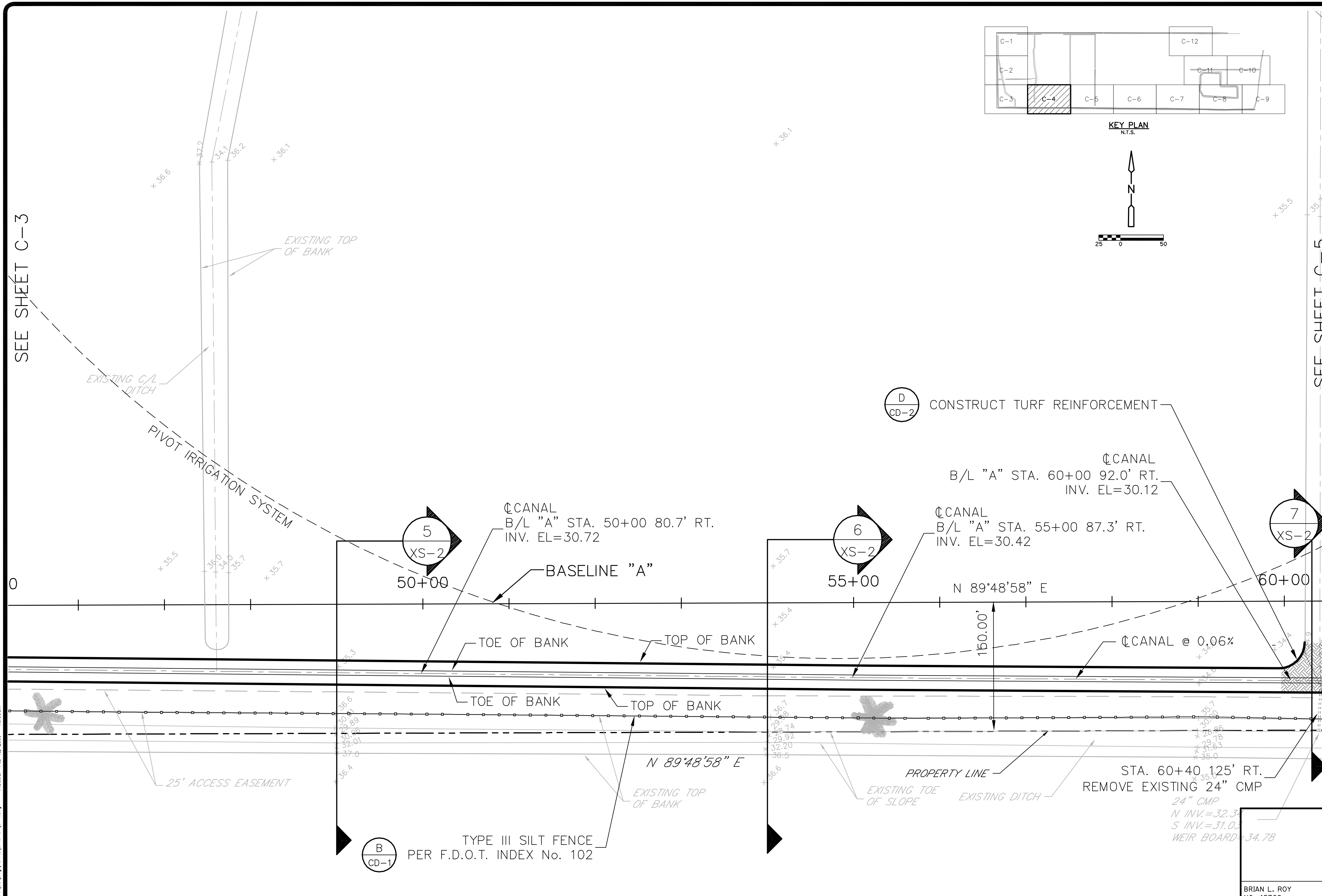
SHEET C-3



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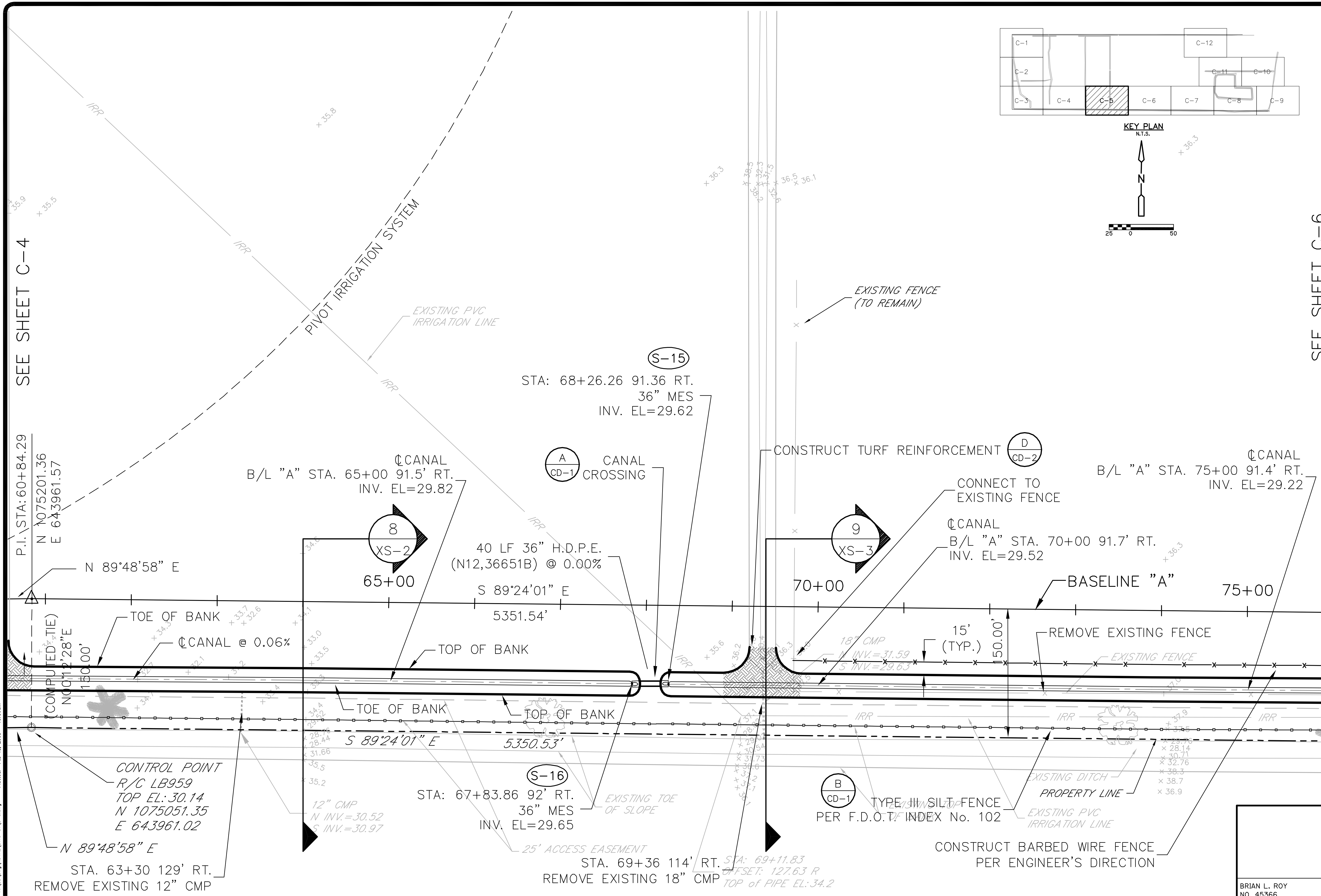
SHEET
C-4



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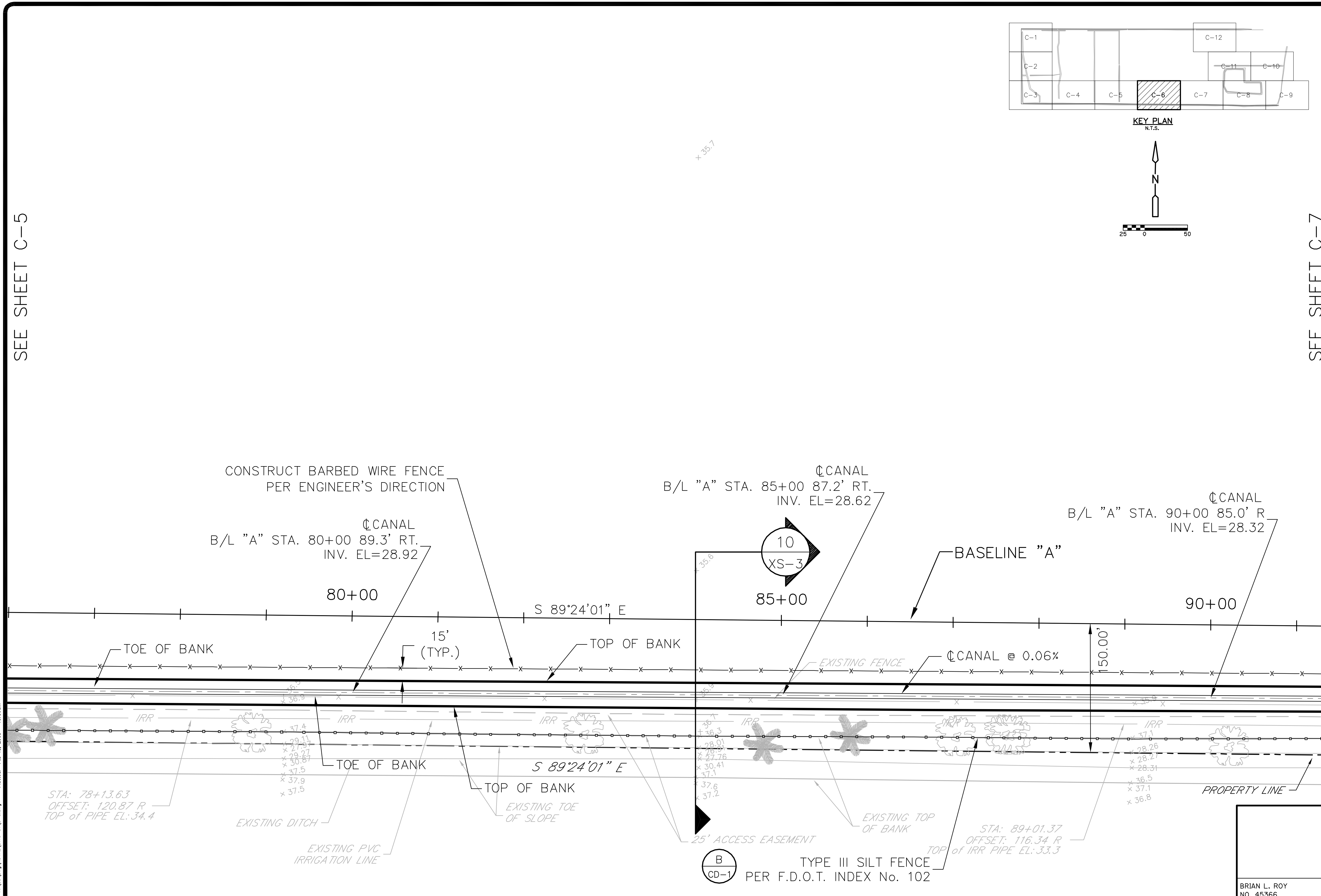

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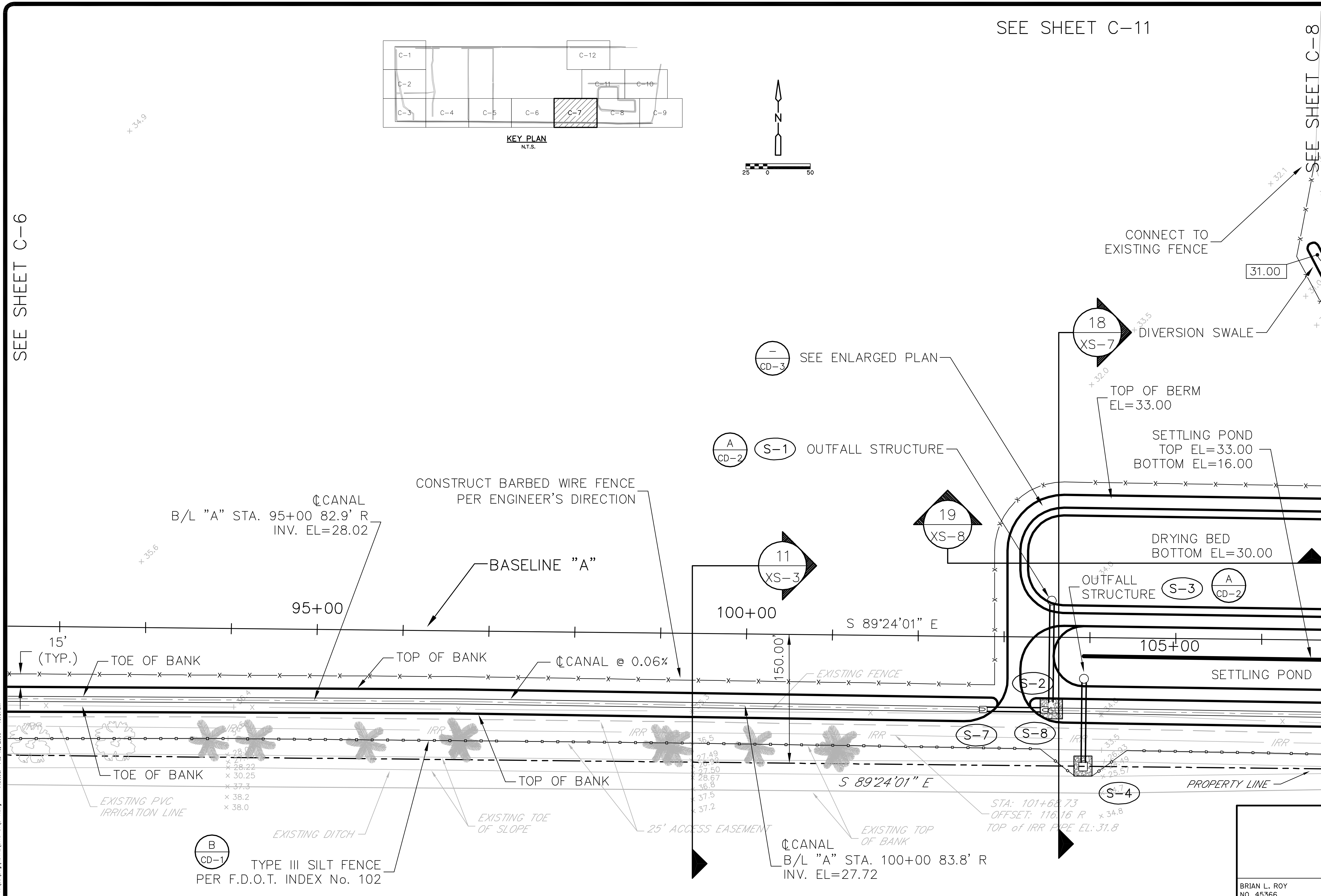


JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

REVISION

NO. DATE

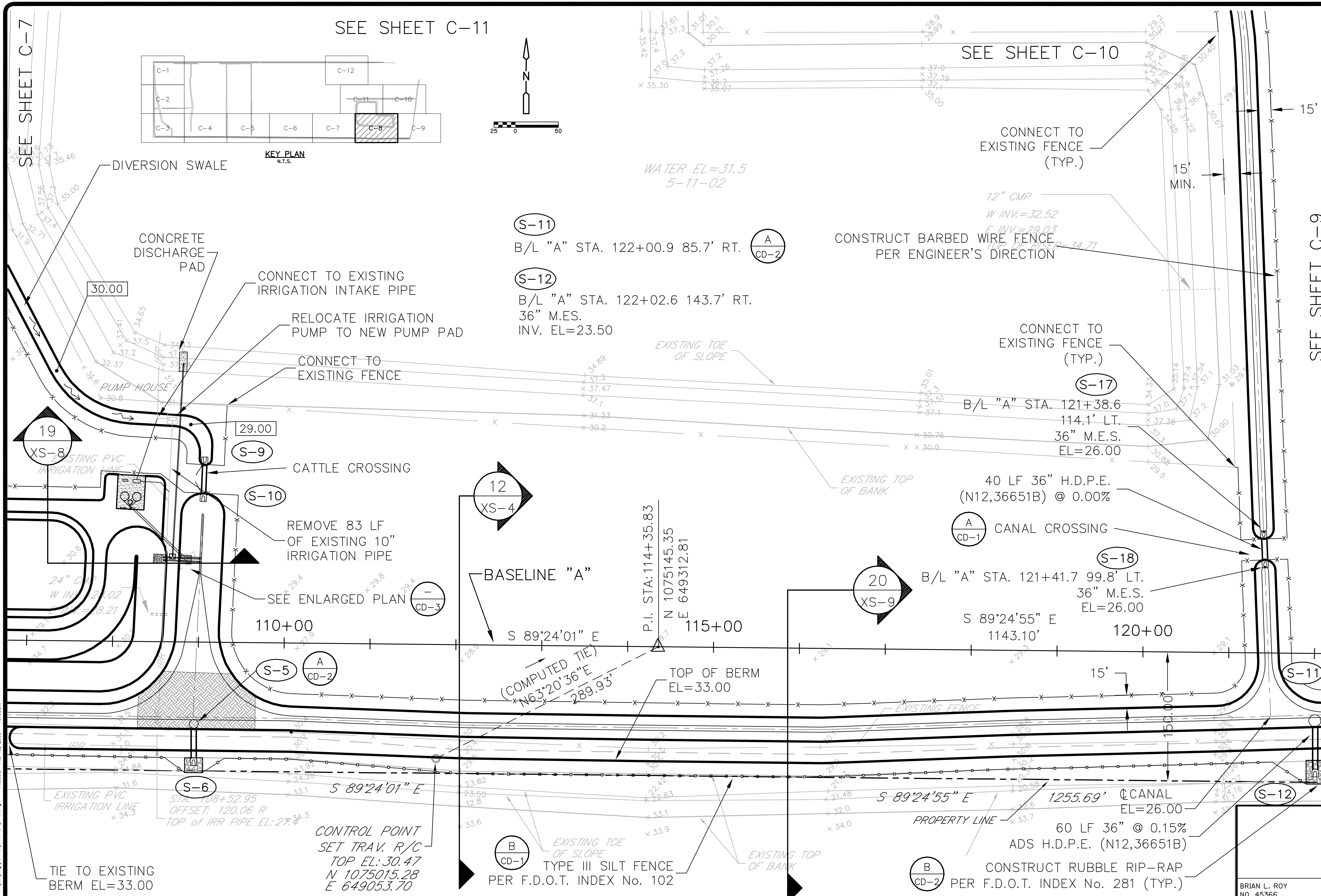
BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

SITE PLAN

Royal Consulting Services, Inc.
102 Frances Circle
Altamonte Springs, FL 32701
(407) 831-3095 phone
(407) 831-5095 fax
www.royalconsulting.com
FL COA No. 7290

SHEET C-7

F:\CD\Dwg\ROYAL\0110-01\C-7.dwg Plotted: Feb 18, 2003 – 10:57am



JOB NO. 0110-01
SCALE: AS SHOWN
DATE 2-19-03
DESIGN B.L.R.
DRAWN J.R.R.
CHECKED B.L.R.
APPROVED

NO.	DATE	REVISION

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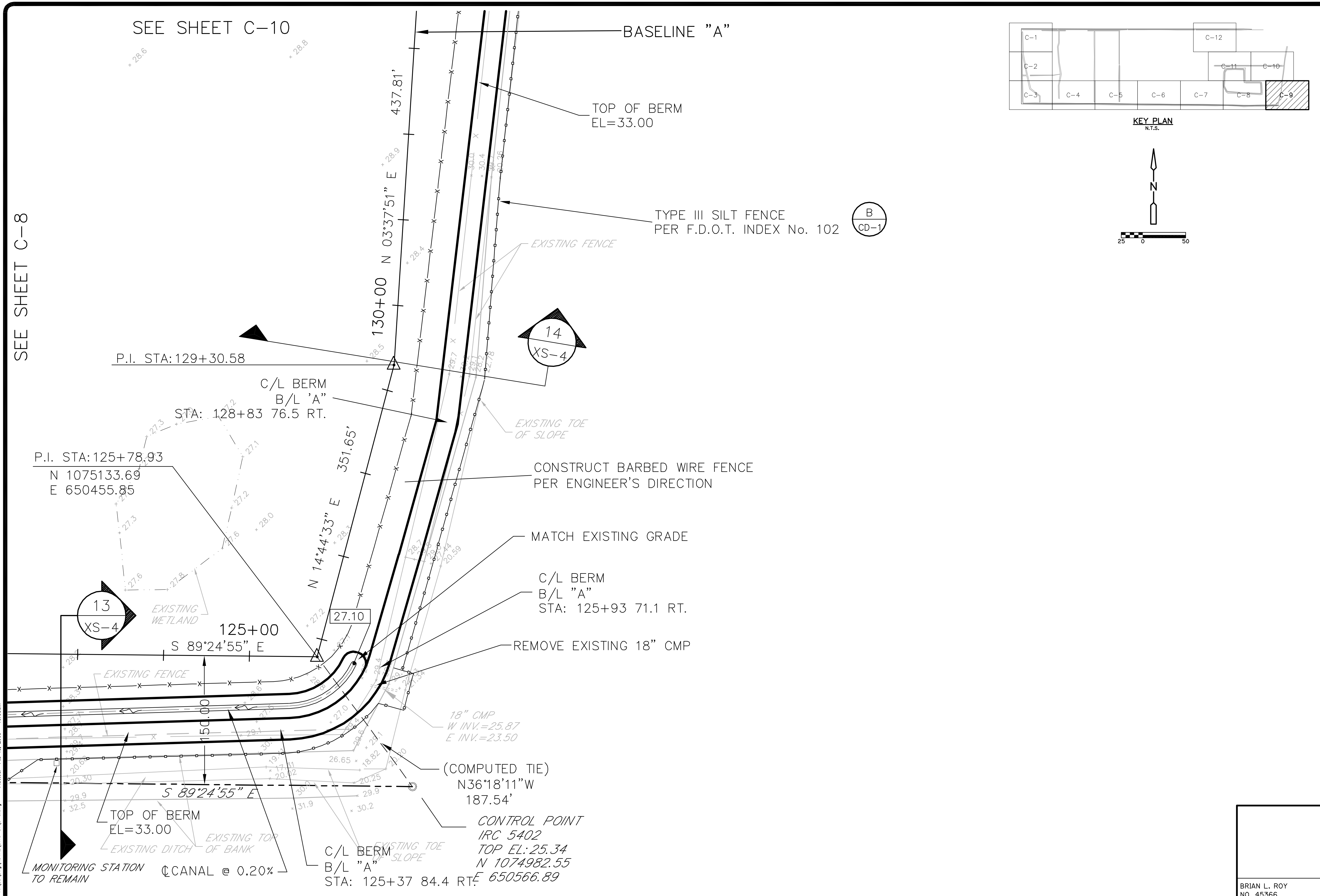
FL COA No. 7290

BRIAN L. ROY
NO. 45366

SHEET C-8



BRIAN L. ROY
NO. 45366

Plotted: Feb 18, 2003 – 10:58am
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JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO. DATE REVISION

BUTLER OAKS FARM, INC.
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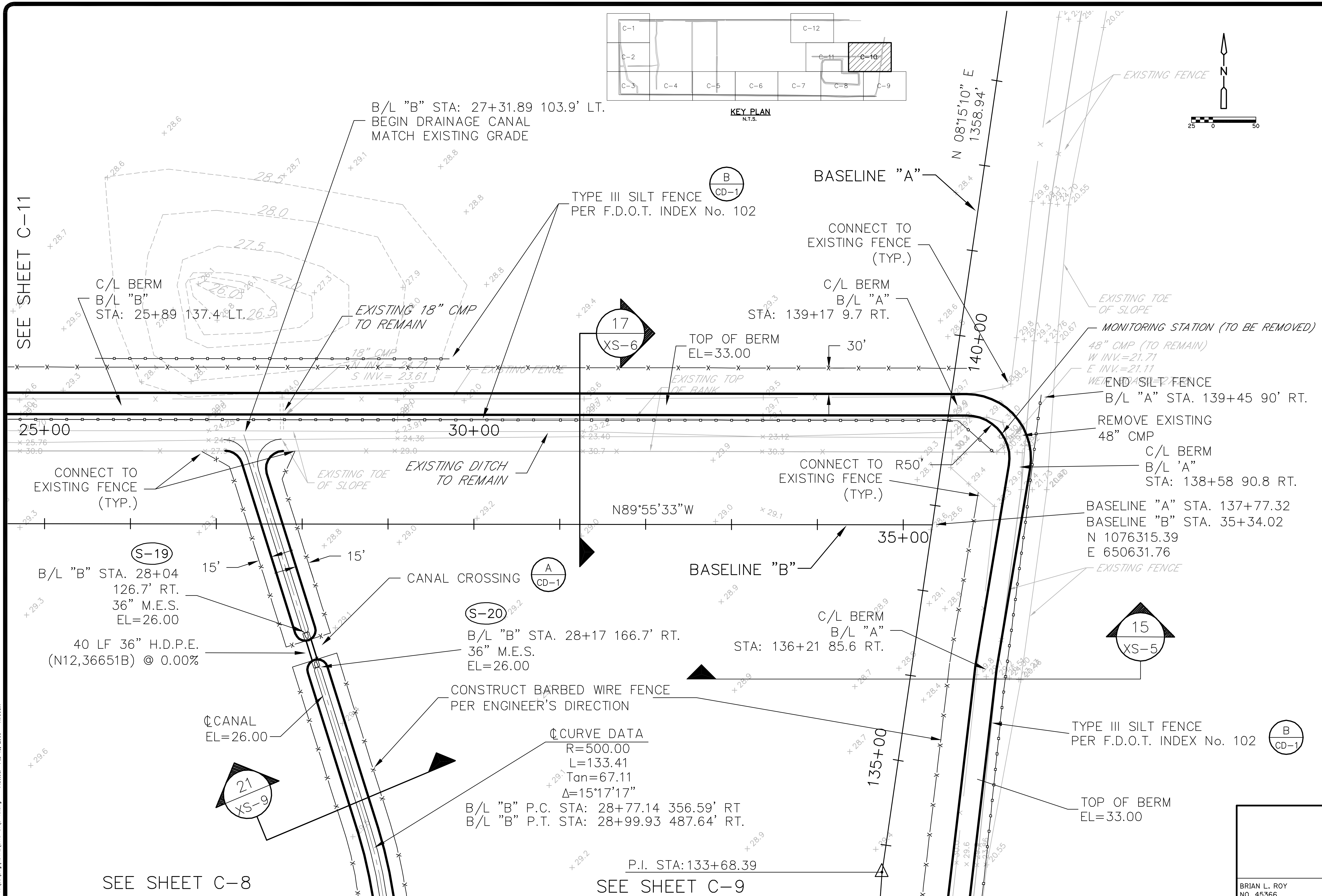
SHEET
C-9



JOB NO. 0110-01
SCALE: AS SHOWN
DATE 2-19-03
DESIGN B.L.R.
DRAWN J.R.R.
CHECKED B.L.R.
APPROVED

NO.	DATE	REVISION

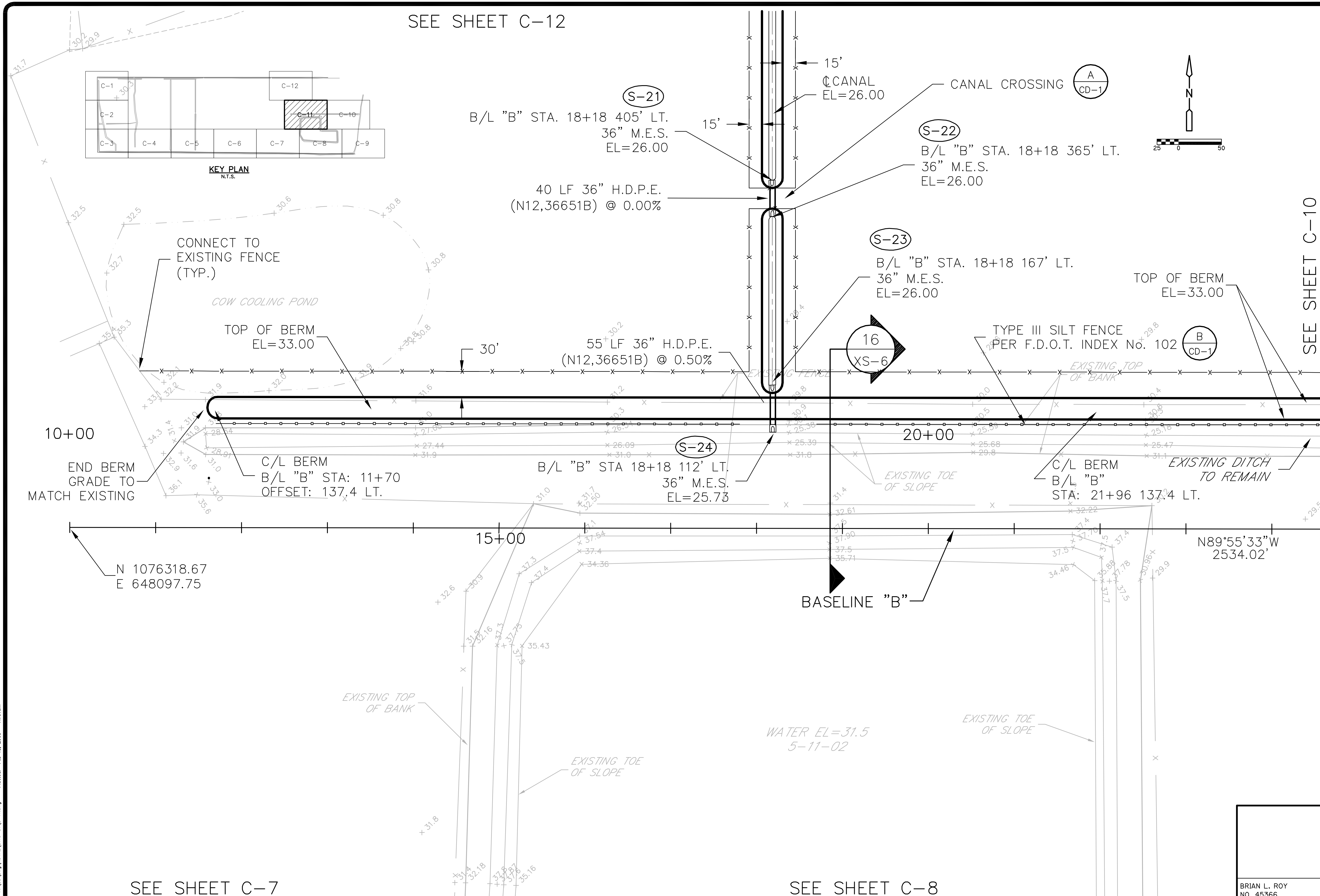
BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

SITE PLAN

Royal Consulting Services, Inc.

BRIAN L. ROY
NO. 45366

SHEET
C-10



JOB NO. 0110-01
SCALE: AS SHOWN
DATE 2-19-03
DESIGN B.L.R.
DRAWN J.R.R.
CHECKED B.L.R.
APPROVED

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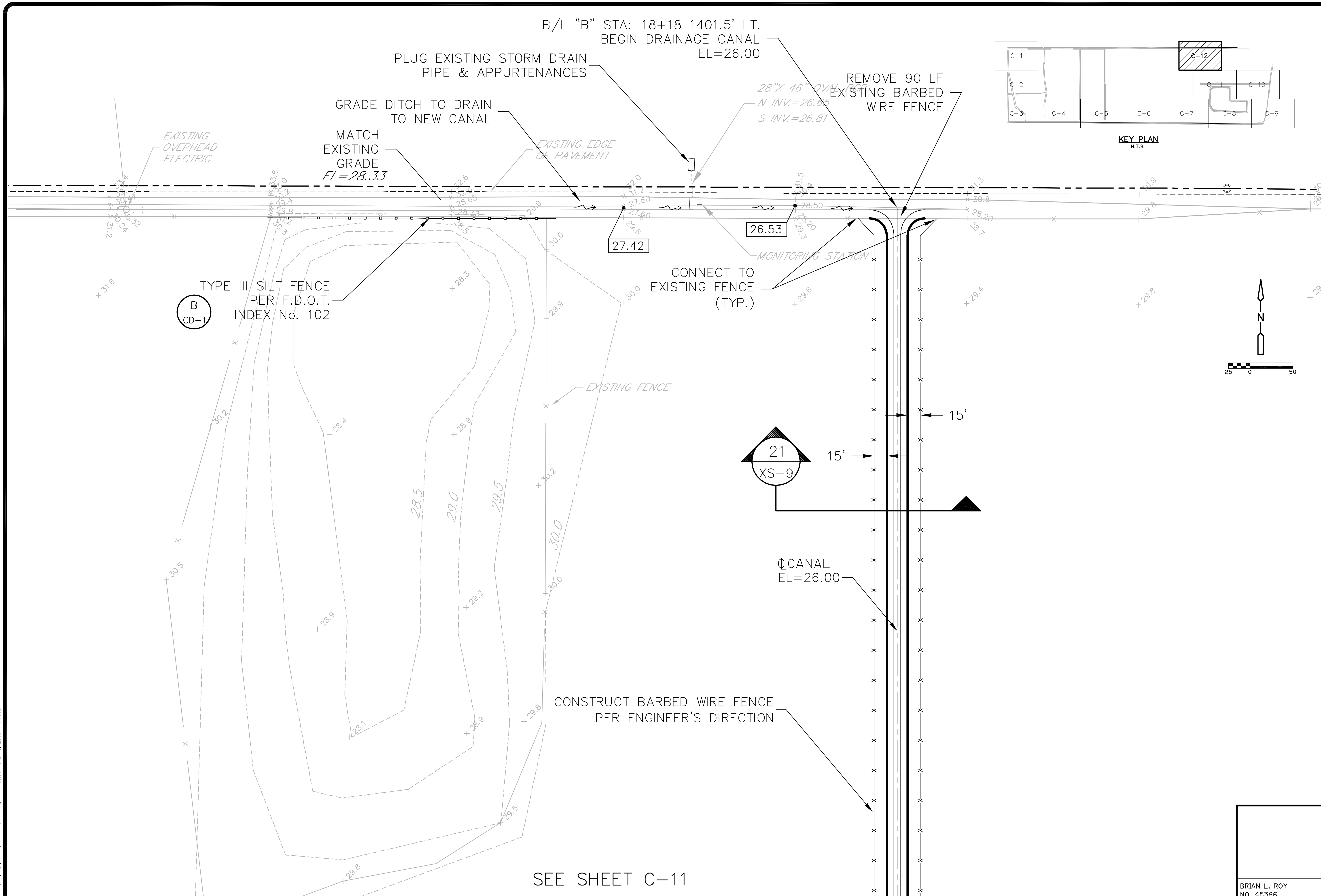
BRIAN L. ROY
NO. 45366

SHEET
C-11

F:\CD\Dwg\ROYAL\0110-01\C-11.dwg Plotted: Feb 19, 2003 - 11:01am



JOB NO. 0110-01
SCALE: AS SHOWN
DATE 2-19-03
DESIGN B.L.R.
DRAWN J.R.R.
CHECKED B.L.R.
APPROVED

REVISION

NO. DATE

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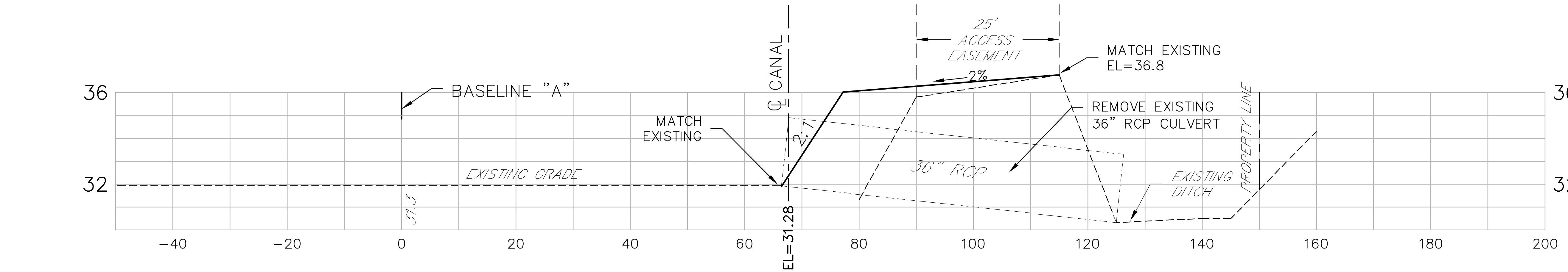
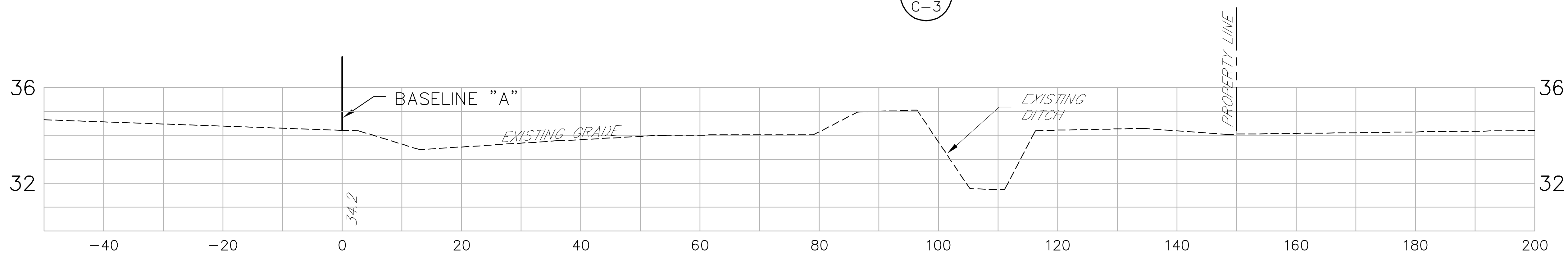
SHEET
C-12

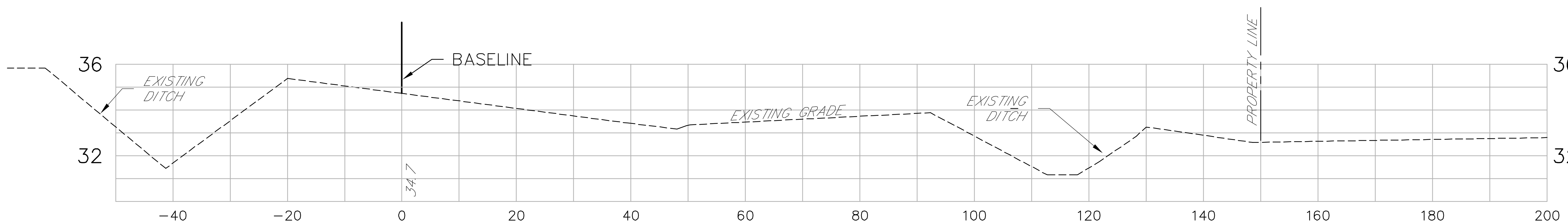
F:\CG\Dwg\ROYAL\0110-01\C-12.dwg Plotted: Feb 18, 2003 - 11:01am



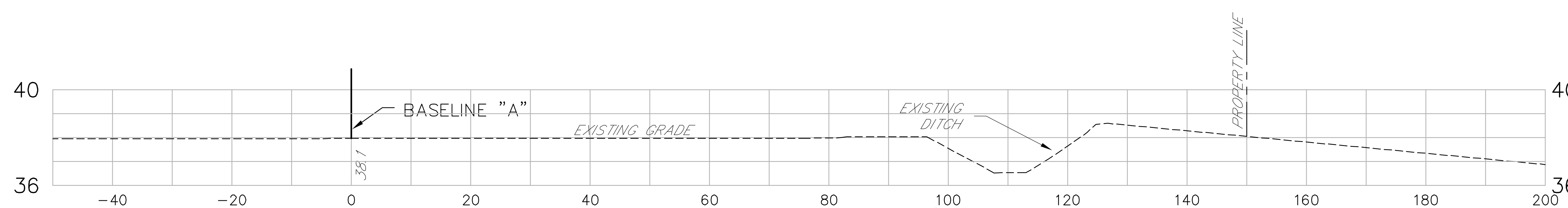
B/L "A" STA. 40+70 (4 / C-3)



B/L "A" STA. 31+00 (3 / C-3)



B/L "A" STA. 26+00 (2 / C-2)



B/L "A" STA. 11+40 (1 / C-1)

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO.	DATE	REVISION

BUTLER OAKS FARM, INC.
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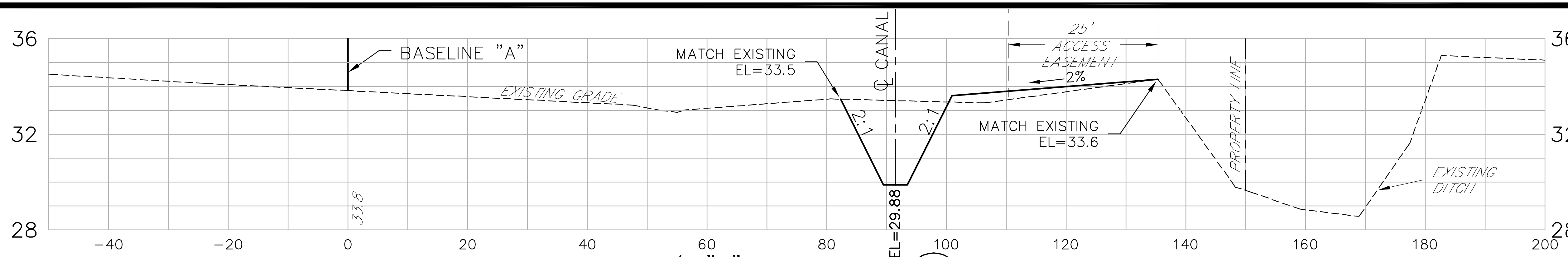
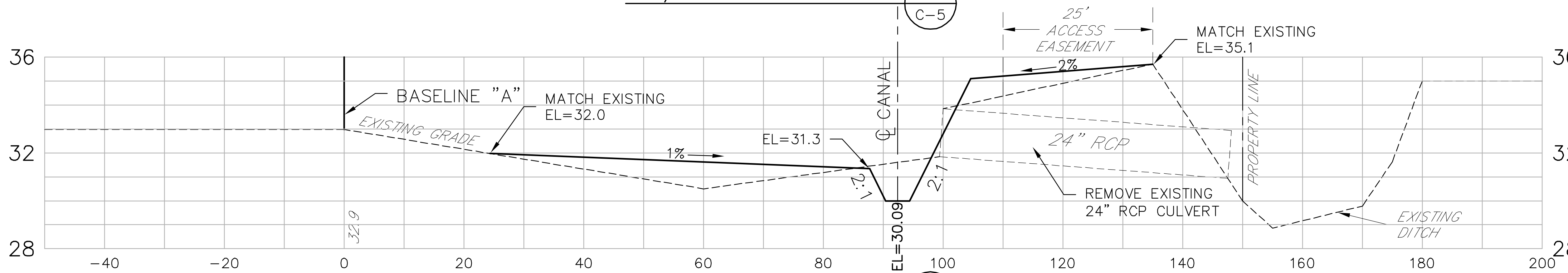
FL COA No. 7290

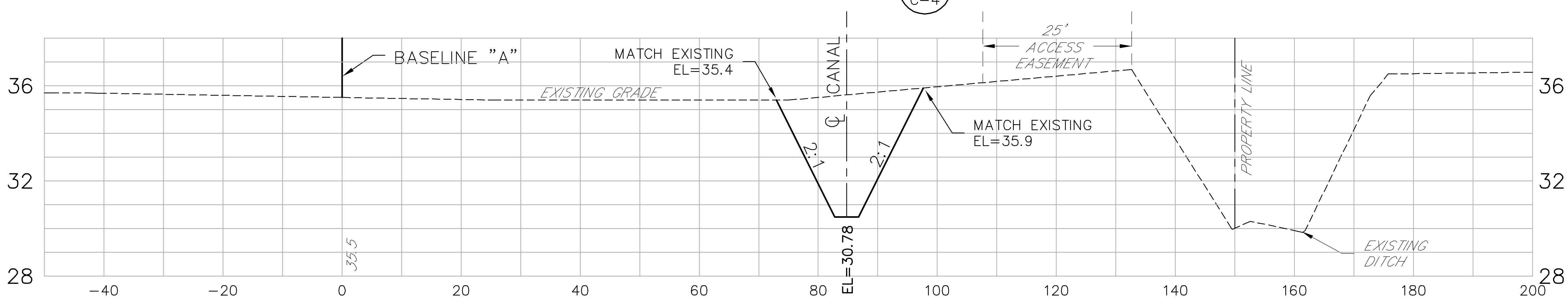
SHEET
XS-1



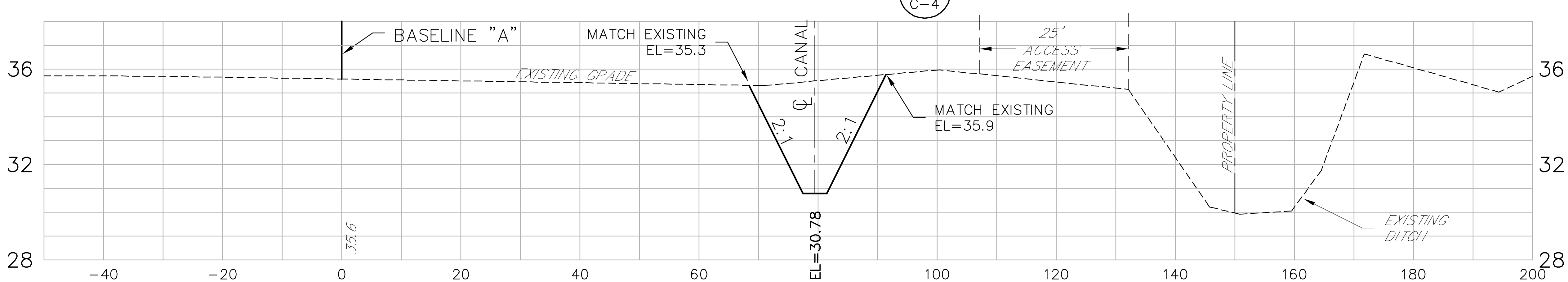
B/L "A" STA. 64+00 8 C-5



B/L "A" STA. 60+40 7 C-4



B/L "A" STA. 54+00 6 C-4



B/L "A" STA. 49+00 5 C-4

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO.	DATE	REVISION

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

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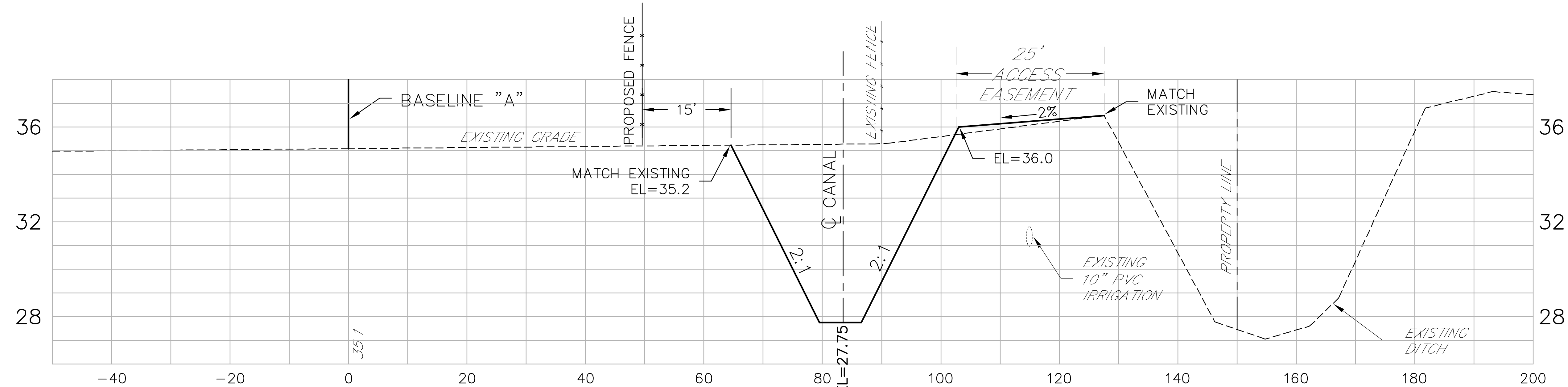
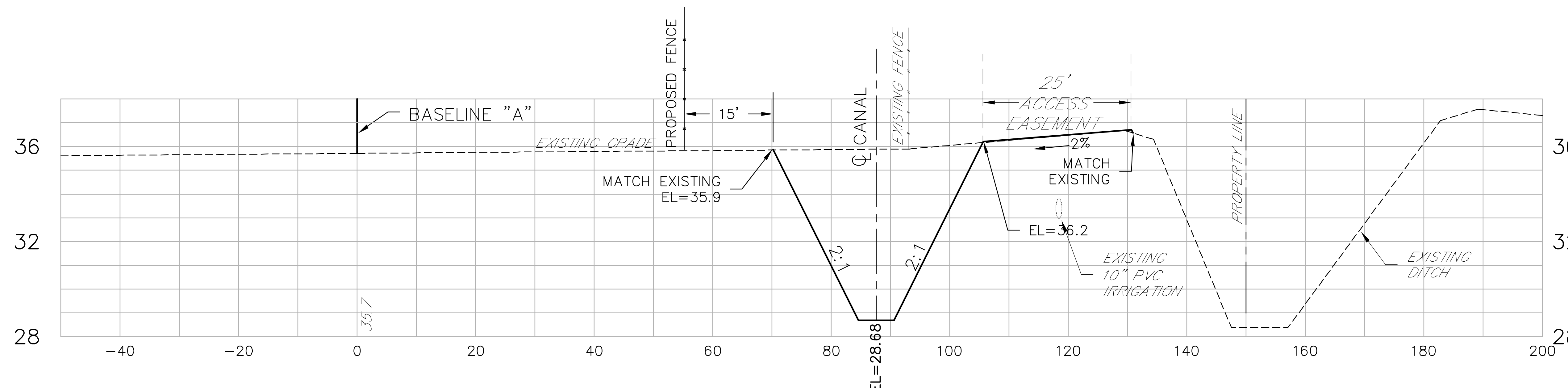
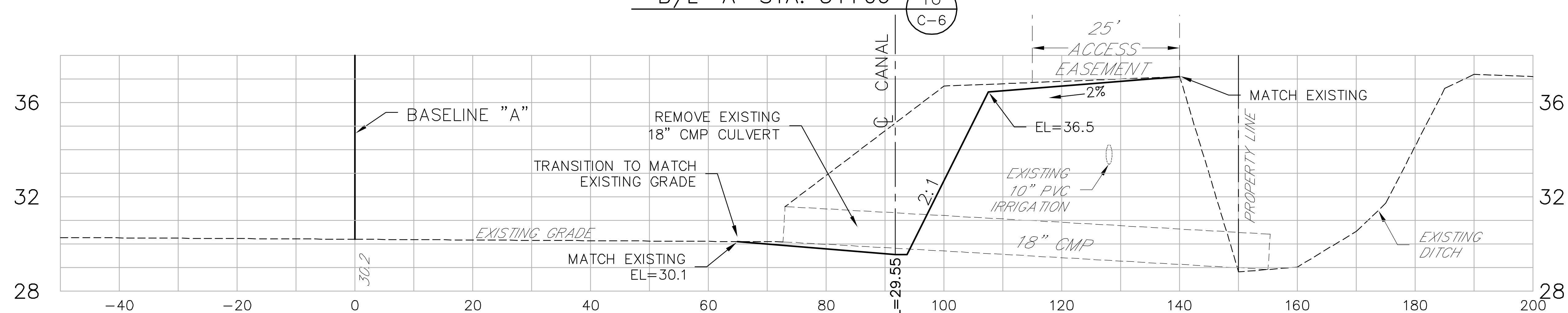
SHEET
XS-2



B/L "A" STA. 99+40 11 C-7



B/L "A" STA. 84+00 10 C-6



B/L "A" STA. 69+40 9 C-5

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

REVISION
NO. DATE

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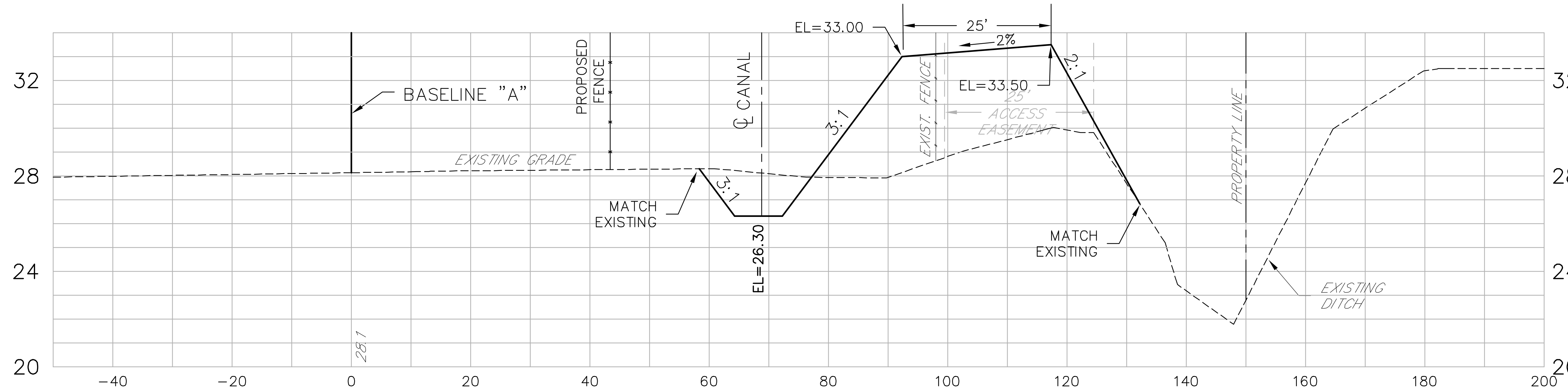
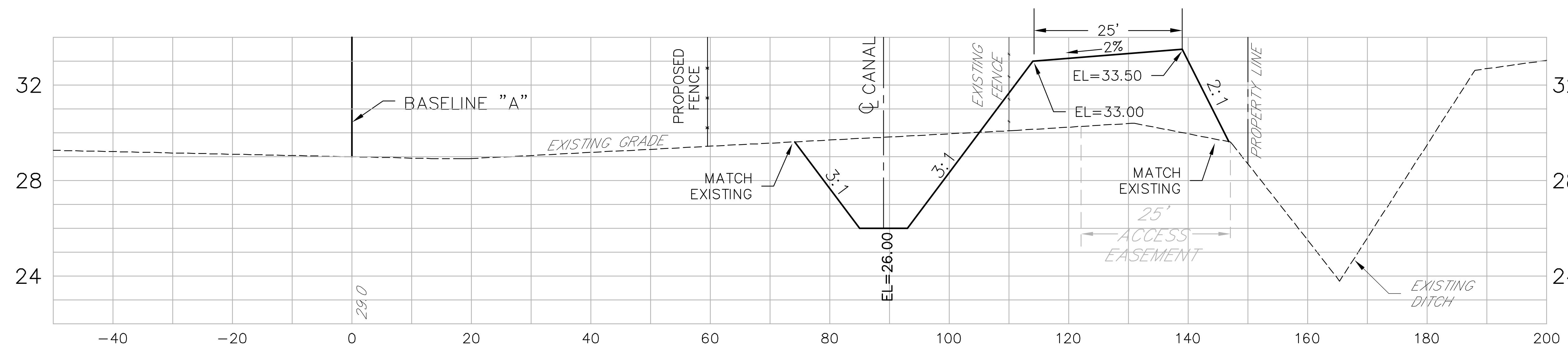
SHEET
XS-3

F:\CG\Dwg\ROYAL\0110-01\XS-3.dwg Plotted: Feb 18, 2003 - 11:03am



B/L "A" STA. 122+85 (13 / C-9)



B/L "A" STA. 112+10 (12 / C-8)

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO.	DATE	REVISION

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

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Altamonte Springs, FL 32701
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(407) 831-5095 fax
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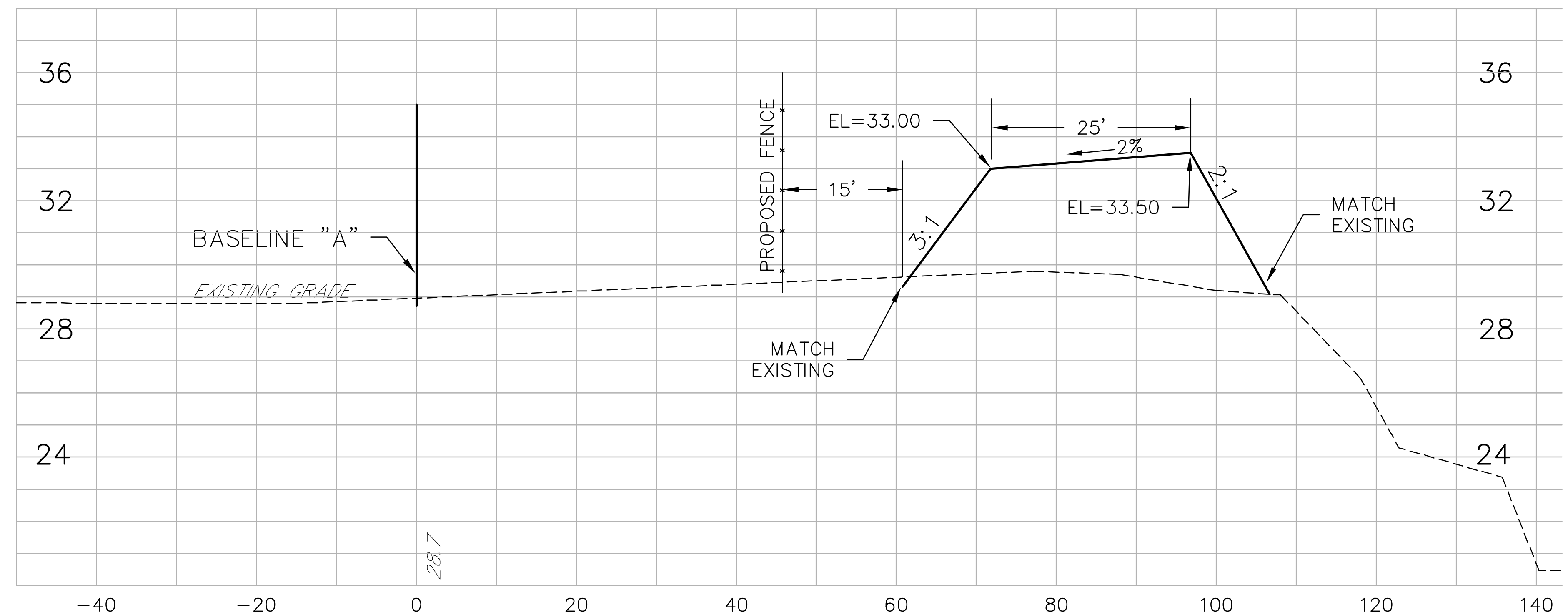
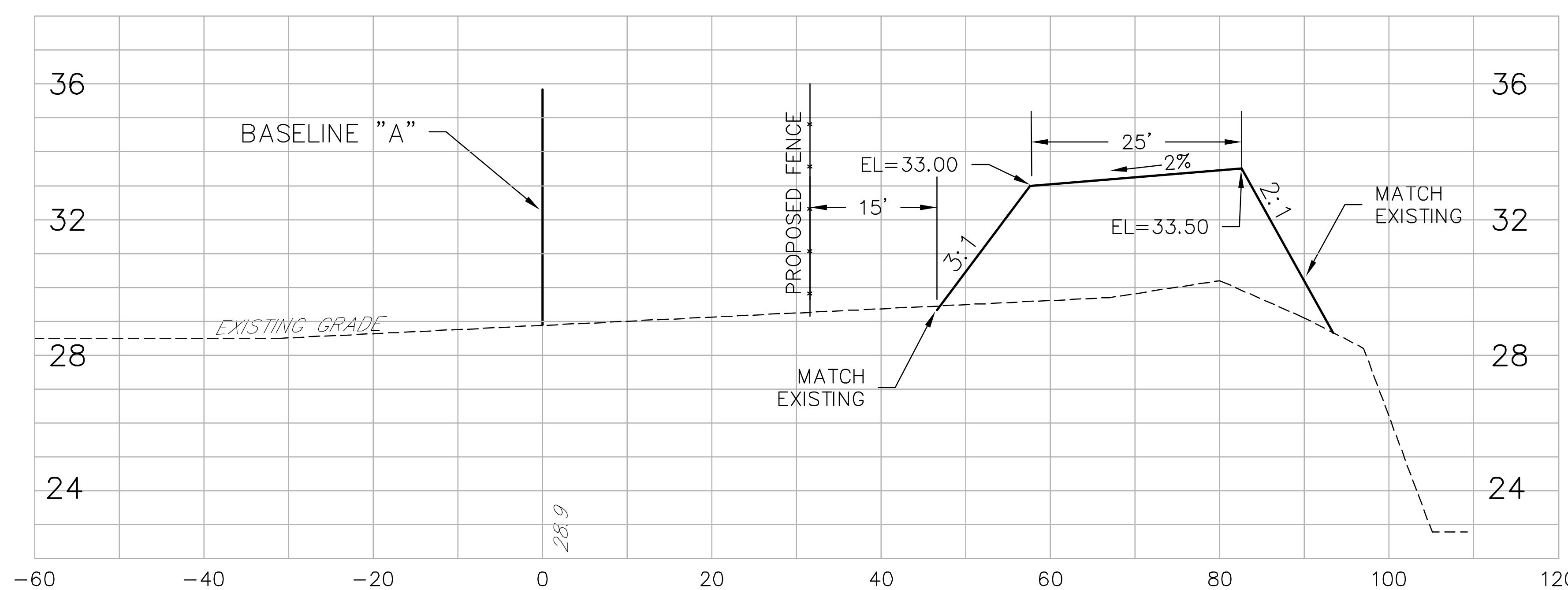
SHEET
XS-4

F:\CG\Dwg\ROYAL\0110-01\XS-4.dwg Plotted: Feb 19, 2003 - 11:03am



B/L "A" STA. 136+10 15 C-10



B/L "A" STA. 129+30 14 C-9

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO.	DATE	REVISION

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HIGHLANDS COUNTY FLORIDA

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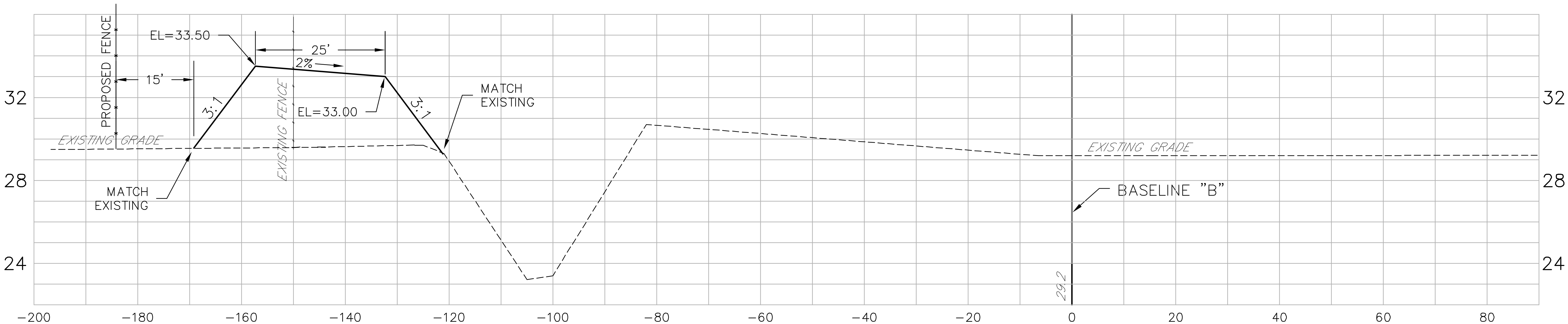
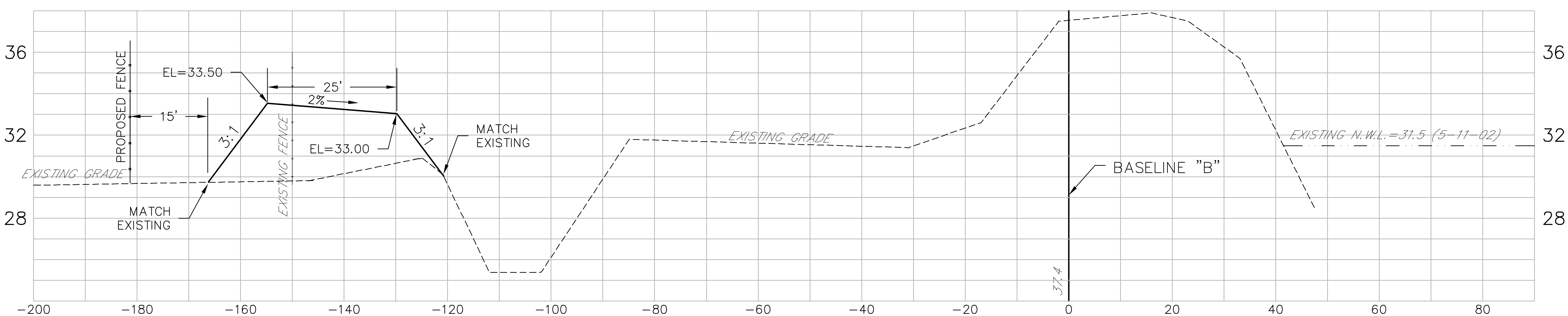
FL COA No. 7290

SHEET
XS-5



B/L "B" STA. 31+30 (17 / C-10)



B/L "B" STA. 18+50 (16 / C-11)

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO.	DATE	REVISION

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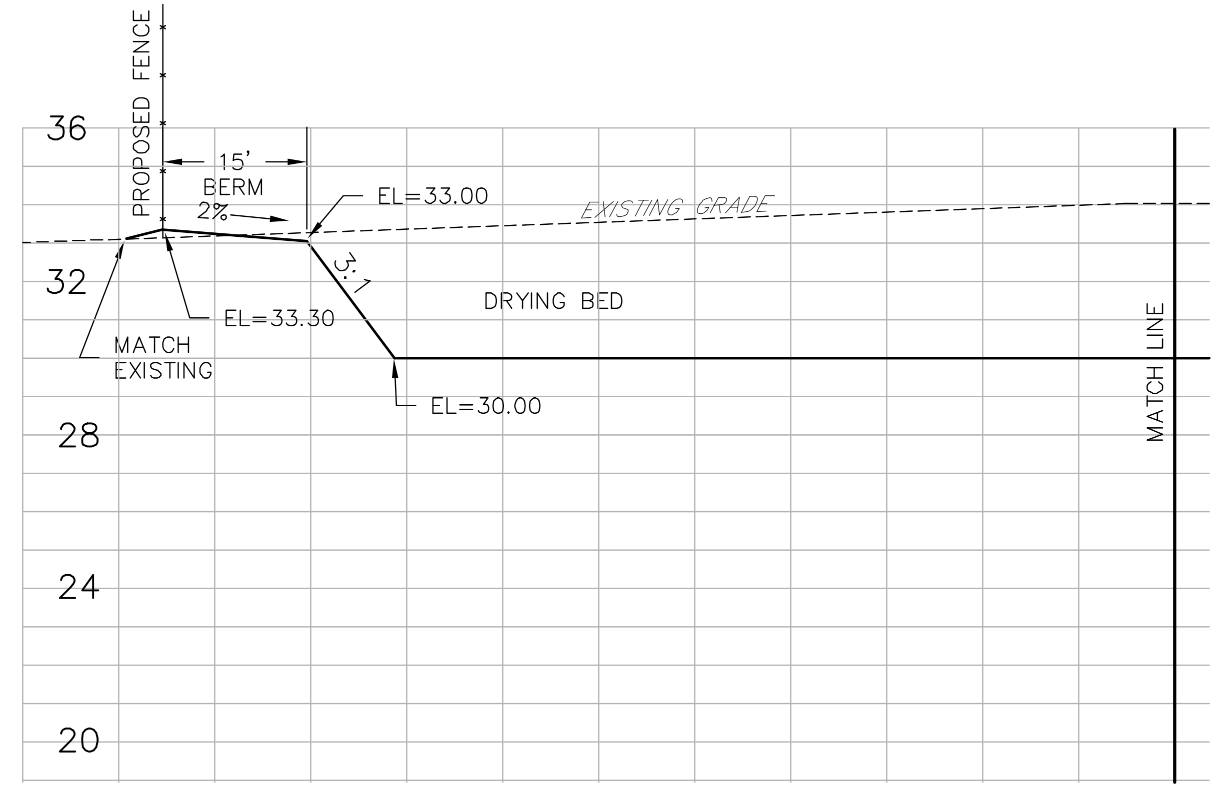
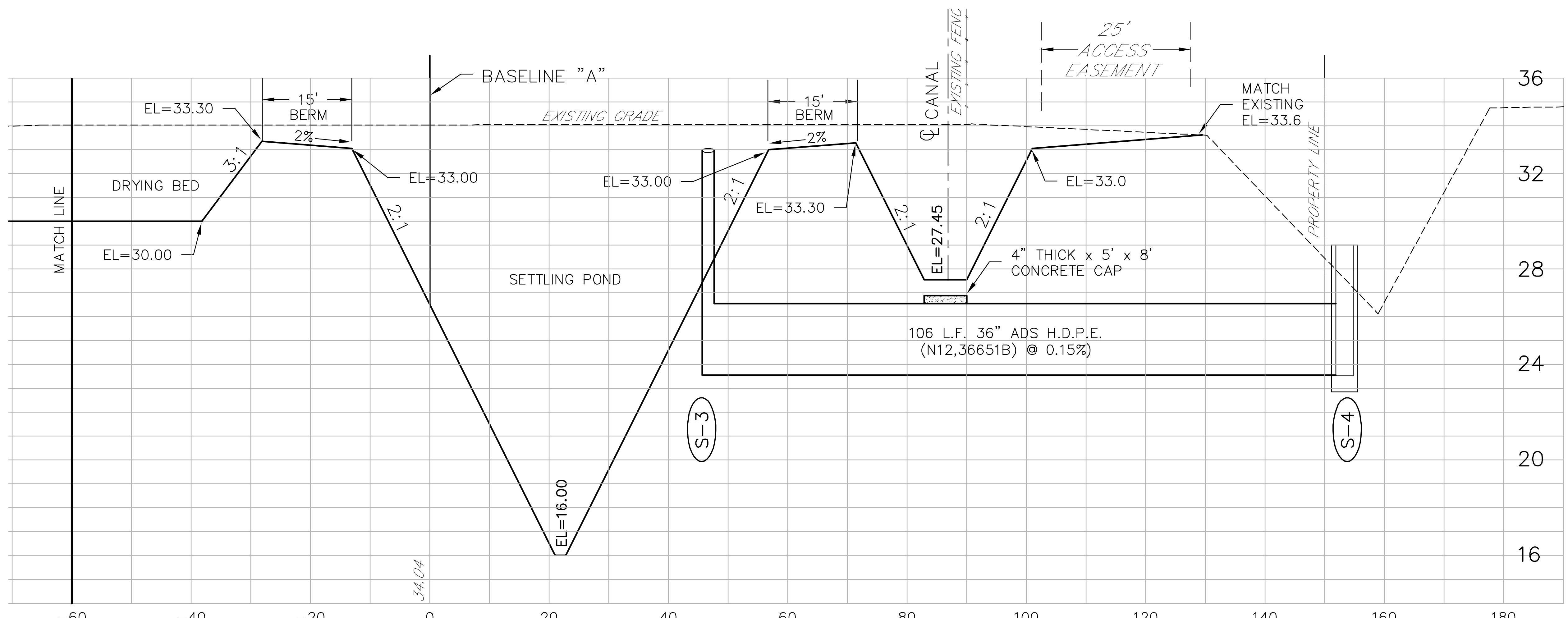
SHEET XS-6

F:\CG\Dwg\ROYAL\0110-01\XS-6.dwg Plotted: Feb 18, 2003 - 11:04am





SECTION 18 C-7

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
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DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

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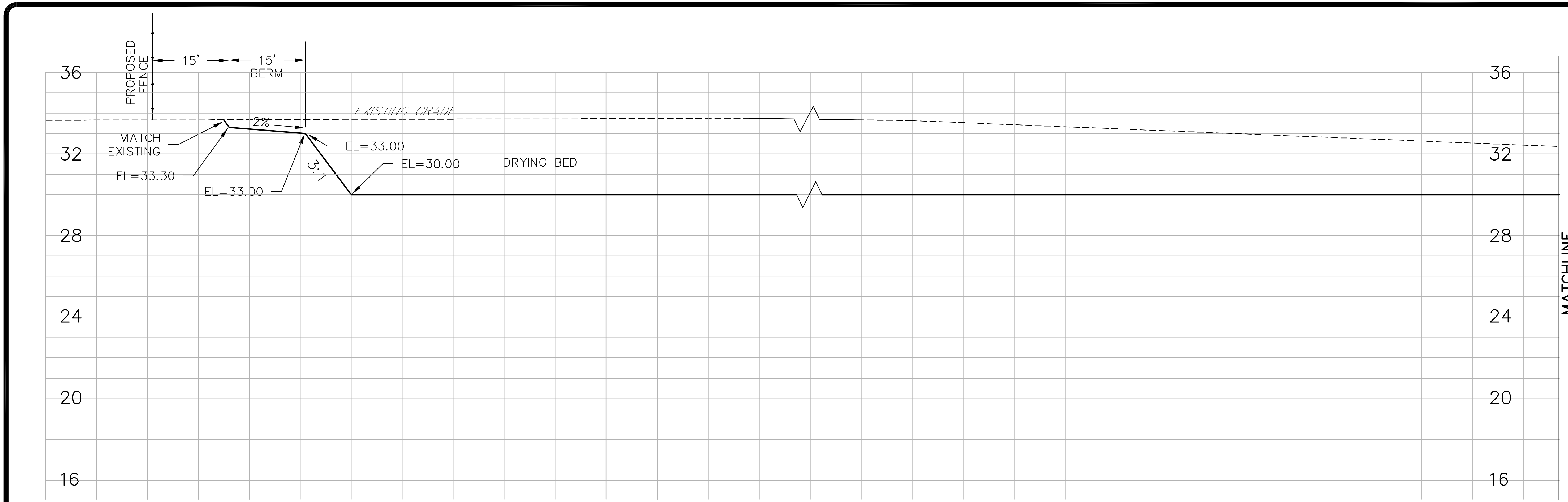
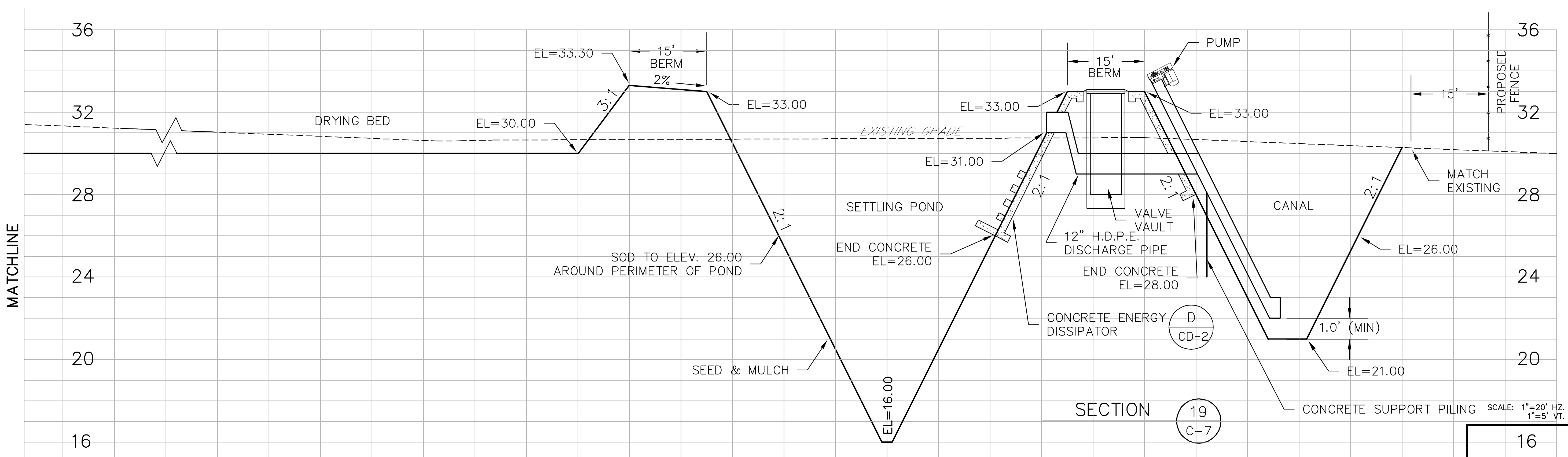
SHEET
XS-7

F:\CG\Dwg\ROYAL\0110-01\XS-7.dwg Plotted: Feb 18, 2003 - 11:05am





SECTION 19/C-7

SCALE: 1"=20' HZ. 1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE VERIFY BEFORE SCALING DIMENSIONS

BRIAN L. ROY
NO. 45366

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DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

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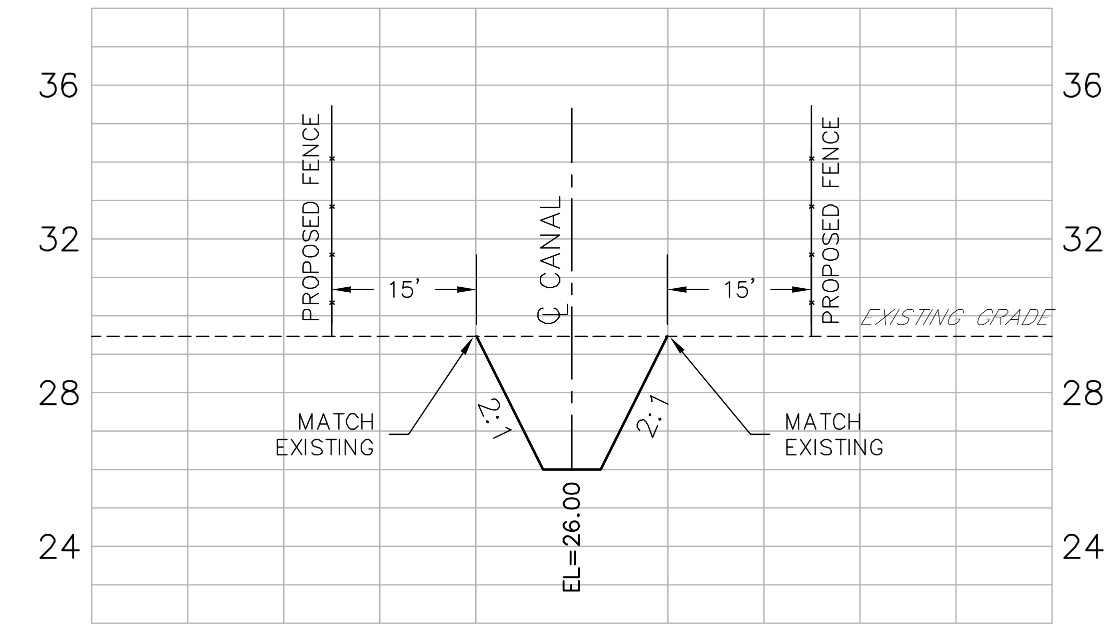
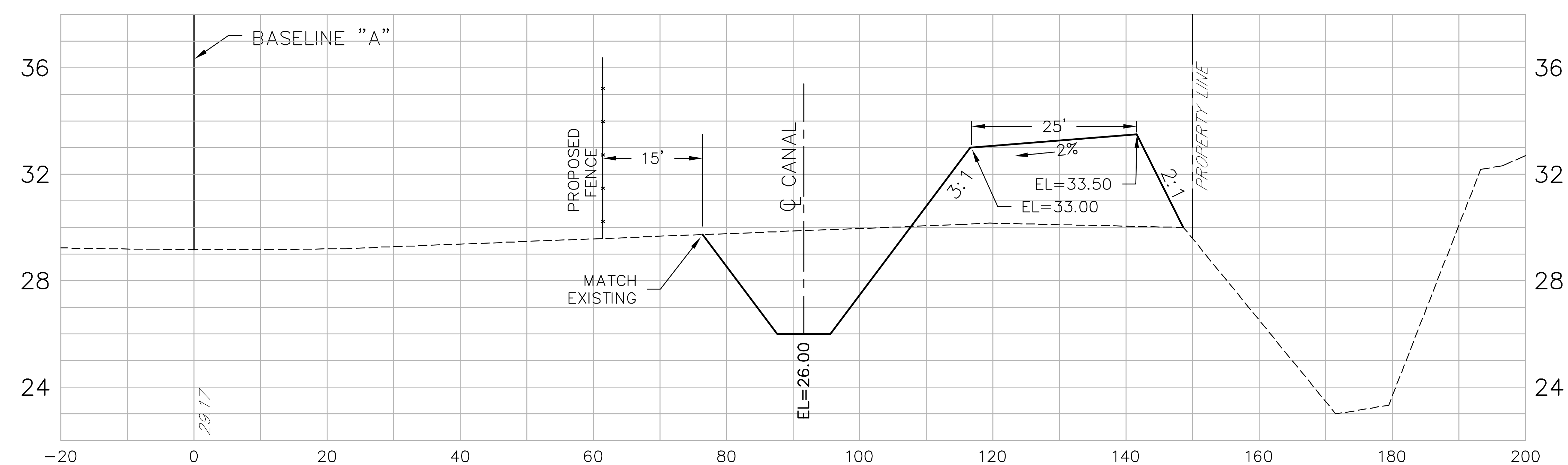
SHEET XS-8



SECTION 21 C-12



SECTION 20 C-8

SCALE: 1"=20' HZ.
1"=5' VT.

THIS PLAN MAY HAVE BEEN REDUCED IN SIZE
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NO. 45366

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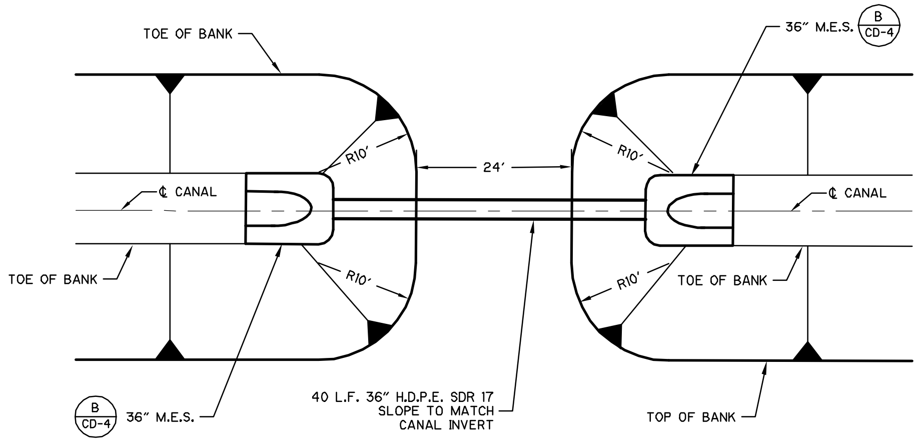
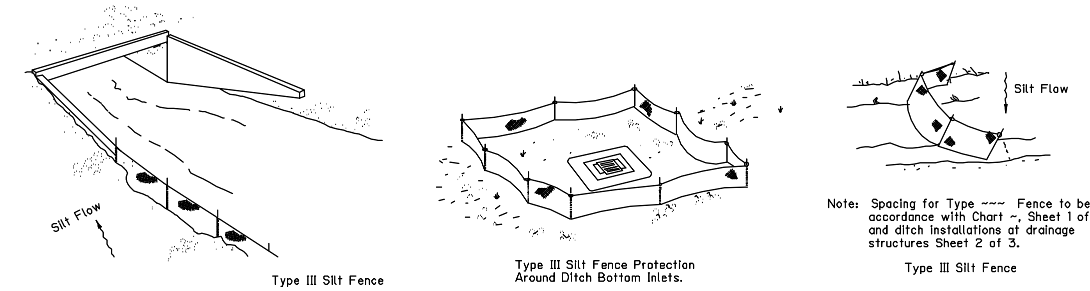
SHEET XS-9

F:\CD\Dwg\ROYAL\0110-01\XS-9.dwg Plotted: Feb 18, 2003 - 11:05am



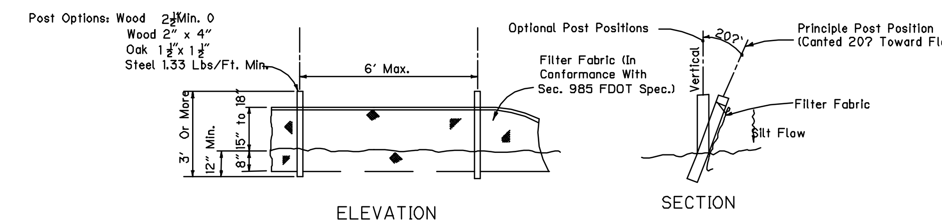
TYPICAL CANAL CROSSING (A / -)

N.T.S.



Do not deploy in a manner that silt fences will act as a dam across permanent flowing watercourses. Silt fences are to be used at upland locations and turbidity barriers used at permanent bodies of water.

SILT FENCE APPLICATIONS



Note: Silt Fence to be paid for under the contract unit price for Staked Silt Fence (LF).

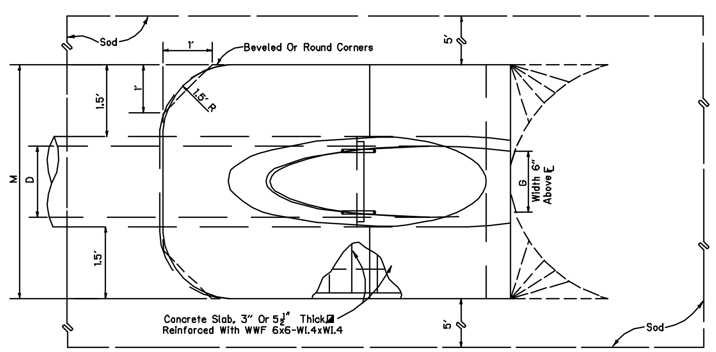
TYPE III SILT FENCE

(F.D.O.T. INDEX No. 102)

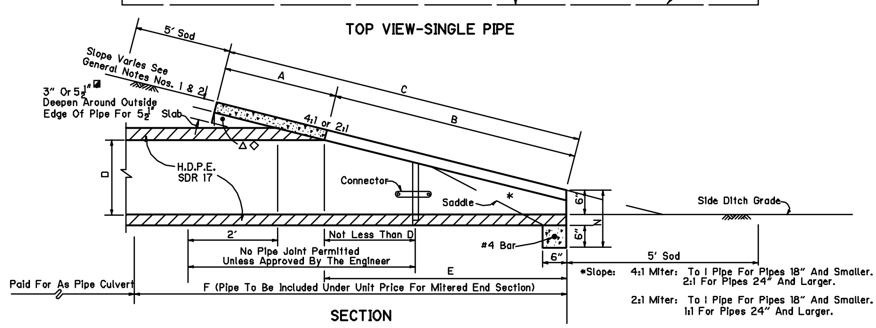
SILT FENCE DETAIL (B / -)

N.T.S.

									M					5½" CONCRETE SLAB (CY) ◪				SODDING (SQ. YDS.)			
	D	X	A	B	C	E	F	G	Single Pipe	Double Pipe	Triple Pipe	Quad. Pipe	N	Single Pipe	Double Pipe	Triple Pipe	Quad. Pipe	Single Pipe	Double Pipe	Triple Pipe	Quad. Pipe
2:1 Slope	15"	2'-7"	1.92'	2.18'	4.10'	2.06'	5'	1.22'	4.63'	7.21'	9.79'	12.37'	1.19'	0.38	0.58	0.77	0.96	21	24	27	30
	18"	2'-10"	1.97'	2.74'	4.71'	2.56'	6'	1.41'	4.92'	7.75'	10.58'	13.42'	1.21'	0.44	0.65	0.87	1.09	22	25	28	31
	24"	3'-5"	2.06'	3.85'	5.91'	3.56'	7'	1.73'	5.50'	8.92'	12.33'	15.75'	1.25'	0.54	0.83	1.12	1.42	24	28	32	35
	30"	4'-3"	2.15'	4.95'	7.10'	4.56'	8'	2.00'	6.08'	10.33'	14.58'	18.83'	1.29'	0.66	1.09	1.50	1.91	26	31	35	40
	36"	5'-1"	2.25'	6.08'	8.33'	5.56'	9'	2.24'	6.67'	11.75'	16.83'	21.92'	1.33'	0.81	1.38	1.95	2.51	28	34	39	45
	42"	6'-0"	2.34'	7.21'	9.55'	6.56'	10'	2.45'	7.25'	13.25'	19.25'	25.25'	1.38'	0.97	1.70	2.45	3.19	30	37	43	50
	48"	6'-9"	2.43'	8.33'	10.76'	7.56'	11'	2.65'	7.83'	14.58'	21.33'	28.08'	1.42'	1.13	2.04	2.93	3.84	32	39	47	54
	54"	7'-8"	2.52'	9.44'	11.96'	8.56'	12'	2.83'	8.42'	16.08'	23.75'	31.42'	1.46'	1.31	2.44	3.58	4.72	34	42	51	59
	60"	8'-6"	2.62'	10.56'	13.18'	9.56'	14'	3.00'	9.00'	17.50'	26.00'	34.50'	1.50'	1.51	2.89	4.28	5.68	36	45	55	64
	66"	9'-2"	2.71'	11.68'	14.39'	10.56'	15'	3.18'	9.58'	18.75'	27.92'	37.08'	1.54'	1.68	3.25	4.84	6.43	38	48	58	68
	72"	10'-0"	2.80'	12.80'	15.60'	11.56'	16'	3.30'	10.16'	20.16'	30.16'	40.16'	1.58'	1.89	3.74	5.59	7.45	40	51	62	73
4:1 Slope	15"	2'-7"	2.27'	4.09'	6.36'	4.03'	8'	1.22'	4.63'	7.21'	9.79'	12.37'	1.19'	0.57	0.87	1.15	1.44	23	26	29	32
	18"	2'-10"	2.36'	5.12'	7.48'	5.03'	9'	1.41'	4.92'	7.75'	10.58'	13.42'	1.21'	0.66	0.99	1.31	1.65	25	28	31	35
	24"	3'-5"	2.53'	7.18' △	9.71'	7.03' △	11'	1.73'	5.50'	8.92'	12.33'	15.75'	1.25'	0.85	1.30	1.75	2.20	28	32	36	40
	30"	4'-3"	2.70'	9.25'	11.95'	9.03'	13'	2.00'	6.08'	10.33'	14.58'	18.83'	1.29'	1.10	1.74	2.39	3.05	31	36	41	46
	36"	5'-1"	2.87'	11.31' ◇	14.18'	11.03' —	15'	2.24'	6.67'	11.75'	16.83'	21.92'	1.33'	1.32	2.21	3.08	3.96	34	40	46	52
	42"	6'-0"	3.05'	13.37'	16.42'	13.03'	17'	2.45'	7.25'	13.25'	19.25'	25.25'	1.38'	1.58	2.76	3.91	5.09	38	44	51	58
	48"	6'-9"	3.22'	15.43'	18.65'	15.03'	19'	2.65'	7.83'	14.58'	21.33'	28.08'	1.42'	1.85	3.30	4.73	6.17	41	48	56	63
	54"	7'-8"	3.39'	17.49'	20.88'	17.03'	21'	2.83'	8.42'	16.08'	23.75'	31.42'	1.46'	2.14	3.95	5.77	7.58	44	52	61	69
	60"	8'-6"	3.56'	19.55'	23.11'	19.03'	23'	3.00'	9.00'	17.50'	26.00'	34.50'	1.50'	2.45	4.66	6.87	9.07	47	56	66	75
	66"	9'-2"	3.73'	21.62'	25.35'	21.03'	25'	3.18'	9.58'	18.75'	27.92'	37.08'	1.54'	2.88	5.54	8.18	10.84	49	59	69	80
	72"	10'-0"	3.91'	22.68'	26.59'	23.03'	27'	3.30'	10.16'	20.16'	30.16'	40.16'	1.58'	3.18	6.27	9.36	12.45	52	63	74	85



TOP VIEW-SINGLE PIPE

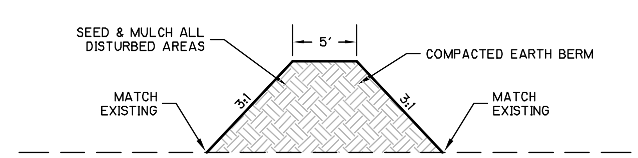


SECTION

(F.D.O.T. INDEX No. 272)

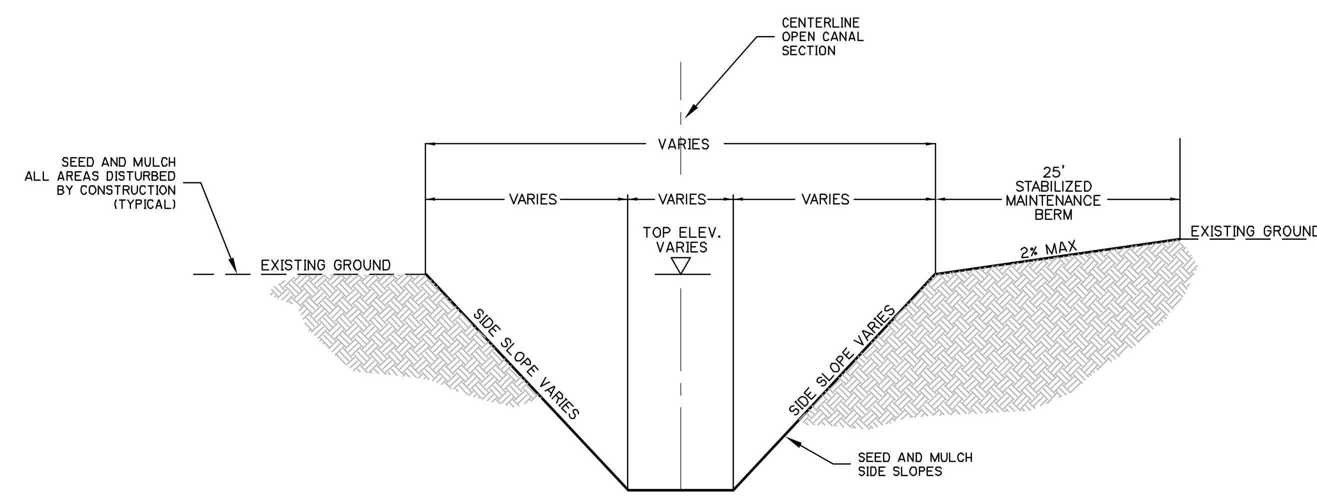
MITERED END SECTION (C / -)

N.T.S.



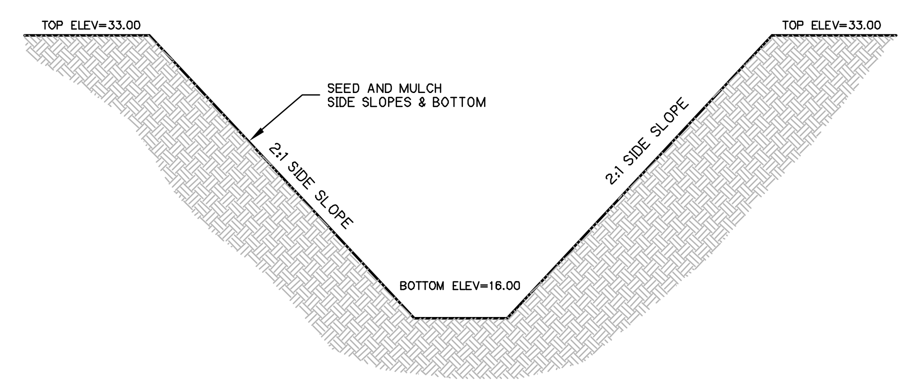
TYPICAL DITCH BLOCK (D / C-2)

N.T.S.



TYPICAL CANAL SECTION (E / C-3)

N.T.S.



SETTLING POND SECTION (F / C-10)

N.T.S.

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

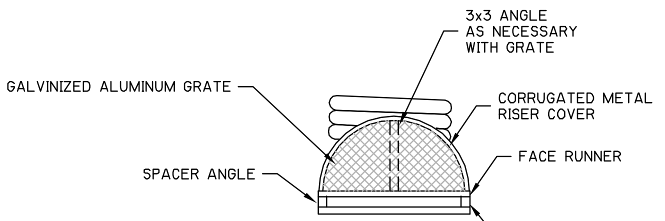
NO. DATE REVISION

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

MISCELLANEOUS DETAILS

Royal Consulting Services, Inc.
102 Frances Circle
Altamonte Springs, FL 32701
(407) 831-3095 phone
(407) 831-5095 fax
www.royalconsulting.com
FL COA No. 7290

SHEET CD-1

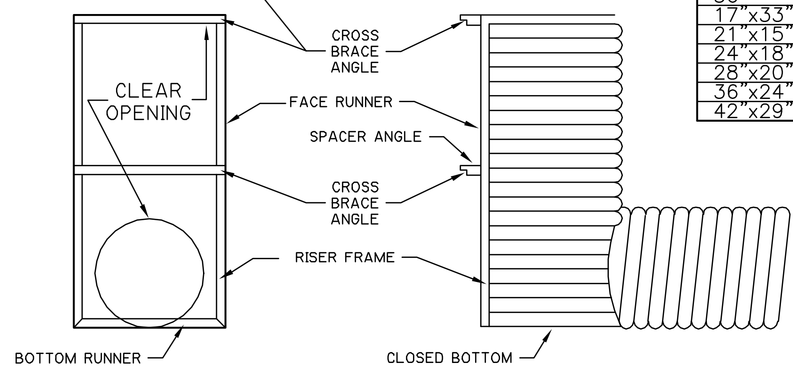


CHANNEL

STEEL
1 7/8"x3"x1 7/8x3/16"

ALUMINUM
24" FACE AND LESS:
2 1/4"x3"x2 1/4"x3/16"
GREATER THAN 24" FACE:
2 1/4"x3"x 2 1/4"x1/4"

ANGLE (ALL)
2"x2"x1/4"



SINGLE FACE RISER
N.T.S.

ALUMINUM RISER DETAIL (A/-)
N.T.S.

STUB. DIA.	STUB. GA.	RISER COVER FACE WTH.	RISER COVER GA.	RISER COVER SHEET LENGTH	FRAME WIDTH
12"	16	21	16	35	23
15"	16	24	16	40	26
18"	16	27	16	45	29
21"	16	30	16	50	32
24"	16	36	16	57.5	38
30"	14	42	14	68	44
36"	14	48	14	78	50
17"x33"	16	24	16	40	26
21"x15"	16	27	16	40	29
24"x18"	16	30	16	53	32
28"x20"	16	36	16	57.5	38
36"x24"	14	42	14	68	44
42"x29"	14	48	14	78	50

NOTES

1. RISERS GREATER THAN 5' HIGH HAVE CROSS BRACE ANGLE IN CENTER OF RISER FACE.
2. RISERS LESS THAN 1' CLEAR OPENING HAVE ONLY ONE BRACE AT TOP OF RISER.
3. DIMENSIONS & SPECIFICATIONS PER SOUTHERN CULVERT OR APPROVED EQUAL.

STRUCTURE No.	PIPE DIA.	TOP RISER ELEV.	INVERT ELEV.	WEIR ELEV.
S-1	18"	33.00	27.65	32.00
S-3	36"	33.00	23.49	30.50
S-5	36"	33.00	25.08	31.00
S-11	36"	33.00	23.59	31.00

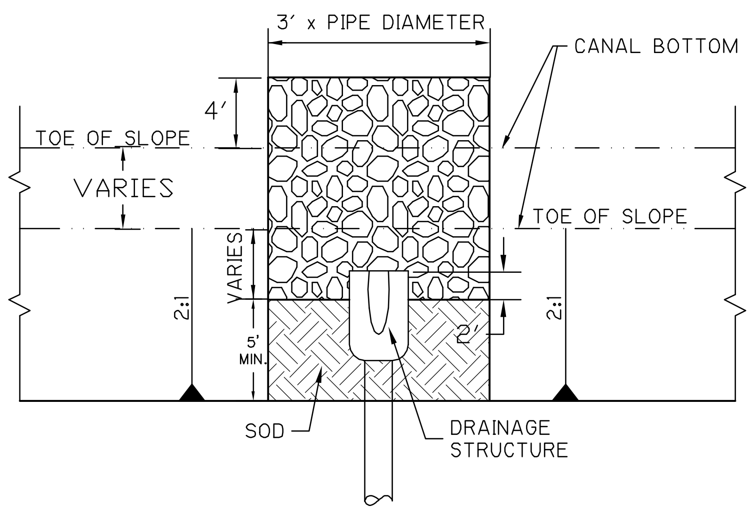
TURF REINFORCEMENT & SOD		
STRUCTURE	APPROXIMATE DIMENSIONS	AREA (S.Y.)
S-5	122' x 64'	870
B/L "A" STA. 40+68 50' RT.	60' x 60'	400
B/L "A" STA. 60+30 92' RT.	60' x 60'	400
B/L "A" STA. 69+46 90' RT.	90' x 60'	600

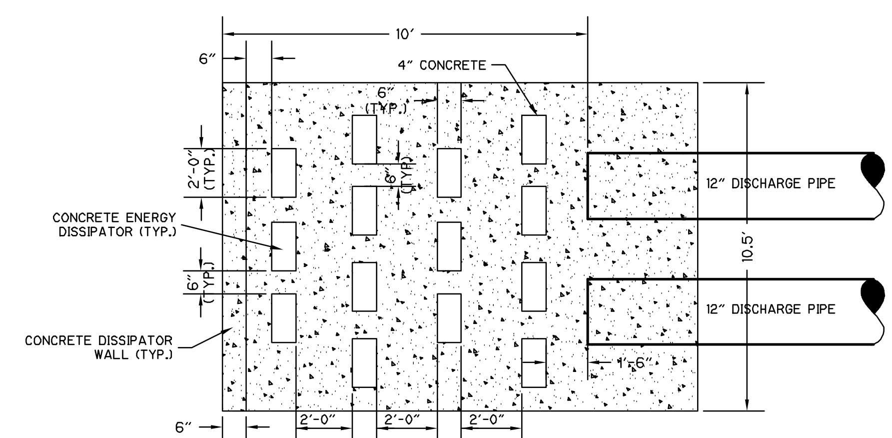
TURF REINFORCEMENT & SOD
(LAND-LOK MODEL 450)
OR APPROVED EQUAL

TURF REINFORCEMENT (C/-)
N.T.S.

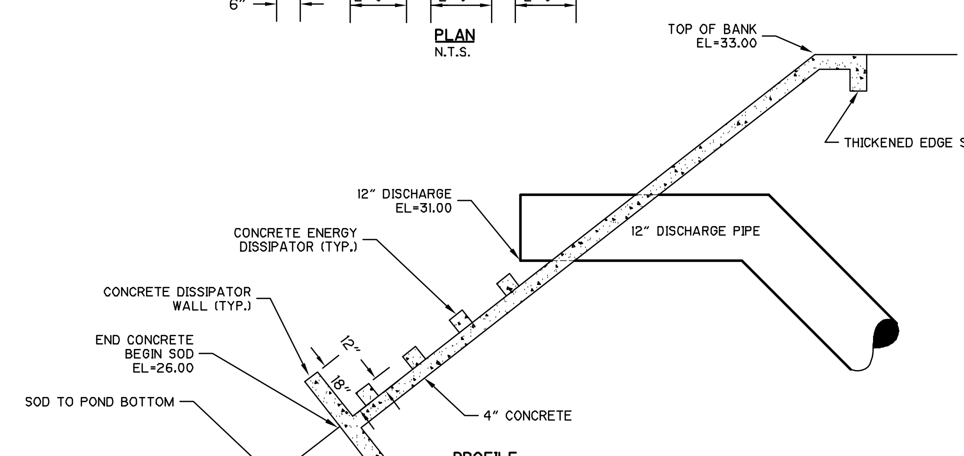
PROPOSED GRADE 2 STONE RUBBLE RIP-RAP D50 10" ROCK SIZE (CONTRACTOR TO SUBMIT SHOP DRAWING WITH GRADATION AND PERCENT PASSING.

RUBBLE RIP-RAP SHALL MEET THE REQUIREMENTS OF SECTION 530 OF THE STANDARD SPECIFICATIONS.





PLAN
N.T.S.



PROFILE
N.T.S.

OUTLET ENERGY DISSIPATOR (D/CD-4)
N.T.S.

RUBBLE RIP-RAP			
STRUCTURE	APPROXIMATE DIMENSIONS	AREA (S.Y.)	TONS
(S-2) (S-8)	25' x 25'	70	77
S-4	10' x 20'	22	24.4
S-6	10' x 20'	22	24.4
S-12	10' x 20'	22	24.4
S-14	10' x 20'	22	24.4

RUBBLE RIP-RAP OUTLET PROTECTION (B/-)
N.T.S.

BRIAN L. ROY
NO. 45366

JOB NO.	0110-01
SCALE:	AS SHOWN
DATE	2-19-03
DESIGN	B.L.R.
DRAWN	J.R.R.
CHECKED	B.L.R.
APPROVED	

NO. DATE REVISION

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

MISCELLANEOUS DETAILS

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102 Frances Circle
Altamonte Springs, FL 32701
(407) 831-3095 phone
(407) 831-5095 fax
www.royalconsulting.com
FL COA No. 7290

SHEET
CD-2

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S-1
B/L "A" STA. 103+55.1 42.4' LT. (A / CD-2)

S-2
B/L "A" STA. 103+55.1 81.2' RT.
36" MES
INV. EL= 27.48

S-3
B/L "A" STA. 103+93.5 48.0' RT. (A / CD-2)

S-4
B/L "A" STA. 103+93.5 149.9' RT.
F.D.O.T. TYPE "G" INLET
GRATE EL=29.00
INV. EL= 23.29

S-5
B/L "A" STA. 108+95.4 93.2' RT. (A / CD-2)

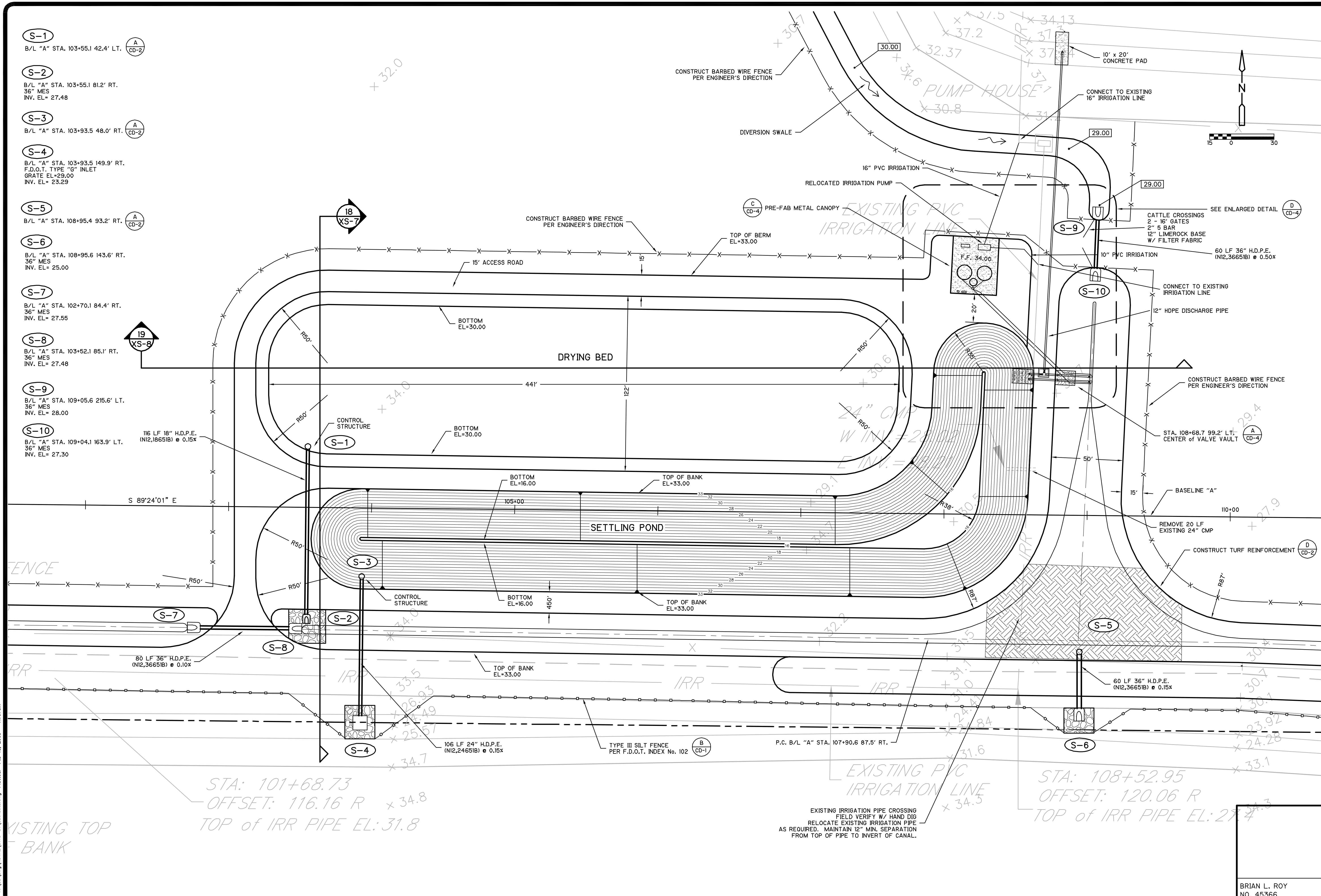
S-6
B/L "A" STA. 108+95.6 143.6' RT.
36" MES
INV. EL= 25.00

S-7
B/L "A" STA. 102+70.1 84.4' RT.
36" MES
INV. EL= 27.55

S-8
B/L "A" STA. 103+52.1 85.1' RT.
36" MES
INV. EL= 27.48

S-9
B/L "A" STA. 109+05.6 215.6' LT.
36" MES
INV. EL= 28.00

S-10
B/L "A" STA. 109+04.1 163.9' LT.
36" MES
INV. EL= 27.30



BRIAN L. ROY
NO. 45366

JOB NO. 0110-01
SCALE: AS SHOWN
DATE 2-19-03
DESIGN B.L.R.
DRAWN J.R.R.
CHECKED B.L.R.
APPROVED

NO.	DATE	REVISION

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

ENLARGED SITE PLAN

Royal Consulting Services, Inc.
102 Frances Circle
Altamonte Springs, FL 32701
(407) 831-3095 phone
(407) 831-5095 fax
www.royalconsulting.com
FL COA No. 7290

SHEET
CD-3

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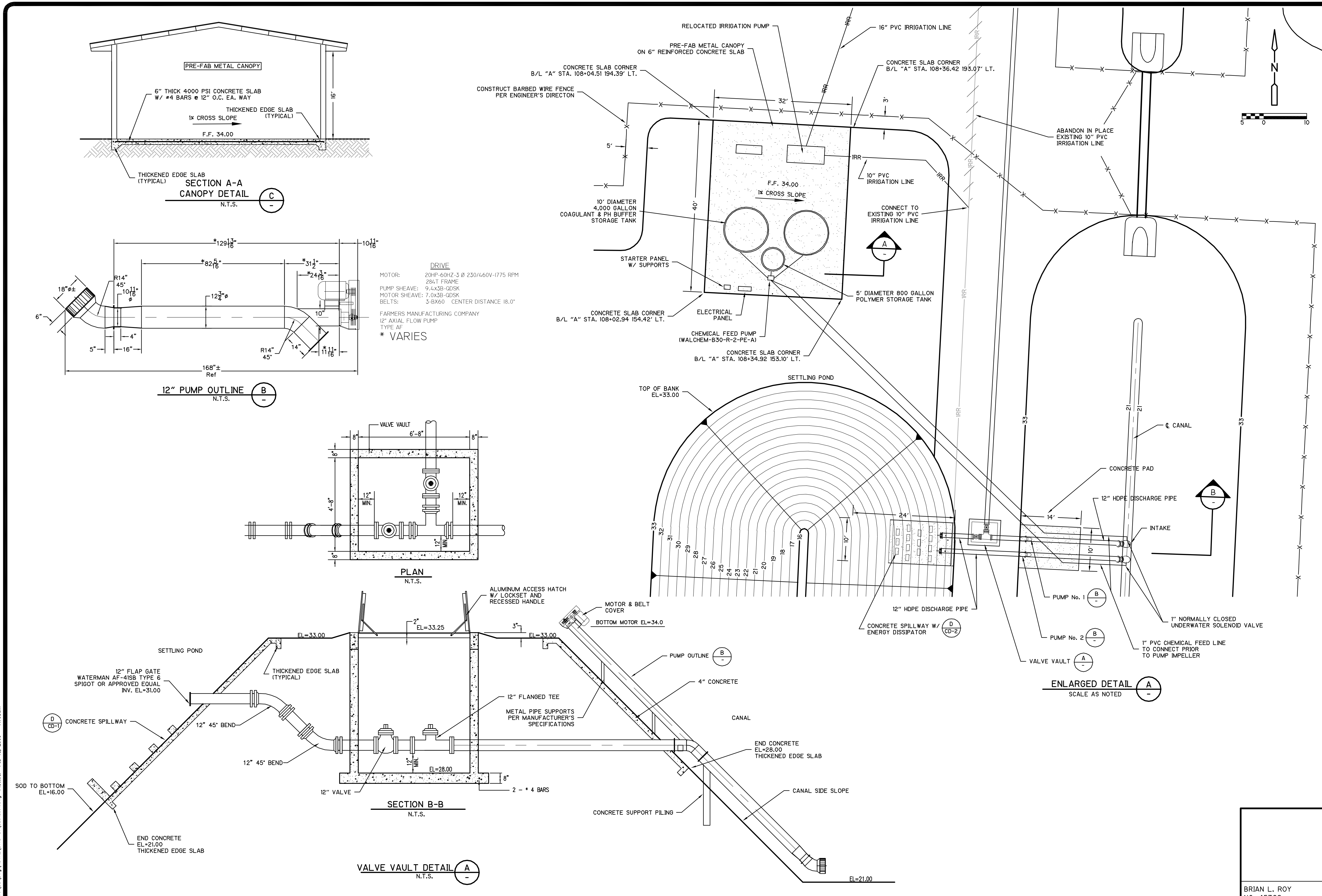

JOB NO. 0110-01
SCALE: AS SHOWN
DATE 2-19-03
DESIGN B.L.R.
DRAWN J.R.R.
CHECKED B.L.R.
APPROVED

REVISION
NO. DATE

BUTLER OAKS FARM, INC.
SFWMD CONTRACT C-11652
HIGHLANDS COUNTY FLORIDA

MISCELLANEOUS DETAILS

Royal Consulting Services, Inc.
102 Frances Circle
Altamonte Springs, FL 32701
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www.royalconsulting.com
FL COA No. 7290

BRIAN L. ROY
NO. 45366

SHEET CD-4

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Appendix D
Project Schedule and Cost Data Sheets

DESIGN/BUILD PHASE
SFWMD CONTRACT C-11652
BUTLER OAKS FARM, INC. - HIGHLAND COUNTY, FLORIDA

Royal Consulting Services

ID No. **0110-01-ES**

Engineer: **Royal Consulting Services, Inc.**

PROJECT BUDGET SUMMARY - February 2003

	Estimated To Date *	Estimated Total Cost	Project Totals
Services			
Engineering	$80,000.00	$100,000.00	
Surveying	$16,500.00	$16,500.00	
Wetlands	$9,500.00	$9,500.00	
Permits	$12,000.00	$12,000.00	
Jar Testing	$2,000.00	$2,000.00	
Services - Total			$140,000.00
Construction **			
Drainage	$0.00	$223,000.00	
Pump Stations	$0.00	$75,000.00	
Retention Ponds	$0.00	na	
Water Reuse System	$0.00	$45,000.00	
Chemical System	$0.00	$35,000.00	
Access Roads	$0.00	$0.00	
Settling Pond	$0.00	$32,000.00	
Construction - Total			$410,000.00
Services and Construction Total ***			$550,000.00
Contingency			$25,000.00
CONTRACT TOTAL			**$575,000.00**

* through January 2003

** see attached detailed estimate

DESIGN/BUILD PHASE
SFWMD CONTRACT C-11652
BUTLER OAKS FARM, INC. - HIGHLAND COUNTY, FLORIDA

Royal Consulting Services

ID No. **0110-01-ES**

Engineer: **Royal Consulting Services, Inc.**

2002: 2nd Quarter (Apr, May, Jun), 3rd Quarter (Jul, Aug, Sep), 4th Quarter (Oct, Nov, Dec); 2003: 1st Quarter (Jan, Feb, Mar), 2nd Quarter (Apr, May, Jun)

WORK ITEM DESCRIPTION	EST DUR	PROGRESS
PHASE ONE		A P
Contract Award (Milestone)	1	A P
Surveying	10	A P
Engineering and Design	120	A P
Permitting	120	A P
PHASE TWO		A P
Subcontracts and Procurement	30	A P
Project Mobilization	10	A P
Erosion Control Measures	10	A P
Set-up Surface Dewatering Systems	5	A P
Base Line And Construction Layout	5	A P
Clearing and Grubbing	15	A P
Demolition of Existing Pipes and Structures	5	A P
Initial Soil Testing	2	A P
Excavation of Canals	60	A P
Placement of Embankment and Grading	60	A P
Drainage Piping	15	A P
Concrete Overflow and Misc.	15	A P
Pump Installation	5	A P
Chemical Equipment and Tanks	10	A P
Misc. Mechanical and Piping	10	A P
Electrical Work - Power Distribution	60	A P
Electrical Work - Controls and Connections	10	A P
Punch Out and Subcontractor Demobilization	5	A P
Pump Start-up & Testing	5	A P
PHASE THREE		A P
System Initialization	5	A P
Testing	10	A P
System Commissioning	10	A P
PHASE FOUR		A P
Project Turnover (Milestone)	1	A P
		A P

19-Feb-03

BUTLER OAKS FARM, INC.

BID SUMMARY

ITEM NO.	BID ITEMS	QNTY	UNIT MSR	MATERIAL	LABOR	EQUIPMENT	SUBCONTRACT	OTHER	TOTAL COST w/ BURDEN	UNIT PRICE	EXTENDED TOTAL
1	GENERAL REQUIREMENTS	1.0	LSUM	1,000.0	48,260.0		16,065.0	8,710.0	74,035.00	80,698.15	80,698.15
2	SITE PREPARATION	1.0	LSUM	6,535.4	18,222.8	15,363.9	29,118.8		69,240.85	75,472.52	75,472.52
3	EARTHWORK & GRADING	1.0	LSUM		27,958.4	45,067.5			73,025.93	79,598.26	79,598.26
4	STORM WATER DRAINAGE SYSTEM	1.0	LSUM	23,053.6	6,106.9	5,894.0		442.8	35,497.26	38,692.01	38,692.01
5	SOIL/TURF STABILIZATION	1.0	LSUM	1,053.0	3,018.6				4,071.60	4,438.04	4,438.04
6	SODDING & GRASSING	1.0	LSUM				27,700.0		27,700.00	30,193.00	30,193.00
7	PIPE, FITTINGS & VALVES	1.0	LSUM	9,179.4	2,750.2	1,022.3	0.6	0.0	12,952.42	14,118.14	14,118.14
8	PUMPS AND CHEMICAL TREATMENT EQUIPMENT	1.0	LSUM	44,709.9	1,784.9	135.0		240.0	46,869.77	51,088.04	51,088.04
9	CONCRETE PADS AND DISSIPATOR	1.0	LSUM	1,090.0	550.4	105.0		80.0	1,825.40	1,989.69	1,989.69
10	PRE-FABRICATED METAL BUILDING	1.0	LSUM	2,713.6	935.7		7,200.0		10,849.28	11,825.72	11,825.72
12	ELECTRICAL	1.0	LSUM				19,825.0		19,825.00	21,609.25	21,609.25
											-
END OF ESTIMATE									**GRAND TOTAL AMOUNT**		**$ 409,722.82**

EXCLUSIONS AND QUALIFICATIONS

NO. **EXCLUSIONS & QUALIFICATIONS**

THANKYOU FOR THE OPPORTUNITY TO QUOTE THIS PROJECT

20-Nov-02

BUTLER OAKS FARM, INC.

HIGHLAND COUNTY, FLORIDA

ITEM NO.	ITEM DESCRIPTIONS	QNTY	UNIT MSR	MATERIAL	MH P/UNIT	ADJ. RATE	CREW	UNIT LABOR	UNIT EQUIPMENT	UNIT SUB-CON	UNIT OTHER	TOTAL MATERIAL	TOTAL MANHOURS	TOTAL LABOR	TOTAL EQUIPMENT	TOTAL SUB-CON	TOTAL OTHER	TOTAL COST*	UNIT PRICE	TOTAL AMOUNT
												-		-	-	-	-	-	-	-
1	**GENERAL REQUIREMENTS**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	SURVEYING							-				-	-	-	-	-	-	-	-	-
	Baseline Survey	32.00	crhrs					-		85.00		-	-	-	-	2,720.00	-	2,720.00	92.65	2,964.80
	Construction Layout & Staking	60.00	crhrs					-		85.00		-	-	-	-	5,100.00	-	5,100.00	92.65	5,559.00
	As-Built Drawing (Red-Line)	1.00	lsum					-		750.00		-	-	-	-	750.00	-	750.00	817.50	817.50
	ADMINISTRATION							-				-	-	-	-	-	-	-	-	-
	Project Management and Coordination	3.00	mnth		40.000	95.00		3,800.00				-	120.00	11,400.00	-	-	-	11,400.00	4,142.00	12,426.00
	Travel and Subsistence	3.00	mnth					-			2,500.00	-	-	-	-	-	7,500.00	7,500.00	2,725.00	8,175.00
	Field Personnel, Superintendent	3.00	mnth		160.000	75.00		12,000.00				-	480.00	36,000.00	-	-	-	36,000.00	13,080.00	39,240.00
	Postal Box	3.00	mnth					-			25.00	-	-	-	-	-	75.00	75.00	27.25	81.75
	Initial Schedule Expense	3.00	mnth					-			100.00	-	-	-	-	-	300.00	300.00	109.00	327.00
	Monthly Schedule Updates	3.00	mnth					-			150.00	-	-	-	-	-	450.00	450.00	163.50	490.50
	Progress Photographs	3.00	mnth					-			45.00	-	-	-	-	-	135.00	135.00	49.05	147.15
	QUALITY CONTROL							-				-	-	-	-	-	-	-	-	-
	Material Testing	1.00	lsum					-		500.00		-	-	-	-	500.00	-	500.00	545.00	545.00
	Soil Testing and Analysis	1.00	lsum					-		1,200.00		-	-	-	-	1,200.00	-	1,200.00	1,308.00	1,308.00
	Field Density Tests	1.00	each					-		2,000.00		-	-	-	-	2,000.00	-	2,000.00	2,180.00	2,180.00
	Pollution Prevention Plan	1.00	lsum					-		2,500.00		-	-	-	-	2,500.00	-	2,500.00	2,725.00	2,725.00
	TEMPORARY FACILITIES							-				-	-	-	-	-	-	-	-	-
	Project Mob. & Demobilization	1.00	lsum		40.000			860.00				-	40.00	860.00	-	-	-	860.00	937.40	937.40
	Field Office Trailer	3.00	mnth					-		145.00		-	-	-	-	435.00	-	435.00	158.05	474.15
	Port-O-Lets	6.00	mnth					-		85.00		-	-	-	-	510.00	-	510.00	92.65	555.90
	Project Sign	1.00	each					-		350.00		-	-	-	-	350.00	-	350.00	381.50	381.50
	COMMISSIONING							-				-	-	-	-	-	-	-	-	-
	Pumps & Chemical Feed Start-Up	1.00	lsum	1,000.00				-				1,000.00	-	-	-	-	-	1,000.00	1,090.00	1,090.00
	Temporary Power	1.00	lsum					-			250.00	-	-	-	-	-	250.00	250.00	272.50	272.50
2	**SITE PREPARATION**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	SILT FENCE							-				-	-	-	-	-	-	-	-	-
	Install Silt Fence	13,990.00	lnft	0.46	0.014			0.30				6,435.40	195.86	4,210.99	-	-	-	10,646.39	0.83	11,604.57
	Install and Maintain Best Management Practices	1.00	lsum					-		1,500.00		-	-	-	-	1,500.00	-	1,500.00	1,635.00	1,635.00
	Remove Silt Fence	13,990.00	lnft		0.008			0.17				-	111.92	2,406.28	-	-	-	2,406.28	0.19	2,622.85
	DEMOLITION							-				-	-	-	-	-	-	-	-	-
	Remove Existing 10" PVC.Pipe	83.00	lnft		0.100			2.15	3.60			-	8.30	178.45	298.80	-	-	477.25	6.27	520.20
	Remove Existing 12" RC.Pipe	48.00	lnft		0.120			2.58	3.60			-	5.76	123.84	172.80	-	-	296.64	6.74	323.34
	Remove Existing 18" RC.Pipe	120.00	lnft		0.120			2.58	3.60			-	14.40	309.60	432.00	-	-	741.60	6.74	808.34
	Remove Existing 24" RC.Pipe	76.00	lnft		0.120			2.58	3.60			-	9.12	196.08	273.60	-	-	469.68	6.74	511.95
	Remove Existing 36" RC.Pipe	64.00	lnft		0.140			3.01	3.80			-	8.96	192.64	243.20	-	-	435.84	7.42	475.07
	Remove Existing 48" RC.Pipe	24.00	lnft		0.140			3.01	3.80			-	3.36	72.24	91.20	-	-	163.44	7.42	178.15
	Plug Storm Drain Pipe	1.00	each	25.00	3.000			64.50				25.00	3.00	64.50	-	-	-	89.50	97.56	97.56
	Remove Monitoring Station	1.00	each		0.500			10.75				-	0.50	10.75	-	-	-	10.75	11.72	11.72
	Protect Monitoring Station	1.00	each	5.00	0.500			10.75				5.00	0.50	10.75	-	-	-	15.75	17.17	17.17
	Off-Site Disposal of Debris	5.00	loads		0.750			16.13	33.75			-	3.75	80.63	168.75	-	-	249.38	54.36	271.82
	CLEARING AND GRUBBING							-				-	-	-	-	-	-	-	-	-
	Clean Out Existing Ditch	4,000.00	sqyd		0.012			0.26		0.85		-	48.00	1,032.00	-	3,400.00	-	4,432.00	1.21	4,830.88
	Clearing and Grubbing (Medium Density)	8.00	acres		36.000			774.00	1,250.00			-	288.00	6,192.00	10,000.00	-	-	16,192.00	2,206.16	17,649.28
	Open Burn On-Site	2.00	days	25.00	8.000			172.00	340.00			50.00	16.00	344.00	680.00	-	-	1,074.00	585.33	1,170.66
	STRIP TOPSOIL							-				-	-	-	-	-	-	-	-	-
	Strip Topsoil (Pond Area Only)	2,261.00	cuyd		0.022			0.47	0.55			-	49.74	1,069.45	1,243.55	-	-	2,313.00	1.12	2,521.17
	Strip Topsoil (Berm Area Only)	3,200.00	cuyd		0.022			0.47	0.55			-	70.40	1,513.60	1,760.00	-	-	3,273.60	1.12	3,568.22
	DEWATERING							-				-	-	-	-	-	-	-	-	-
	Surface Stormwater Collection and Pumping	1.00	mnth					-		1,600.00		-	-	-	-	1,600.00	-	1,600.00	1,744.00	1,744.00
	Stone/Gravel Sump	100.00	tons					-		15.50		-	-	-	-	1,550.00	-	1,550.00	16.90	1,689.50
	FENCING							-				-	-	-	-	-	-	-	-	-
	Remove Existing B/W Fence	4,000.00	lnft					-		0.50		-	-	-	-	2,000.00	-	2,000.00	0.55	2,180.00
	Connect to Existing Fence	10.00	each	2.00	1.000			21.50				20.00	10.00	215.00	-	-	-	235.00	25.62	256.15
	Install New B/W Fence	15,255.00	lnft					-		1.25		-	-	-	-	19,068.75	-	19,068.75	1.36	20,784.94
3	**EARTHWORK & GRADING**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-

20-Nov-02

BUTLER OAKS FARM, INC.

HIGHLAND COUNTY, FLORIDA

ITEM NO.	ITEM DESCRIPTIONS	QNTY	UNIT MSR	MATERIAL	MH P/UNIT	ADJ. RATE	CREW	UNIT LABOR	UNIT EQUIPMENT	UNIT SUB-CON	UNIT OTHER	TOTAL MATERIAL	TOTAL MANHOURS	TOTAL LABOR	TOTAL EQUIPMENT	TOTAL SUB-CON	TOTAL OTHER	TOTAL COST*	UNIT PRICE	TOTAL AMOUNT
	EXCAVATION							-				-	-	-	-	-	-	-	-	-
	Excavate Canals and Swales, bank measure	30,920.00	cuyd		0.006			0.13	0.29			-	185.52	3,988.68	8,966.80	-	-	12,955.48	0.46	14,121.47
	Excavate Settling & Drying Ponds, bank measure	21,468.00	cuyd		0.006			0.13	0.29			-	128.81	2,769.37	6,225.72	-	-	8,995.09	0.46	9,804.65
	PLACEMENT & COMPACTION							-				-	-	-	-	-	-	-	-	-
	Construct Ditch Block	200.00	cuyd		0.014			0.30	0.65			-	2.80	60.20	130.00	-	-	190.20	1.04	207.32
	Construct Berms, load fill, haul and place, bank measure	22,428.00	cuyd		0.012			0.26	0.58			-	269.14	5,786.42	13,008.24	-	-	18,794.66	0.91	20,486.18
	Construct Berms, grading and compaction, bank measure	22,428.00	cuyd		0.012			0.26	0.22			-	269.14	5,786.42	4,934.16	-	-	10,720.58	0.52	11,685.44
	GRADING AND FINISH WORK							-				-	-	-	-	-	-	-	-	-
	Finish Grade Ponds & Discharge Canal Slopes	14,475.00	sqyd		0.011			0.24	0.20			-	159.23	3,423.34	2,895.00	-	-	6,318.34	0.48	6,886.99
	Finish Grade Berms	26,538.00	sqyd		0.007			0.15	0.20			-	185.77	3,993.97	5,307.60	-	-	9,301.57	0.38	10,138.71
	Mass Grading , Selected Canal Perimeter @ 12'	20,000.00	sqyd		0.005			0.11	0.18			-	100.00	2,150.00	3,600.00	-	-	5,750.00	0.31	6,267.50
4	**STORM WATER DRAINAGE SYSTEM**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	HDPE DRAINAGE PIPE							-				-	-	-	-	-	-	-	-	-
	18" HDPE Pipe	116.00	lnft	6.00	0.200			4.30	4.00		0.35	696.00	23.20	498.80	464.00	-	40.60	1,699.40	15.97	1,852.35
	36" HDPE Pipe	616.00	lnft	18.60	0.240			5.16	5.00		0.45	11,457.60	147.84	3,178.56	3,080.00	-	277.20	17,993.36	31.84	19,612.76
	CONTROL STRUCTURES / RISERS							-				-	-	-	-	-	-	-	-	-
	48" Sgl. Face Aluminum Riiser Complete 06'-08'	4.00	each	900.00	12.000			258.00	250.00		25.00	3,600.00	48.00	1,032.00	1,000.00	-	100.00	5,732.00	1,561.97	6,247.88
	T&G Stop logs	1.00	lsum	350.00				-				350.00	-	-	-	-	-	350.00	381.50	381.50
	Type "G" DB Inlet 06'-08'	1.00	each	1,650.00	15.000			322.50	350.00		25.00	1,650.00	15.00	322.50	350.00	-	25.00	2,347.50	2,558.78	2,558.78
	RIP-RAP RUBBLE							-				-	-	-	-	-	-	-	-	-
	10" Diameter Rip-Rap Rubble	200.00	tons	26.50	0.250			5.38	5.00			5,300.00	50.00	1,075.00	1,000.00	-	-	7,375.00	40.19	8,038.75
5	**SOIL/TURF STABILIZATION**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	Land-Loc 450 Turf Reinforcement	2,340.00	sqyd	0.45	0.060			1.29				1,053.00	140.40	3,018.60	-	-	-	4,071.60	1.90	4,438.04
6	**SODDING & GRASSING**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	SODDING							-				-	-	-	-	-	-	-	-	-
	Bahai Sod	15,000.00	sqyd					-		1.10		-	-	-	-	16,500.00	-	16,500.00	1.20	17,985.00
	SEED AND MULCH							-				-	-	-	-	-	-	-	-	-
	Seed and Mulch	56,000.00	sqyd					-		0.20		-	-	-	-	11,200.00	-	11,200.00	0.22	12,208.00
7	**PIPE, FITTINGS & VALVES**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	PIPE							-				-	-	-	-	-	-	-	-	-
	1" Sch40 Pvc Pipe	220.00	lnft	0.40	0.120			2.58	2.00			88.00	26.40	567.60	440.00	-	-	1,095.60	5.43	1,194.20
	10" PVC C900 Irrigation Pipe	40.00	lnft	8.50	0.080			1.72	2.80			340.00	3.20	68.80	112.00	-	-	520.80	14.19	567.67
	16" PVC C900 Irrigation Pipe	70.00	lnft	14.50	0.090			1.94	3.00			1,015.00	6.30	135.45	210.00	-	-	1,360.45	21.18	1,482.89
	FITTINGS							-				-	-	-	-	-	-	-	-	-
	12" mj 45% Bends	6.00	each	225.00	3.500			75.25				1,350.00	21.00	451.50	-	-	-	1,801.50	327.27	1,963.64
	12" mj Tee	3.00	each	565.00	4.000			86.00				1,695.00	12.00	258.00	-	-	-	1,953.00	709.59	2,128.77
	12" HDPE Fittings	2.00	each	65.00	3.000			64.50				130.00	6.00	129.00	-	-	-	259.00	141.16	282.31
	10" / 16" Fittings	2.00	each	145.00	1.000			21.50				290.00	2.00	43.00	-	-	-	333.00	181.49	362.97
	VALVES & VALVE BOXES							-				-	-	-	-	-	-	-	-	-
	Solenoid Valve	2.00	each	75.00	1.000			21.50				150.00	2.00	43.00	-	-	-	193.00	105.19	210.37
	12" Butterfly Valve	2.00	each	1,016.00	3.500			75.25				2,032.00	7.00	150.50	-	-	-	2,182.50	1,189.46	2,378.93
	12" Flap Gate	2.00	each	500.00	5.000			107.50				1,000.00	10.00	215.00	-	-	-	1,215.00	662.18	1,324.35
	12" mj Flange Accessory Sets	1.00	each	54.00				-				54.00	-	-	-	-	-	54.00	58.86	58.86
	4' x 6' Concrete Valve Box w/Aluminum Hatch	0.00	each	1,350.00	15.000			322.50	250.00	600.00	45.00	1.35	0.02	0.32	0.25	0.60	0.05	2.57	2,799.00	2.80
	MISC. EQUIPMENT							-				-	-	-	-	-	-	-	-	-
	Concrete CIP Support Pile	2.00	each	350.00	9.000			193.50	130.00			700.00	18.00	387.00	260.00	-	-	1,347.00	734.12	1,468.23
	Steel Pipe Supports	10.00	each	25.00	0.500			10.75				250.00	5.00	107.50	-	-	-	357.50	38.97	389.68
	Lock Set	2.00	each	15.00				-				30.00	-	-	-	-	-	30.00	16.35	32.70
	Anchor Bolts Sets	3.00	each	18.00	3.000			64.50				54.00	9.00	193.50	-	-	-	247.50	89.93	269.78
8	**PUMPS AND CHEMICAL TREATMENT EQUIPMENT**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	PUMP EQUIPMENT											-	-	-	-	-	-	-	-	-
	20 HP Axial Flow Pump w/Starter	2.00	each	19,710.00	24.000			516.00	45.00		120.00	39,420.00	48.00	1,032.00	90.00	-	240.00	40,782.00	22,226.19	44,452.38
	Chemical Feed Pump	1.00	each	1,060.00	14.000			301.00				1,060.00	14.00	301.00	-	-	-	1,361.00	1,483.49	1,483.49
	Polymer Blending Pump	0.00	each	4,000.00	12.000			258.00				4.00	0.01	0.26	-	-	-	4.26	4,641.00	4.64
	Relocate Irrigation Pump	1.00	each	25.00	12.000			258.00	45.00			25.00	12.00	258.00	45.00	-	-	328.00	357.52	357.52
	800 Gal Chemical Storage Tank	0.00	each	900.00	5.000			107.50				0.90	0.01	0.11	-	-	-	1.01	1,098.00	1.10
	4,000 Gal Chemical Storage Tank	1.00	each	4,200.00	9.000			193.50				4,200.00	9.00	193.50	-	-	-	4,393.50	4,788.92	4,788.92
9	**CONCRETE PADS AND DISSIPATOR**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-

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20-Nov-02

BUTLER OAKS FARM, INC.

HIGHLAND COUNTY, FLORIDA

ITEM NO.	ITEM DESCRIPTIONS	QNTY	UNIT MSR	MATERIAL	MH P/UNIT	ADJ. RATE	CREW	UNIT LABOR	UNIT EQUIPMENT	UNIT SUB-CON	UNIT OTHER	TOTAL MATERIAL	TOTAL MANHOURS	TOTAL LABOR	TOTAL EQUIPMENT	TOTAL SUB-CON	TOTAL OTHER	TOTAL COST*	UNIT PRICE	TOTAL AMOUNT
	CONCRETE EQUIPMENT PAD							-				-	-	-	-	-	-	-	-	-
	6" Concrete Pad w/6x6wwf	140.00	sqft	2.50	0.060			1.29	0.25			350.00	8.40	180.60	35.00	-	-	565.60	4.40	616.50
	6" Concrete Pad w/6x6wwf	200.00	sqft	2.50	0.060			1.29	0.25			500.00	12.00	258.00	50.00	-	-	808.00	4.40	880.72
	CONCRETE DISSIPATOR PAD							-				-	-	-	-	-	-	-	-	-
	6" Concrete Pad w/6x6wwf	80.00	sqft	3.00	0.065			1.40	0.25		1.00	240.00	5.20	111.80	20.00	-	80.00	451.80	6.16	492.46
10	**PRE-FABRICATED METAL BUILDING**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	6" Thickened Edge Concrete Slab w/#4 12" O.C./ E.W.	1,280.00	sqft	2.12	0.034			0.73				2,713.60	43.52	935.68	-	-	-	3,649.28	3.11	3,977.72
	Pre-Fabricated Building	1,200.00	sqft					-		6.00		-	-	-	-	7,200.00	-	7,200.00	6.54	7,848.00
12	**ELECTRICAL**	**1.00**	**LSUM**					-				-	-	-	-	-	-	-	-	-
	POWER DISTRIBUTION							-				-	-	-	-	-	-	-	-	-
	Overhead Power	1,500.00	lf					-		9.75		-	-	-	-	14,625.00	-	14,625.00	10.63	15,941.25
	EQUIPMENT							-				-	-	-	-	-	-	-	-	-
	Service Riser	1.00	lsum					-		4,000.00		-	-	-	-	4,000.00	-	4,000.00	4,360.00	4,360.00
	Grounding	1.00	lsum					-		1,200.00		-	-	-	-	1,200.00	-	1,200.00	1,308.00	1,308.00
								-				-	-	-	-	-	-	-	-	-
								-										-		
																		375,892.50		
END OF ESTIMATE																			$	**409,722.83**

NO. EXCLUSIONS & QUALIFICATIONS

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APPENDIX B – Davie Dairy EOF Design Documents

Best Available Technologies Project for Davie Dairy

Engineering Report

February, 2003

Submitted to:

INC.

Soil and Water Engineering Technology, Inc.

Prepared by:

ERD

Environmental Research & Design, Inc.
3419 Trentwood Blvd., Suite 102
Orlando, FL 32812
EB #6244

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SECTION 1

INTRODUCTION

In December 2000, the South Florida Water Management District (SFWMD) selected the Soil and Water Engineering Technology, Inc. (SWET) Team to complete the Dairy Best Available Technologies (BAT) Project (C-11652). The project goal is to select, implement, and monitor best available technologies to significantly reduce dairy industry phosphorus exports to the Okeechobee Basin and bring about the most effective and substantial water quality improvements in the shortest possible time. As part of this project, the SWET Team completed a detailed literature review of available technologies, completed a ranking of Okeechobee dairies for participation, completed nutrient assessment for selected dairies, and ranked and selected the most appropriate technology for meeting the District's goal of 40 ppb total phosphorus concentration at the edge of the farm. Edge-of-farm treatment (impoundment, water reuse, and chemical flocculation) of runoff was found to be the highest ranked method to reduce phosphorus discharge from the farm to meet the project's goals. Based on these findings, the SFWMD Governing Board authorized SWET to contract with Environmental Research & Design, Inc. (ERD) to design and construct an edge-of-farm treatment system for Davie Dairy located in Okeechobee, Florida.

Davie Dairy is a 3410-acre dairy located south of S.R. 70 in Okeechobee County, Florida. Approximately 1500 acres of the property, including the active dairy, and 801 acres of off-site property drain to Nubbin Slough. Nubbin Slough drains to the L-63S Canal which drains into the east side of Lake Okeechobee. Based on previous water quality monitoring, the total phosphorus concentration of the water in Nubbin Slough at the edge of the farm is in the range of 200-600 ppb. The proposed edge-of-farm treatment system has been designed to reduce total phosphorus concentrations in treatment system discharges to below 40 ppb.

The proposed edge-of-farm treatment system includes the construction of a levee across Nubbin Slough. Excess runoff will stage upstream of the levee in natural depressional areas and then discharge through a 48-inch HDPE pipe into a floc settling pond. The water flow rate will be measured as it passes through the pipe and the appropriate amount of aluminum sulfate and sodium hydroxide is mixed with inflow water, with the resulting floc settling in the floc settling pond. The treated supernatant will discharge into Nubbin Slough on Davie Dairy property downstream of the constructed levee. The stormwater detention/chemical treatment system is capable of treating all discharges up to and including the peak discharge for a 3.77-inch rain event.

This engineering report provides a summary of the engineering analyses and calculations performed to design the edge-of-farm treatment system for Davie Dairy. The report is divided into five separate sections. Section 1 contains an introduction to the project and summarizes work efforts performed by ERD during the Design Phase. Section 2 provides a detailed hydrologic evaluation of the Davie Dairy BAT project drainage basin. Section 3 contains a summary of pollutant loadings currently generated within the project drainage basin. Section 4 evaluates the effectiveness of aluminum sulfate and sodium hydroxide for treatment of stormwater runoff from the project drainage basin. Section 5 provides a detailed description of the proposed stormwater treatment system, including annual chemical requirements, floc generation, comparison of pre- and post-treatment pollutant loadings, O&M requirements, and opinion of probable construction cost and annual O&M cost. Appendices are provided which contain a complete listing of data collected by ERD, hydrologic modeling results, and other miscellaneous information.

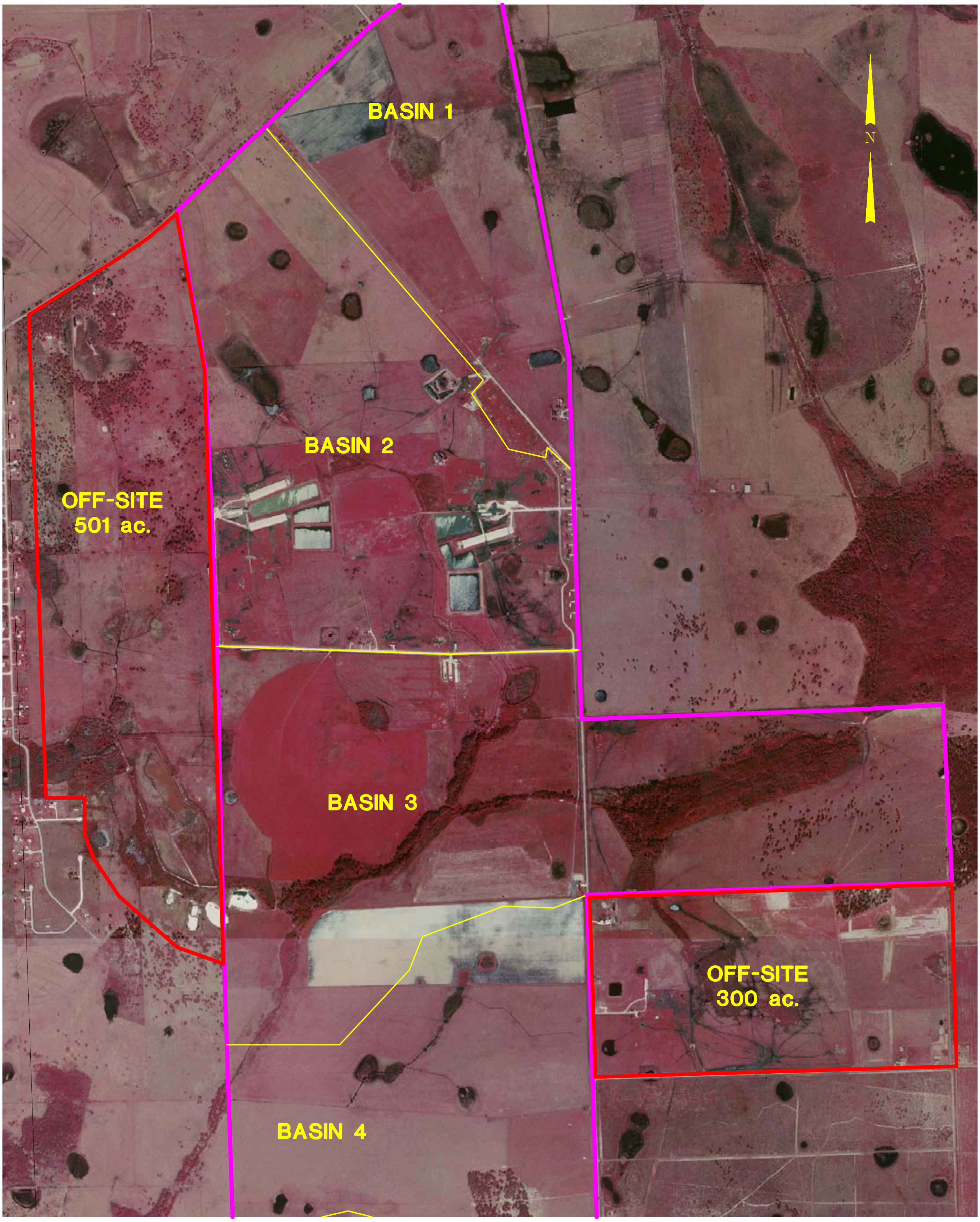
SECTION 2

HYDROLOGIC EVALUATION OF THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN

2.1 Description of the Project Drainage Basin

The point of treatment for the Davie Dairy BAT edge-of-farm treatment system is located along Nubbin Slough, approximately 750 ft north of the intersection of Nubbin Slough and the western property boundary for Davie Dairy. The project watershed was delineated using information provided in "Task 2.8 - Draft Report Comprehensive Nutrient Management Plans for the Three Selected Dairies" prepared by the SWET Team (December 12, 2001), the U.S.G.S. quadrangle map, field evaluations, and discussions with the dairy owner. An outline of the project drainage basin is provided in Figure 2-1. The project drainage basin includes all of Basin 2 (687 acres), 896 acres of Basin 3, 501 acres of off-site area from the west, and 300 acres of off-site area from the east, for a total project drainage basin area of 2384 acres. Nubbin Slough drains from east-to-west across Basin 3, while Basin 2 drains through constructed ditches and into Nubbin Slough, approximately 1000 ft west of Berman Road. Basin 2 contains primarily the dairy operation, while Basin 3 contains pasture areas.

With the exception of areas immediately adjacent to Nubbin Slough, the project watershed is extremely flat, typical for Okeechobee County. Land slope is approximately 0.00025 ft/ft from the northern edge of Basin 2 south to Nubbin Slough. Basin 3 is split by Nubbin Slough. Portions of Basin 3 north of Nubbin Slough drain from north-to-south to the slough, while areas south of the slough drain from south-to-north to the slough. Elevations within the slough fall from approximately 50 ft NGVD at Berman Road to 35 ft NGVD at the western property boundary.



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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

WATERSHED MAP

SCALE	1''=2000'
FIG. NO.	2–1
PROJ. NO.	02–007
DATE	SEPT. 2002

2.2 Drainage Basin Hydrologic Modeling Parameters

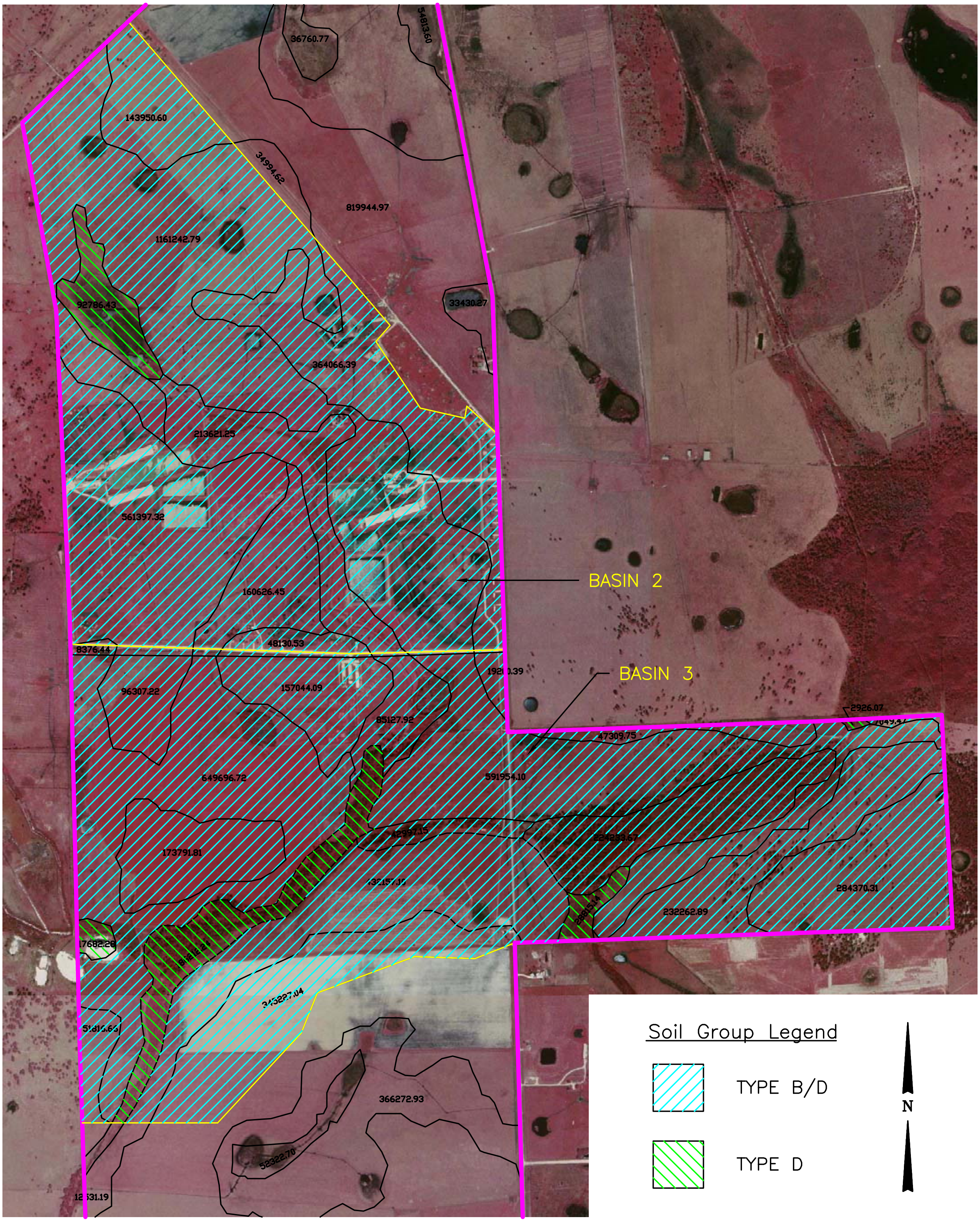
Hydrologic soil group classifications within the project drainage basin are provided in Figure 2-2. The project drainage basin includes 2299 acres of B/D soils, 79 acres of D soils, and 6 acres of impervious area. Soil types include Immokalee Fine Sand, Okeechobee Muck, Wabasso Fine Sand, Myakka Fine Sand, and depressional Bassinger and Placid soils. Most of the project site remains unimproved and, therefore, a hydrologic group classification of D was used for all hydrologic and hydraulic modeling.

A summary of hydrologic parameters used in hydraulic and hydrologic modeling is provided in Table 2-1. The time of concentration was calculated using the kinematic wave formula, with a flow length of 10,000 ft, a roughness of 0.30, a rainfall intensity of 0.438 inches/hour, and a slope of 0.00025 ft/ft.

TABLE 2-1

SUMMARY OF HYDROLOGIC PARAMETERS DEVELOPED FOR THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN

PARAMETER	VALUE
Area	2384 acres
DCIA	0%
CN non-DCIA	80.1
S	2.48 inches
t_c	1900 minutes



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HYDROLOGIC SOIL GROUP MAP

SCALE	1"=500'
FIG. NO.	2–2
PROJ. NO.	02–007
DATE	SEPT. 2002

2.3 Rainfall Data

Historic hourly rainfall data was obtained from the National Climatic and Data Center CD for the Okeechobee Hurricane Gate Station for the period from 1942-1970. A total of 19 rainfall event intervals were established to categorize typical rainfall amounts for rain events which occur within the Davie Dairy area. Next, the number of annual rain events falling within each of the selected interval ranges was estimated based upon a probability distribution of individual rainfall amounts occurring at the Okeechobee Hurricane Gate Station over the period from 1942-1970. Each event separated by more than 3 hours of no rainfall was considered a separate rainfall event. A mean rainfall depth and duration was calculated for each rainfall event range. A summary of the rainfall information from the Okeechobee Hurricane Gate Station is provided in Table 2-2. The total average annual rainfall over this period was 42.93 inches. The minimum annual rainfall was 23.71 inches and the maximum annual rainfall was 61.24 inches.

The owners of Davie Dairy believed that the rainfall data from the Okeechobee Hurricane Gate Station under-estimated the average annual rainfall. The owners of Davie Dairy provided additional annual rainfall data for five stations in the Okeechobee area, as provided in Table 2-3. Based on these five stations, the average annual rainfall is 46.33 inches. The minimum rainfall of 28.29 inches occurred in 2000, and the maximum annual rainfall of 69.49 inches occurred in 1969. Hourly rainfall data, as presented in Table 2-2, is essential to estimating annual runoff volume for the project watershed. To edit the hourly rainfall data in Table 2-2 to agree with the annual rainfall data provided by Davie Dairy, the number of annual rain events within each range, as shown in Table 2-2, were uniformly and proportionally modified to provide an average annual rainfall of 46.33 inches, a minimum annual rainfall of 28.29 inches, and a maximum annual rainfall of 69.49 inches. Additional calculations will be performed throughout the remaining portions of this report using an average annual rainfall of 46.33 inches, a minimum annual rainfall of 28.29 inches, and a maximum annual rainfall of 69.49 inches.

TABLE 2-2

SUMMARY OF RAINFALL DATA FROM THE OKEECHOBEE HURRICANE GATE STATION FOR THE PERIOD FROM 1942-1970

RAINFALL EVENT RANGE (in)	RAINFALL INTERVAL POINT (in)	NUMBER OF ANNUAL EVENTS IN RANGE	TOTAL ANNUAL RAINFALL (in)
0.00-0.10	0.04	57.588	2.30
0.11-0.20	0.15	16.751	2.51
0.21-0.30	0.25	9.604	2.40
0.31-0.40	0.35	6.541	2.29
0.41-0.50	0.46	5.747	2.64
0.51-1.00	0.71	14.747	10.47
1.01-1.50	1.22	5.936	7.24
1.51-2.00	1.73	2.874	4.97
2.01-2.50	2.21	1.172	2.59
2.51-3.00	2.74	0.681	1.87
3.01-3.50	3.16	0.302	0.95
3.51-4.00	3.77	0.189	0.71
4.01-4.50	4.32	0.189	0.82
4.51-5.00	4.78	0.038	0.18
5.01-6.00	--	0.000	0.00
6.01-7.00	6.95	0.038	0.26
7.01-8.00	--	0.000	0.00
8.01-9.00	--	0.000	0.00
> 9.01	9.62	0.076	0.73
		ANNUAL TOTAL:	**42.93 inches**

TABLE 2-3

SUMMARY OF ANNUAL RAINFALL DATA PROVIDED BY DAVIE DAIRY FOR THE OKEECHOBEE AREA FOR THE YEARS 1956-2001

YEAR	STATION RAINFALL (inches)					ANNUAL AVERAGE RAINFALL (inches)
	DAVIE	JUDSON	OPAL	S191	S133	
1956	--	--	47.18	--	--	47.18
1957	--	--	63.76	--	--	63.76
1958	--	--	51.61	--	--	51.61
1959	--	--	67.18	--	--	67.18
1960	--	--	55.36	--	--	55.36
1961	--	--	33.34	--	--	33.34
1962	--	--	53.11	--	--	53.11
1963	--	--	38.33	--	--	38.33
1964	--	--	48.00	--	--	48.00
1965	--	--	37.37	--	--	37.37
1966	--	--	62.24	--	--	62.24
1967	--	--	53.41	--	--	53.41
1968	--	--	55.66	--	--	55.66
1969	--	--	69.49	--	--	69.49
1970	--	--	60.03	--	--	60.03
1971	--	--	45.81	--	37.65	41.73
1972	--	--	28.64	--	37.75	33.20
1973	--	--	30.48	--	41.82	36.15
1974	--	--	44.89	--	--	44.89
1975	--	--	28.98	--	30.14	29.56
1976	--	--	49.08	--	--	49.08
1977	--	--	42.50	--	37.28	39.89
1978	--	--	53.50	--	--	53.50
1979	--	--	53.70	--	57.59	55.65
1980	--	--	42.80	--	46.03	44.42

TABLE 2-3 -- CONTINUED

SUMMARY OF ANNUAL RAINFALL DATA PROVIDED BY DAVIE DAIRY FOR THE OKEECHOBEE AREA FOR THE YEARS 1956-2001

YEAR	STATION RAINFALL (inches)					ANNUAL AVERAGE RAINFALL (inches)
	DAVIE	JUDSON	OPAL	S191	S133	
1981	--	--	33.80	--	31.11	32.46
1982	54.64	--	55.00	--	62.70	57.45
1983	51.24	--	68.60	--	58.51	59.45
1984	40.72	--	30.40	--	45.43	38.85
1985	34.94	--	35.50	--	36.66	35.70
1986	47.23	--	43.10	--	43.50	44.61
1987	37.28	--	--	--	44.73	41.01
1988	--	--	--	--	43.83	43.83
1989	--	--	51.80	--	42.40	47.10
1990	--	--	42.60	--	41.15	41.88
1991	--	--	46.60	--	52.36	49.48
1992	--	--	--	--	49.38	49.38
1993	--	54.16	41.45	--	41.66	45.76
1994	--	55.89	53.50	--	58.11	55.83
1995	--	47.45	46.97	41.24	57.76	48.36
1996	--	33.72	45.38	30.58	38.03	36.93
1997	--	42.97	58.55	39.45	50.96	47.98
1998	--	51.24	60.38	44.38	49.39	51.35
1999	--	46.73	60.58	44.47	50.39	50.54
2000	--	--	29.48	24.46	30.94	28.29
2001	--	--	62.00	--	47.90	54.95

Average of Annual Averages:	**47.51**
Average of Actual Data:	**46.33**

2.4 Estimation of Annual Runoff Volumes

The Santa Barbara Urban Hydrograph Method element within Advanced ICPR was used to calculate event runoff depths for each mean rainfall depth for the 19 rainfall event intervals discussed previously. Annual runoff volumes for each rainfall event range were calculated by multiplying the runoff depth times the number of annual events times the drainage area. The runoff volume for all rainfall event ranges were summed to provide an annual runoff volume for the project drainage basin. A summary of the annual runoff volume calculations for the Davie Dairy BAT project drainage basin for an average rainfall year, a minimum rainfall year, and a maximum rainfall year are provided in Tables 2-4, 2-5, and 2-6, respectively.

At the Project Kick-off Meeting, it was stated that Davie Dairy uses approximately 500,000 gallons of water each day for the washdown of two barns. The used water from each barn discharges into a series of three lagoons and is then pumped onto a pivot sprayfield. One of the pivot sprayfields is underdrained while the other is not. Based on hydrologic modeling results, the coefficient of runoff (C) for the project watershed is 0.139. Applying a "C" value of 0.139 to a washdown volume of 500,000 gallons/day (gpd) results in an average daily discharge from the two pivot sprayfields of 69,500 gpd or approximately 78 ac-ft/yr. The volume of water reaching the proposed detention/chemical treatment system is the sum of the annual runoff volume and the washdown runoff. A summary of the total estimated volume of water reaching the treatment system for a range of annual rainfall is provided in Table 2-7.

TABLE 2-4

SUMMARY OF ANNUAL RUNOFF CALCULATIONS FOR THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN FOR AN AVERAGE RAINFALL YEAR (Total Rainfall = 46.33 inches)

RAINFALL EVENT RANGE (in)	MEAN RAINFALL DEPTH (in)	NUMBER OF ANNUAL EVENTS IN RANGE	EVENT RUNOFF DEPTH (in)	RUNOFF VOLUME (ac-ft)
0.00-0.10	0.04	62.119	0.00	0.00
0.11-0.20	0.15	18.069	0.00	0.00
0.21-0.30	0.25	10.360	0.00	0.00
0.31-0.40	0.35	7.056	0.00	0.00
0.41-0.50	0.46	6.199	0.00	0.00
0.51-1.00	0.71	15.907	0.02	52.49
1.01-1.50	1.22	6.403	0.16	205.54
1.51-2.00	1.73	3.100	0.40	247.08
2.01-2.50	2.21	1.264	0.69	174.33
2.51-3.00	2.74	0.735	1.06	154.41
3.01-3.50	3.16	0.326	1.38	89.32
3.51-4.00	3.77	0.204	1.86	75.15
4.01-4.50	4.32	0.204	2.32	93.80
4.51-5.00	4.78	0.041	2.71	22.07
5.01-6.00	--	--	--	0.00
6.01-7.00	6.95	0.041	4.66	39.33
7.01-8.00	--	--	--	0.00
8.01-9.00	--	--	--	0.00
> 9.01	9.62	0.082	7.17	116.75
			Generated Volume (ac-ft/yr):	**1268.87**
			Weighted Basin "C" Value:	**0.139**

TABLE 2-5

SUMMARY OF ANNUAL RUNOFF CALCULATIONS FOR THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN FOR A MINIMUM RAINFALL YEAR (Total Rainfall = 28.29 inches)

RAINFALL EVENT RANGE (in)	MEAN RAINFALL DEPTH (in)	NUMBER OF ANNUAL EVENTS IN RANGE	EVENT RUNOFF DEPTH (in)	RUNOFF VOLUME (ac-ft)
0.00-0.10	0.04	37.931	0.00	0.00
0.11-0.20	0.15	11.033	0.00	0.00
0.21-0.30	0.25	6.326	0.00	0.00
0.31-0.40	0.35	4.308	0.00	0.00
0.41-0.50	0.46	3.785	0.00	0.00
0.51-1.00	0.71	9.713	0.002	32.05
1.01-1.50	1.22	3.910	0.16	125.51
1.51-2.00	1.73	1.893	0.40	150.87
2.01-2.50	2.21	0.772	0.69	106.45
2.51-3.00	2.74	0.449	1.06	94.29
3.01-3.50	3.16	0.199	1.38	54.54
3.51-4.00	3.77	0.124	1.86	45.89
4.01-4.50	4.32	0.124	2.32	57.28
4.51-5.00	4.78	0.025	2.71	13.48
5.01-6.00	--	--	--	--
6.01-7.00	6.95	0.025	4.66	23.16
7.01-8.00	--	--	--	--
8.01-9.00	--	--	--	--
> 9.01	9.62	0.050	7.17	71.29
			Generated Volume (ac-ft/yr):	**774.80**
			Weighted Basin "C" Value:	**0.139**

TABLE 2-6

SUMMARY OF ANNUAL RUNOFF CALCULATIONS FOR THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN FOR A MAXIMUM RAINFALL YEAR (Total Rainfall = 69.49 inches)

RAINFALL EVENT RANGE (in)	MEAN RAINFALL DEPTH (in)	NUMBER OF ANNUAL EVENTS IN RANGE	EVENT RUNOFF DEPTH (in)	RUNOFF VOLUME (ac-ft)
0.00-0.10	0.04	93.172	0.00	0.00
0.11-0.20	0.15	27.101	0.00	0.00
0.21-0.30	0.25	15.538	0.00	0.00
0.31-0.40	0.35	10.583	0.00	0.00
0.41-0.50	0.46	9.298	0.00	0.00
0.51-1.00	0.71	23.859	0.02	78.74
1.01-1.50	1.22	9.604	0.16	308.28
1.51-2.00	1.73	4.560	0.40	370.59
2.01-2.50	2.21	1.896	0.69	261.48
2.51-3.00	2.74	1.102	1.06	231.60
3.01-3.50	3.16	0.489	1.38	133.98
3.51-4.00	3.77	0.306	1.86	112.71
4.01-4.50	4.32	0.306	2.32	140.69
4.51-5.00	4.78	0.061	2.71	33.10
5.01-6.00	--	--	--	--
6.01-7.00	6.95	0.061	4.66	56.89
7.01-8.00	--	--	--	--
8.01-9.00	--	--	--	--
> 9.01	9.62	0.123	7.17	175.11
			Generated Volume (ac-ft/yr):	**1903.17**
			Weighted Basin "C" Value:	**0.139**

TABLE 2-7

SUMMARY OF ANNUAL WATER VOLUME DISCHARGING FROM THE DAVIE DAIRY BAT PROJECT WATERSHED TO THE POINT OF TREATMENT

ANNUAL RAINFALL (in)	RUNOFF VOLUME (ac-ft)	WASHDOWN VOLUME (ac-ft)	TOTAL WATER VOLUME (ac-ft)
Minimum = 28.29	775	78	853
Average = 46.33	1269	78	1347
Maximum = 69.49	1903	78	1981

SECTION 3

EVALUATION OF POLLUTANT LOADINGS FROM THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN

3.1 Chemical Characteristics of Stormwater Runoff Collected in the Project Drainage Basin

Following an extended period of "dry" weather, significant rainfall occurred at Davie Dairy during June 2002. The owner of Davie Dairy collected stormwater runoff from Nubbin Slough near the western property boundary on June 5, 7, 12, 17, and 24, 2002. Collected samples were immediately refrigerated. Samples were picked up by ERD personnel, placed on ice, and returned to the ERD laboratory for analysis. A summary of measured stormwater runoff characteristics is provided in Table 3-1. Total phosphorus concentration ranged from 494-1186 µg/l, with a mean value of 836 µg/l. Much of the phosphorus present was in the form of orthophosphorus. The mean total nitrogen concentration was 2570 µg/l and the mean total suspended solids concentration was 16.6 mg/l. All stormwater runoff samples were slightly acidic with pH values ranging from 6.25-6.70, and were poorly buffered with alkalinities ranging from 14.9-32.4 mg/l as $CaCO_3$.

3.2 Estimated Annual Mass Pollutant Loadings from the Project Drainage Basin

Annual water volumes reaching the point of treatment for the Davie Dairy BAT project drainage basin were provided in Table 2-7. Estimated pre-treatment pollutant loadings from the Davie Dairy BAT project drainage basin were calculated by multiplying the annual water volumes times the mean pollutant concentrations listed in Table 3-1. A summary of estimated pre-treatment pollutant loadings for total phosphorus, total nitrogen, and total suspended solids are provided in Table 3-2. Separate values are provided for minimum, average, and maximum rainfall years. Pre-treatment annual mass total phosphorus loadings ranged from 878-2040 kg/yr based on annual rainfall volume.

TABLE 3-1

SUMMARY OF STORMWATER RUNOFF CHARACTERISTICS MEASURED IN THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN DURING JUNE 2002

DATE COLLECTED	PARAMETER									
	NH_3 (µg/l)	NO_x (µg/l)	TN (µg/l)	OP (µg/l)	TP (µg/l)	pH (s.u.)	Spec. Cond. (µmho/cm)	Alk. (mg/l)	Turb. (NTU)	TSS (mg/l)
6/5/02	57	12	934	518	1026	6.65	151	16.7	12.8	21.0
6/7/02	110	132	1097	598	971	6.52	120	18.1	19.7	30.6
6/12/02	< 5	30	794	349	494	6.25	196	14.9	5.0	9.1
6/17/02	37	5725	6745	378	501	6.51	360	26.3	11.2	4.6
6/24/02	101	1152	3281	943	1186	6.70	232	32.4	12.6	17.6

TABLE 3-2

SUMMARY OF ESTIMATED PRE-TREATMENT POLLUTANT LOADINGS FROM THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN

ANNUAL RAINFALL	AVERAGE ANNUAL MASS POLLUTANT LOADING (kg/yr)		
	TP	TN	TSS
Minimum	878	2,700	17,440
Average	1,387	4,264	27,540
Maximum	2,040	6,270	40,502

SECTION 4

EVALUATION OF THE EFFECTIVENESS OF ALUM FOR TREATMENT OF STORMWATER RUNOFF FROM THE DAVIE DAIRY BAT PROJECT DRAINAGE BASIN

4.1 Laboratory Testing Procedures

During June 2002, laboratory testing was conducted on stormwater runoff samples collected at Davie Dairy to evaluate the effectiveness of alum for reducing pollutant concentrations in stormwater runoff inputs. Jar tests were conducted on runoff samples collected on June 5, 7, 12, 17, and 24, 2002. Stormwater samples were treated with alum at doses ranging from 5-20 mg/l as aluminum. Laboratory testing at each of the alum doses was conducted individually using a sample volume of 2 liters or greater. To begin a test, the appropriate volume of alum was added to a 2 liter water sample and the alum/water mixture was vigorously agitated for approximately 15 seconds. Measurements of pH were conducted initially in the raw sample at a time of one minute, one hour, and 24 hours after addition of the alum coagulant to document changes in pH which typically occur after addition of chemical coagulants. The alum treated samples were then allowed to settle for a period of 24 hours. At the end of the 24-hour settling period, the clear supernatant was decanted for laboratory analysis.

An important element of laboratory testing is to determine if the water has sufficient buffering capacity to allow the use of alum alone, or whether an additional buffering agent will be necessary to maintain a minimum pH level of 6.0 following treatment. A conservative approach is used while conducting each of the laboratory jar tests to evaluate the need for additional buffering compounds. At the beginning of each test, a 2-liter sample of test water is mixed vigorously using a paddle stirrer. A pH probe is inserted into the sample for continuous monitoring of solution pH. The alum coagulant is then added to the test solution, with careful monitoring of pH. Measurements of pH are taken at one minute, one hour, and 24 hours after addition of the alum coagulant. A minimum pH level of approximately 6.0 is established for each laboratory jar test based upon the pH measurement taken one minute after addition of the alum. In general, the minimum pH level in alum treated water is achieved approximately one minute after addition of the alum to the sample. The pH value of the treated water continues to increase steadily following the alum addition for a period of approximately 24 hours, with a majority of the pH increase occurring within the first hour after the alum is added. In general, equilibrium pH levels increase approximately 0.2-0.3 pH units within the first hour, with a total pH increase of approximately 0.5-1.0 pH units after 24 hours for most samples.

Laboratory jar tests conducted on stormwater runoff samples collected at Davie Dairy were based upon a minimum pH value of 6.0 one minute following the addition of alum. Each of the treated water samples were evaluated in the laboratory for a wide range of chemical parameters, including general inorganic parameters, nutrients, and suspended solids.

4.2 Effectiveness of Alum for Removal of Stormwater Pollutants

Laboratory jar test results conducted on multiple stormwater runoff samples collected at Davie Dairy are presented in Tables 4-1 through 4-5, respectively. Mean results of laboratory jar tests for all five sampling dates are provided in Table 4-6. Stormwater runoff collected at Davie Dairy was slightly acidic, with raw water pH values from 6.23-6.70. All stormwater runoff samples were poorly buffered, with initial alkalinity values ranging from 14.9-32.4 mg/l as $CaCO_3$. Because the stormwater runoff was slightly acidic, and had low alkalinity values, the addition of alum at a dose of only 5 mg/l required the addition of sodium hydroxide to maintain a pH of 6.0 one minute following alum addition. Sodium hydroxide requirements increased with increasing alum dose.

TABLE 4-1

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY ON JUNE 5, 2002

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg/l as Al)			
			5	10	15	20
pH (initial)	s.u.	6.23	6.23	6.23	6.23	6.23
pH (1 minute)	s.u.	--	5.99	5.98	5.96	6.03
pH (1 hour)	s.u.	--	6.32	6.27	6.25	6.29
pH (24 hours)	s.u.	6.65	6.51	6.49	6.44	6.50
Spec. Cond.	µmho/cm	151	199	252	311	366
Alkalinity	mg/l	16.7	9.2	6.6	6.8	7.4
NH_3	µg/l	57	19	5	6	5
NO_x	µg/l	12	11	11	12	5
Total Nitrogen	µg/l	934	374	282	235	243
Orthophosphorus	µg/l	518	9	3	3	3
Total Phosphorus	µg/l	1026	124	31	14	13
Turbidity	NTU	12.8	3.7	1.3	0.5	0.8
TSS	mg/l	21.0	6.4	3.6	1.6	0.8
NaOH Buffer Added	mg/l	--	14	32	52	73

TABLE 4-2

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY ON JUNE 7, 2002

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg/l as Al)	
			7.5	12.5
pH (initial)	s.u.	6.65	6.65	6.65
pH (1 minute)	s.u.	--	4.66	4.52
pH (1 hour)	s.u.	--	6.36	6.38
pH (24 hours)	s.u.	6.52	6.16	6.15
Spec. Cond.	µmho/cm	120	188	243
Alkalinity	mg/l	18.1	10.3	9.4
NH_3	µg/l	110	3	3
NO_x	µg/l	132	85	88
Total Nitrogen	µg/l	1097	354	354
Orthophosphorus	µg/l	598	3	3
Total Phosphorus	µg/l	971	30	19
Turbidity	NTU	19.7	1.2	1.1
TSS	mg/l	30.6	2.0	1.3
NaOH Buffer Added	mg/l	--	10	20

TABLE 4-3

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY ON JUNE 12, 2002

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg/l as Al)			
			7.5	10	12.5	15
pH (initial)	s.u.	6.53	6.53	6.53	6.53	6.53
pH (1 minute)	s.u.	--	5.80	5.79	5.82	5.84
pH (1 hour)	s.u.	--	6.16	6.04	5.99	6.01
pH (24 hours)	s.u.	6.25	6.00	6.02	6.08	6.03
Spec. Cond.	µmho/cm	196	241	263	277	301
Alkalinity	mg/l	14.9	5.0	6.0	4.4	4.0
NH_3	µg/l	3	3	16	24	19
NO_x	µg/l	30	36	30	32	40
Total Nitrogen	µg/l	794	416	389	337	381
Orthophosphorus	µg/l	349	3	3	4	4
Total Phosphorus	µg/l	494	26	25	19	25
Turbidity	NTU	5.0	1.2	1.3	0.9	1.0
TSS	mg/l	9.1	1.5	3.2	2.0	3.0
NaOH Buffer Added	mg/l	--	21	29	40	49

TABLE 4-4

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY ON JUNE 17, 2002

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg/l as Al)			
			7.5	10	12.5	15
pH (initial)	s.u.	6.56	6.56	6.56	6.56	6.56
pH (1 minute)	s.u.	--	5.88	5.84	5.93	5.93
pH (1 hour)	s.u.	--	5.94	5.88	5.93	5.91
pH (24 hours)	s.u.	6.51	6.07	6.07	6.10	6.12
Spec. Cond.	µmho/cm	360	399	420	448	471
Alkalinity	mg/l	26.3	10.6	8.8	8.6	9.8
NH_3	µg/l	37	3	3	12	21
NO_x	µg/l	5725	5874	5883	5832	5829
Total Nitrogen	µg/l	6745	6459	6272	6194	6047
Orthophosphorus	µg/l	378	9	5	4	4
Total Phosphorus	µg/l	501	169	70	23	17
Turbidity	NTU	11.2	2.8	2.5	1.3	0.9
TSS	mg/l	4.6	4.0	5.5	1.3	2.0
NaOH Buffer Added	mg/l	--	16	24	31	44

TABLE 4-5

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY ON JUNE 24, 2002

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg/l as Al)			
			7.5	10	12.5	15
pH (initial)	s.u.	6.80	6.80	6.80	6.80	6.23
pH (1 minute)	s.u.	--	5.94	5.95	6.00	5.96
pH (1 hour)	s.u.	--	6.37	6.24	6.22	6.25
pH (24 hours)	s.u.	6.70	6.19	6.16	6.23	6.44
Spec. Cond.	µmho/cm	232	281	300	340	311
Alkalinity	mg/l	32.4	12.1	8.6	9.2	6.8
NH_3	µg/l	101	3	85	98	6
NO_x	µg/l	1152	1183	1210	1202	12
Total Nitrogen	µg/l	3281	2664	2375	2214	235
Orthophosphorus	µg/l	943	19	8	7	3
Total Phosphorus	µg/l	1186	516	226	124	14
Turbidity	NTU	12.6	9.7	8.9	2.9	0.5
TSS	mg/l	17.6	11.3	4.0	2.0	1.6
NaOH Buffer Added	mg/l	--	5	8	14	52

TABLE 4-6

MEAN RESULTS OF LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY DURING JUNE 2002

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg/l as Al)			
			7.5	10	12.5	15
pH (initial)	s.u.	6.55	6.64	6.53	6.64	6.39
pH (1 minute)	s.u.	--	5.57	5.89	5.57	5.92
pH (1 hour)	s.u.	--	6.21	6.11	6.13	6.11
pH (24 hours)	s.u.	6.53	6.11	6.19	6.14	6.26
Spec. Cond.	µmho/cm	212	277	309	327	349
Alkalinity	mg/l	21.7	9.5	7.5	7.9	6.9
NH_3	µg/l	62	3	27	34	13
NO_x	µg/l	1410	1795	1784	1789	1473
Total Nitrogen	µg/l	2570	2473	2330	2275	1725
Orthophosphorus	µg/l	557	9	5	5	4
Total Phosphorus	µg/l	836	185	88	46	18
Turbidity	NTU	12.3	3.7	3.5	1.6	0.7
TSS	mg/l	16.6	4.7	4.1	1.7	2.1
NaOH Buffer Added	mg/l	--	13	23	29	47

ERD initially performed laboratory jar tests on stormwater runoff collected on June 5, 2002 without sodium hydroxide addition to evaluate floc formation and floc settling characteristics. Raw stormwater runoff treated with only alum did not form a settleable floc and resulted in high remaining total phosphorus concentrations, even at very high alum doses. ERD has observed this same characteristic with jar testing of other low pH/low alkalinity, highly organic agricultural runoff.

With the combination of aluminum sulfate and sodium hydroxide, substantial reductions in concentrations were observed for orthophosphorus, total phosphorus, turbidity, and total suspended solids. As stated previously, the primary project goal is to reduce total phosphorus concentrations in treated runoff to less than 40 µg/l. For the June 5, 2002 runoff sample, the addition of an alum dose of 10 mg/l as Al and a sodium hydroxide dose of 32 mg/l decreased the total phosphorus concentration from 1026 µg/l to 31 µg/l. On June 7, 2002, an alum dose of 7.5 mg/l as Al and a sodium hydroxide dose of 10 mg/l reduced the total phosphorus concentration from 971 µg/l to 30 µg/l. On June 12, 2002, the addition of a 7.5 mg/l alum dose and 21 mg/l sodium hydroxide dose decreased the total phosphorus concentration from 494 µg/l to 26 µg/l. The June 17, 2002 stormwater runoff sample required an alum dose of 12.5 mg/l as Al and a sodium hydroxide dose of 31 mg/l to achieve a total phosphorus concentration in the treated water of 23 µg/l. The stormwater runoff sample collected on June 24th required a dose of 15 mg/l as Al and a sodium hydroxide dose of 52 mg/l to achieve a total phosphorus concentration of 14 µg/l. Although alum doses greater than 10 mg/l were required to achieve a total phosphorus concentration less than 40 µg/l for the June 17 and 24 samples, the resulting total phosphorus concentrations were significantly less than 40 µg/l.

4.3 Removal Efficiencies Achieved with Alum Treatment

Mean removal efficiencies obtained in laboratory jar tests conducted on stormwater runoff samples collected during June 2002 are summarized in Table 4-7. Alum treatment of stormwater runoff at a dose of 7.5 mg/l as Al reduced concentrations of orthophosphorus by 98% and total phosphorus by 78%. At a dose of 10 mg/l as Al, the removal efficiency for orthophosphorus increased to 99% and the removal efficiency for total phosphorus increased to 89%. This in an 11% increase over stormwater runoff samples treated with 7.5 mg/l as Al. At an alum dose of

12.5 mg/l as Al, the total phosphorus removal efficiency increased to 94%, a 5% increase over a 10 mg/l dose. Total phosphorus removal efficiency increased only slightly at an alum dose of 15 mg/l as Al.

TABLE 4-7

MEAN REMOVAL EFFICIENCIES ACHIEVED IN LABORATORY JAR TESTS CONDUCTED ON STORMWATER RUNOFF SAMPLES COLLECTED FROM DAVIE DAIRY DURING JUNE 2002

PARAMETER	UNITS	REMOVAL EFFICIENCY (%) (Alum Dose in mg/l as Al)			
		7.5	10	12.5	15
NH_3	µg/l	-96	-56	-45	-79
NO_x	µg/l	27	26	27	4
Total Nitrogen	µg/l	-4	-9	-11	-33
Orthophosphorus	µg/l	-98	-99	-99	-99
Total Phosphorus	µg/l	-78	-89	-94	-98
Turbidity	NTU	-70	-71	-87	-94
TSS	mg/l	-72	-75	-90	-88

4.4 Recommended Alum Treatment Dose

The project goal is to reduce the total phosphorus concentration in stormwater runoff leaving Davie Dairy to less than 40 µg/l. During June 2002, jar tests were conducted on five separate stormwater runoff samples. A total phosphorus concentration of less than 40 µg/l was achieved in two samples at a dose of 7.5 mg/l as Al, in one sample at a dose of 10 mg/l as Al, in one sample at a dose of 12.5 mg/l as Al, and in one sample at a dose of 15 mg/l as Al. The total phosphorus concentrations achieved for the higher doses were significantly less than 40 ppb.

Based upon the laboratory results and ERD's experience with 40 previous alum stormwater treatment projects, an alum dose of 10 mg/l as Al is recommended for treatment of stormwater runoff discharging from the Davie Dairy BAT project drainage basin. A sodium hydroxide dose of approximately 25 mg/l will also be required to maintain a pH above 6.0 and to ensure proper floc formation and settling. The chemical feed equipment installed at Davie Dairy will have the capacity to add up to 20 mg/l of aluminum sulfate and 50 mg/l of sodium hydroxide.

SECTION 5

PROPOSED STORMWATER TREATMENT SYSTEM

5.1 Treatment System Description

The proposed edge-of-farm treatment system for Davie Dairy includes the construction of an earthen levee across Nubbin Slough, a 48-inch HDPE inflow pipe from Nubbin Slough upstream of the levee to a floc settling pond, a 48-inch HDPE outflow pipe from the floc settling pond to Nubbin Slough downstream of the levee, and the alum equipment enclosure, equipment and chemical storage tanks. The earthen levee will be constructed across Nubbin Slough approximately 700 ft upstream of the intersection of Nubbin Slough and the western property boundary for Davie Dairy. The earthen levee will be constructed to an elevation of 44.0 ft NGVD, blending into the existing 44-ft elevation contours on the east and west sides of the slough. The levee will have an overflow weir adjacent to the slough, 50-ft wide at elevation 41.0 ft NGVD. Three 36-inch HDPE pipes with downstream gates will be constructed through the levee to allow bypass of the chemical treatment system. Stage/storage information for Nubbin Slough areas upstream of the proposed levee were calculated using survey cross-sections, as provided in Table 5-1. Nubbin Slough has a natural storage of approximately 65.1 ac-ft at elevation 44.0 ft NGVD.

A 48-inch HDPE inflow pipe will be constructed from Nubbin Slough upstream of the earthen levee to the floc settling pond. The water flow rate will be measured using a depth/velocity flow meter located in the 48-inch HDPE inflow pipe. The depth/velocity information will be sent through shielded cables to flow meter electronics located in the alum equipment enclosure. The water flow meter electronics will produce a 4-20 mA signal. At 0 cfs flow, the water flow meter will produce a 4 mA signal. At full flow, the water flow meter electronics will produce a 20 mA signal.

TABLE 5-1

STAGE/STORAGE INFORMATION FOR NUBBIN SLOUGH UPSTREAM OF PROPOSED EARTHEN LEVEE

ELEVATION (ft NGVD)	INCREMENTAL VOLUME (ac-ft)	CUMULATIVE VOLUME (ac-ft)
34.0	0.00	0.00
35.0	0.05	0.05
36.0	0.20	0.25
37.0	0.57	0.82
38.0	1.06	1.88
39.0	1.78	3.66
40.0	2.70	6.36
41.0	4.53	10.9
42.0	10.4	21.3
43.0	17.6	38.9
44.0	26.2	65.1
45.0	37.6	102.7
46.0	50.6	153.3
47.0	65.5	218.8
48.0	82.4	301.2
49.0	108.5	409.7
50.0	149.1	558.8

The mA signal will be sent to an alum feed pump controller and a buffer feed pump controller. The alum feed pump controller and the buffer (NaOH) feed pump controller will produce a DC voltage proportional to the water flow rate. At no flow, 0 volts DC will be produced while at full flow 180 volts DC will be produced. The DC voltage will be sent to the alum feed pump and buffer feed pump so that the proper alum dose and sodium hydroxide dose are maintained at all water flow rates. Alum and sodium hydroxide will be added to flowing water in the 48-inch HDPE pipe 125 ft upstream of the floc settling pond.

Treated water will discharge into the floc settling pond. The floc settling pond is sized to provide a minimum 3-hour detention time for the peak flow rate for the design storm event. Floc will settle to the bottom of the floc settling pond while the treated supernatant will discharge through a 8-ft wide riser at elevation 38.0 ft NGVD and an 48-inch HDPE outfall pipe into Nubbin Slough on Davie Dairy property downstream of the earthen levee. The floc settling pond will be loaded for a period of approximately one year. After approximately one year, the wet floc will be pumped from the settling pond onto an adjacent drying area. After drying, the floc will be landspread on the farm adjacent to the chemical treatment system or disposed of at the solid waste landfill just north of Davie Dairy.

5.2 Storm Event Modeling

The Santa Barbara Urban Hydrograph Method within Advanced ICPR was used to calculate the peak discharge and the event runoff volume for each mean rainfall depth for each of 19 event rainfall ranges previously discussed. A summary of peak discharges and event runoff volumes for all 19 rainfall event intervals is provided in Table 5-2.

At the Project Kick-off Meeting, SWET indicated that the proposed stormwater treatment system should treat approximately a 3.5-inch event which produces approximately 2 inches of runoff. Based on hydrologic modeling completed by ERD, as described in Section 2, a 3.77-inch storm event will produce 1.86 inches of runoff. Per Table 5-2, this storm has a peak discharge of 81 cfs and a total event runoff volume of 369 ac-ft. Based on the rainfall probability distribution provided in Section 2, rainfall events exceeding 3 inches in depth occur less than once each average year. Therefore, the selection of a 3.77-inch event for design will result in the treatment of practically all runoff in an average annual rainfall year.

TABLE 5-2

SUMMARY OF PEAK STAGES AND DISCHARGES FOR THE PROPOSED DAVIE DAIRY BAT STORMWATER TREATMENT SYSTEM

MEAN RAINFALL DEPTH (inches)	PEAK DISCHARGE (cfs)	EVENT RUNOFF VOLUME (ac-ft)
0.15	0.00	0
0.25	0.00	0
0.35	0.00	0
0.46	0.00	0
0.71	0.75	3.3
1.22	7.25	32.1
1.72	17.92	79.7
2.21	30.89	137.9
2.73	46.88	210.2
3.16	61.26	274.2
3.77	80.96	368.6
4.24	102.72	460.1
4.78	120.59	538.4
6.95	191.26	925.3
9.62	273.06	1424.1

5.3 Hydraulic Modeling

To evaluate the operational characteristics and performance efficiency of the proposed treatment system, a hydraulic model of the treatment system was developed using Advanced ICPR. A schematic flow diagram of the proposed treatment system is provided in Figure 5-1. The model was used to evaluate a 3.77-inch/24-hour event, a 10-year/5.0-inch/24-hour event, a 25-year/6.0-inch/24-hour event, and 100-year/7.5-inch/24-hour event. With the proposed stormwater treatment system configuration, a 3.77-inch storm event produces a discharge of approximately 63 cfs

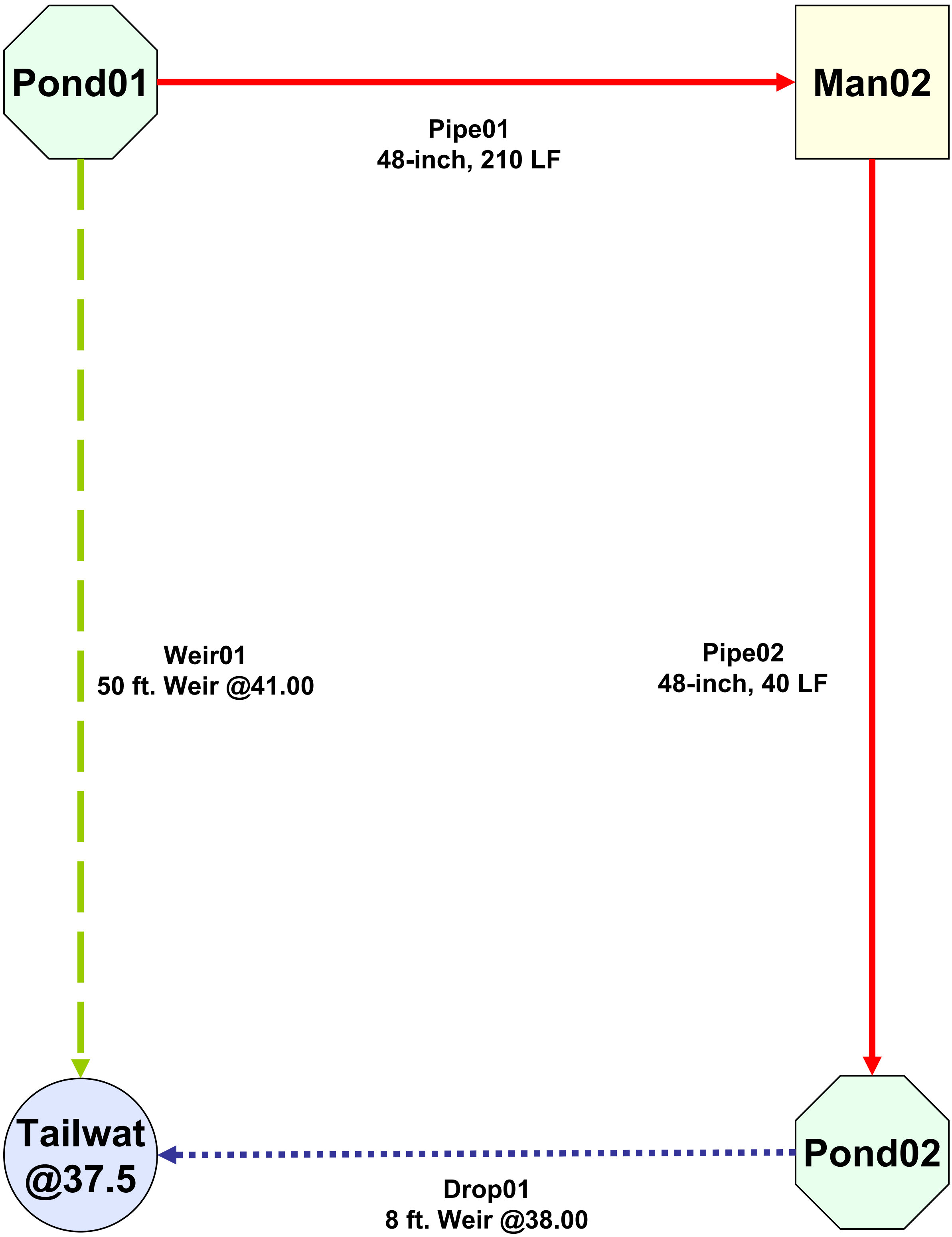

Figure 5-1. Schematic Hydraulic Modeling Flow Diagram.

through the floc settling pond. Based on laboratory jar tests, floc settled almost completely within 90 minutes of alum and sodium hydroxide addition. To provide a safety factor of 2, a minimum floc settling time of 3 hours was selected for the peak discharge for the 3.77-inch design storm event. Therefore, the minimum floc settling pond volume is 15.6 ac-ft at the peak water elevation in the floc settling cell. The stage/storage relationship for the floc settling pond is provided in Table 5-3. A storage volume of 18.9 ac/ft occurs at elevation 40.25 ft NGVD. Peak stages and discharges were calculated in Nubbin Slough upstream of the earthen levee and in the floc settling pond using the hydraulic model. The modeling results for the four modeled storm events are summarized in Table 5-4. The actual peak elevation in the floc settling pond is 40.25 ft NGVD for a 3.77-inch rain event. Therefore, the pond provides a detention time in excess of 3 hours for the design storm event. A copy of modeling input and output data for the four storm events is provided in Appendix A.

TABLE 5-3

STAGE/STORAGE INFORMATION FOR THE DAVIE DAIRY FLOC SETTLING POND

POND ELEVATION (ft. NGVD)	CUMULATIVE STORAGE (ac-ft)
20.0	0.00
25.0	1.71
30.0	5.08
35.0	10.5
40.0	18.5
44.0	26.9

TABLE 5-4

SUMMARY OF PEAK STAGES AND DISCHARGES FOR THE PROPOSED DAVIE DAIRY TREATMENT SYSTEM

STORM EVENT	PEAK DISCHARGE (cfs)		PEAK STAGE (ft NGVD)	
	DETENTION AREA	FLOC SETTLING CELL	DETENTION AREA	FLOC SETTLING CELL
3.77-inch	81.0	63.1	41.23	40.25
10-year/5.0-inch	123	67.2	41.50	40.39
25-year/6.0-inch	161	69.9	41.69	40.49
100-year/7.5-inch	219	73.4	41.94	40.62

The proposed treatment system will treat all runoff up to the peak discharge for the 3.77-inch storm event. A portion of the runoff for storm events greater than 3.77 inches will flow over the earthen berm weir crest at elevation 41.0 ft NGVD and will not be treated. Tables 5-5, 5-6, and 5-7 provide a summary of annual runoff volume treated and untreated for the minimum, average, and maximum rainfall years, respectively. The runoff volume to be treated ranges from 723 ac-ft during a minimum rainfall year to 1775 ac-ft during a maximum rainfall year.

TABLE 5-5

SUMMARY OF RUNOFF VOLUME TREATED AT DAVIE DAIRY DURING A MINIMUM RAINFALL YEAR

RAINFALL EVENT RANGE (in)	MEAN RAINFALL DEPTH (in)	NUMBER OF ANNUAL EVENTS IN RANGE	RUNOFF VOLUME (ac-ft)	
			TREATED	UNTREATED
0.00-0.10	0.04	37.931	0.00	0.00
0.11-0.20	0.15	11.033	0.00	0.00
0.21-0.30	0.25	6.326	0.00	0.00
0.31-0.40	0.35	4.308	0.00	0.00
0.41-0.50	0.46	3.785	0.00	0.00
0.51-1.00	0.71	9.713	32.05	0.00
1.01-1.50	1.22	3.910	125.51	0.00
1.51-2.00	1.73	1.893	150.87	0.00
2.01-2.50	2.21	0.772	106.37	0.08
2.51-3.00	2.74	0.449	94.28	0.00
3.01-3.50	3.16	0.199	54.54	0.00
3.51-4.00	3.77	0.124	43.67	2.22
4.01-4.50	4.32	0.124	50.63	6.65
4.51-5.00	4.78	0.025	11.23	2.24
5.01-6.00	--	--	--	--
6.01-7.00	6.95	0.025	15.40	7.76
7.01-8.00	--	--	--	--
8.01-9.00	--	--	--	--
> 9.01	9.62	0.050	38.22	33.07
		TOTAL:	**722.78**	**52.02**

TABLE 5-6

SUMMARY OF RUNOFF VOLUME TREATED AT DAVIE DAIRY DURING AN AVERAGE RAINFALL YEAR

RAINFALL EVENT RANGE (in)	MEAN RAINFALL DEPTH (in)	NUMBER OF ANNUAL EVENTS IN RANGE	RUNOFF VOLUME (ac-ft)	
			TREATED	UNTREATED
0.00-0.10	0.04	62.119	0.00	0.00
0.11-0.20	0.15	18.069	0.00	0.00
0.21-0.30	0.25	10.360	0.00	0.00
0.31-0.40	0.35	7.056	0.00	0.00
0.41-0.50	0.46	6.199	0.00	0.00
0.51-1.00	0.71	15.907	52.49	0.00
1.01-1.50	1.22	6.403	205.54	0.00
1.51-2.00	1.73	3.100	247.08	0.00
2.01-2.50	2.21	1.264	174.21	0.00
2.51-3.00	2.74	0.735	154.41	0.13
3.01-3.50	3.16	0.326	89.32	0.00
3.51-4.00	3.77	0.204	71.52	3.63
4.01-4.50	4.32	0.204	82.91	10.89
4.51-5.00	4.78	0.041	18.40	3.67
5.01-6.00	--	--	--	--
6.01-7.00	6.95	0.041	25.21	12.72
7.01-8.00	--	--	--	--
8.01-9.00	--	--	--	--
> 9.01	9.62	0.082	62.59	54.16
		TOTAL:	**1183.68**	**85.19**

TABLE 5-7

SUMMARY OF RUNOFF VOLUME TREATED AT DAVIE DAIRY DURING A MAXIMUM RAINFALL YEAR

RAINFALL EVENT RANGE (in)	MEAN RAINFALL DEPTH (in)	NUMBER OF ANNUAL EVENTS IN RANGE	RUNOFF VOLUME (ac-ft)	
			TREATED	UNTREATED
0.00-0.10	0.04	93.172	0.00	0.00
0.11-0.20	0.15	27.101	0.00	0.00
0.21-0.30	0.25	15.538	0.00	0.00
0.31-0.40	0.35	10.583	0.00	0.00
0.41-0.50	0.46	9.298	0.00	0.00
0.51-1.00	0.71	23.859	78.74	0.00
1.01-1.50	1.22	9.604	308.28	0.00
1.51-2.00	1.73	4.650	370.59	0.00
2.01-2.50	2.21	1.896	261.29	0.19
2.51-3.00	2.74	1.102	231.60	0.00
3.01-3.50	3.16	0.489	133.98	0.00
3.51-4.00	3.77	0.306	107.27	5.44
4.01-4.50	4.32	0.306	124.36	16.33
4.51-5.00	4.78	0.061	27.59	5.51
5.01-6.00	--	--	--	--
6.01-7.00	6.95	0.061	37.82	19.07
7.01-8.00	--	--	--	--
8.01-9.00	--	--	--	--
> 9.01	9.62	0.123	93.08	81.23
		TOTAL:	**1775.40**	**127.77**

5.4 Annual Chemical Requirements

The annual water volume to be treated by the proposed chemical treatment system includes the treated runoff volumes listed in Tables 5-5 through 5-7 and the additional 78 ac-ft of washdown volume listed in Table 2-7. Annual aluminum sulfate and sodium hydroxide chemical requirements, based on an alum dose of 10 mg/l as Al and a sodium hydroxide dose of 25 mg/l, are provided in Table 5-8. The proposed alum and sodium hydroxide storage tanks will each hold 9000 gallons. Since a semi-tractor trailer tanker truck can deliver a maximum of 4500 gallons of alum or sodium hydroxide, the tanks should be refilled when the level reaches approximately 4500 gallons. Based on a total average annual alum requirement of 75,720 gallons, this system will receive approximately 17 alum deliveries per year. Based on a total average annual sodium hydroxide requirement of 23,978 gallons, the buffer feed system will require approximately 6 refills each year.

TABLE 5-8

ESTIMATED ANNUAL SUMMARY OF CHEMICAL REQUIREMENTS FOR THE DAVIE DAIRY BAT TREATMENT SYSTEM

RAINFALL	ANNUAL WATER VOLUME TREATED (ac-ft)	ANNUAL ALUM REQUIRED (gal)	ANNUAL NaOH REQUIRED (gal)
Minimum	801	48,060	15,219
Average	1,262	75,720	23,978
Maximum	1,853	111,180	35,207

5.5 Floc Accumulation and Handling

When alum and sodium hydroxide mix with stormwater runoff, a floc particle is produced which attracts both suspended and dissolved materials in the stormwater flow by adsorption and enmeshment into and onto the floc particle. Floc formation is typically complete within 45-60 seconds following alum and sodium hydroxide addition. The floc produced during the coagulation process will form inside the stormsewer system prior to discharge into the floc settling pond. The floc produced during this process will settle to the bottom of the floc settling pond, gradually forming a layer of floc accumulating more in the upstream than downstream area of the pond.

As previously discussed, laboratory jar tests were conducted on five stormwater runoff samples collected from Davie Dairy. Following the completion of each of these jar tests, the generated floc was placed into a graduated cylinder and observed for a period of 30 days. A summary of floc consolidation over 30 days based on floc collected from laboratory jar tests on Davie Dairy runoff samples is provided in Figure 5-2. At the proposed alum treatment dose of 10 mg/l as Al, floc generation was approximately 0.5% of the treated water volume after 30 days. After 30 days, the floc volume was approximately 5% solids. Based on previous projects performed by ERD, alum floc can easily dry to 30% solids over a relatively short period of time. Estimated annual wet and dry floc volumes produced at Davie Dairy for three rainfall conditions are provided in Table 5-9. Approximately 6.3 ac-ft of wet floc volume (5% solids) and 1694 yd^3 of dry floc (30% solids) will be produced at Davie Dairy during an average rainfall year.

The floc settling pond will receive alum treated water for approximately one year. The wet floc will then be pumped onto adjacent drying areas and allowed to dry until the solids reach the desired moisture content. Once the material has reached the desired percent solids, the solids will be distributed over the farm or hauled to the adjacent solid waste landfill.

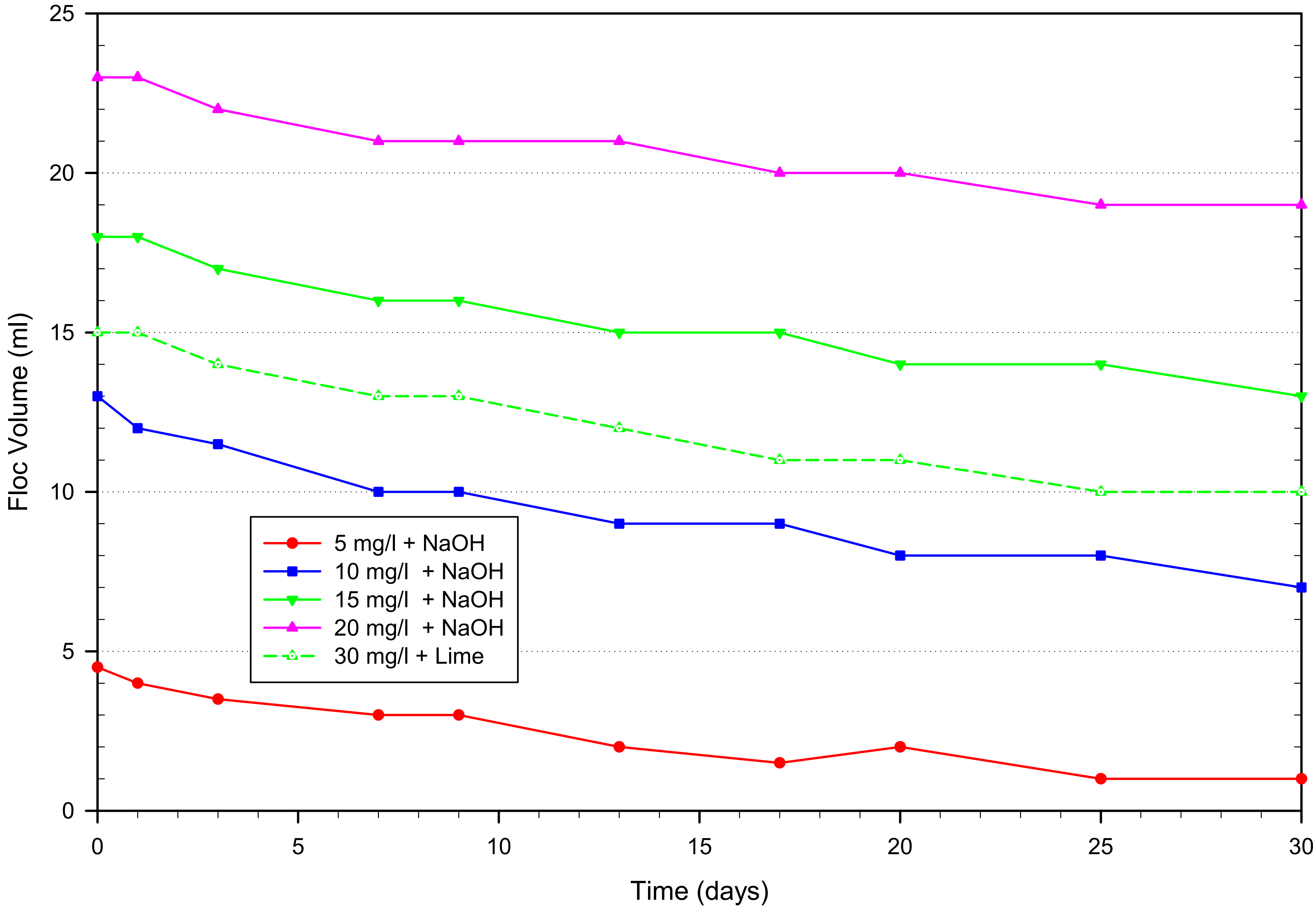

Figure 5-2. Dairy BAT Floc Settling Characterization for Jar Test Sample Collected on 6/5/02.

TABLE 5-9

ESTIMATED ANNUAL WET AND DRY FLOC VOLUMES PRODUCED AT DAVIE DAIRY

RAINFALL	ANNUAL WATER VOLUME TREATED (ac-ft)	WET FLOC (5% SOLIDS) @ 30 DAYS (ac-ft)	DRIED FLOC (30% SOLIDS) VOLUME (cy)
Minimum	801	4.0	1,075
Average	1,262	6.3	1,694
Maximum	1,853	9.3	2,487

5.6 Comparison of Pre- and Post-Treatment Pollutant Loadings

A comparison of pre- and post-treatment pollutant loadings for the minimum, average, and maximum rainfall years are provided in Tables 5-10, 5-11 and 5-12, respectively. The proposed stormwater treatment system provides an annual 88.4% reduction in total phosphorus and a 70% reduction in total suspended solids. For the average rainfall year, total phosphorus is reduced from 1387 kg/yr to 224 kg/yr.

5.7 Opinion of Probable Construction Cost and Estimated Operation and Maintenance Cost

5.7.1 Construction Cost

The opinion of probable construction cost for the Davie Dairy stormwater treatment system is $450,000. The opinion of cost includes all features shown on the construction drawings, including clearing and grubbing, earthwork, entrance road, erosion control, pipe, manholes, gates, risers, equipment shed, tanks, chemical feed equipment, fencing, electrical, mobilization/bonds/ insurance, and other related items.

TABLE 5-10

ESTIMATED REDUCTIONS IN STORMWATER POLLUTANT LOADINGS RESULTING FROM THE PROPOSED DAVIE DAIRY TREATMENT SYSTEM FOR A MINIMUM RAINFALL YEAR (28.29 inches)

PARAMETER	ANNUAL LOAD (kg/yr)	
	PRE-TREATMENT	POST-TREATMENT
Total Nitrogen	2,700	2,272
Total Phosphorus	878	140
TSS	17,440	5,232

TABLE 5-11

ESTIMATED REDUCTIONS IN STORMWATER POLLUTANT LOADINGS RESULTING FROM THE PROPOSED DAVIE DAIRY TREATMENT SYSTEM FOR AN AVERAGE RAINFALL YEAR (46.33 inches)

PARAMETER	ANNUAL LOAD (kg/yr)	
	PRE-TREATMENT	POST-TREATMENT
Total Nitrogen	4,264	3,588
Total Phosphorus	1,387	224
TSS	27,540	8,262

TABLE 5-12

ESTIMATED REDUCTIONS IN STORMWATER POLLUTANT LOADINGS RESULTING FROM THE PROPOSED DAVIE DAIRY TREATMENT SYSTEM FOR A MAXIMUM RAINFALL YEAR (69.49 inches)

PARAMETER	ANNUAL LOAD (kg/yr)	
	PRE-TREATMENT	POST-TREATMENT
Total Nitrogen	6,270	5,276
Total Phosphorus	2,040	331
TSS	40,502	12,151

5.7.2 Estimated Annual Operation and Maintenance Cost

The annual operation and maintenance (O&M) cost for the Davie Dairy stormwater treatment system includes labor to operate the system, purchase of aluminum sulfate and sodium hydroxide, power cost, renewal and replacement cost, and floc removal and disposal cost. The labor cost is based on an hourly rate of $15/hour. Normal labor is anticipated to be 5 hours/week during a minimum rainfall year, 10 hours/week during an average rainfall year, and 15 hours/week during a maximum rainfall year. Chemical costs include $0.50/gallon for aluminum sulfate and $1/gallon for sodium hydroxide. Power cost is assumed to be $72.50/month during a minimum rainfall year, $217.50/month during an average rainfall year, and $290/month during a maximum rainfall year. The useful life of the equipment, including the HDPE tanks; alum pump, buffer pump and control panels; water flow meter and alum flow meter is anticipated to be 20 years. Based on the opinion of probable construction cost of these items of $103,120, the annual renewal and replacement cost is $5,156. The floc removal and disposal cost is assumed to be $2/yd^3 of wet floc volume and assumes the dewatered floc is retained and landspread on-site. A summary of estimated O&M costs for the three rainfall conditions is provided in Table 5-13. The estimated annual O&M cost for the average rainfall year is $97,729.

TABLE 5-13

SUMMARY OF ESTIMATED ANNUAL O&M COSTS FOR THE DAVIE DAIRY TREATMENT SYSTEM

RAINFALL CONDITION	LABOR COST ($)	CHEMICAL COST ($)	POWER COST ($)	RENEWAL AND REPLACEMENT COST ($)	FLOC REMOVAL AND DISPOSAL ($)	TOTAL COST ($)
Minimum	3,900	39,249	870	5,156	12,908	62,083
Average	7,800	61,838	2,610	5,156	20,325	97,729
Maximum	11,700	90,797	3,480	5,156	30,008	141,141

5.8 Project Permitting

During the Project Kick-off Meeting, SWET indicated that the stormwater detention/chemical treatment system would be incorporated into the Davie Dairy FDEP Permit. No separate environmental resource permit would be required from FDEP or the SFWMD. SWET also stated that no NPDES permits would be required for this project. Because Nubbin Slough passes through Davie Dairy property and contains jurisdictional wetlands, a permit is required from the U.S. Army Corps of Engineers to construct facilities within jurisdictional areas and to stage water within Nubbin Slough. SWET had their environmental subconsultant, David W. Hall, Ph.D., perform an evaluation of the project site.

On May 14, 2002, personnel from SWET, ERD, and Peninsula Design & Engineering (PD&E) attended a Pre-Application Meeting with Irene Sadowski, Team Leader, at the Merritt Island Regulatory Office of US ACOE. A copy of the pre-application meeting memorandum is provided in Appendix B. A permit application for the Davie Dairy proposed stormwater treatment system was submitted to Irene Sadowski on August 27, 2002. A copy of the permit application is also provided in Appendix B. Based on the pre-application meeting minutes, Ms. Sadowski anticipated that the Nationwide 43 permit would be issued for the Davie Dairy project within 30 days of permit application submittal. Therefore, a permit should be obtained from the US ACOE by the end of September 2002.

5.9 Project Schedule

A project schedule for the Davie Dairy BAT project was prepared and submitted to SWET on July 31, 2002. A copy of this project schedule is attached. Material acquisition has been initiated, with hard construction to begin following receipt of the US ACOE permit during the beginning or middle of October. This assumes that approvals are obtained by that time from the SWET Team and the SFWMD. If construction begins by the middle of October, construction should be substantially completed in December 2002.

DAVIE DAIRY BAT PROJECT SCHEDULE

Prepared By
Environmental Research & Design, Inc.
July 31, 2002

TASK	DESCRIPTION	SCHEDULE 2002								
		Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1.	Attend kick-off meeting	*								
2.	Attend Pre-Application meeting with ACOE		*							
3.	Perform jar testing									
4.	Prepare/submit Preliminary Drawings and Engineering Calculations									
5.	Attend review meeting; receive authorization to proceed				*					
6.	Prepare/submit 60% Construction Documents									
7.	Prepare/submit ACOE Permit Application									
8.	Prepare/submit 100% Construction Documents									
9.	Receive ACOE Permit						*			
10.	Project construction									

APPENDIX A

HYDROLOGIC MODELING INPUT AND OUTPUT DATA

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [1]

Dairy Bat Input Data

********** Input Report **
--------Class: Node--

Name: MAN01 Base Flow(cfs): 0 Init Stage(ft): 42
Group: BASE Warn Stage(ft): 47
Comment:

Stage(ft)	Area(ac)
40.68	0.2
47	0.2

--------Class: Node--

Name: MAN02 Base Flow(cfs): 0 Init Stage(ft): 42
Group: BASE Warn Stage(ft): 47
Comment:

Stage(ft)	Area(ac)
40.36	0.2
47	0.2

--------Class: Node--

Name: MAN03 Base Flow(cfs): 0 Init Stage(ft): 42
Group: BASE Warn Stage(ft): 47
Comment:

Stage(ft)	Area(ac)
40.05	0.2
47	0.2

--------Class: Node--

Name: POND01 Base Flow(cfs): 0 Init Stage(ft): 42
Group: BASE Warn Stage(ft): 46
Comment:

Stage(ft)	Area(ac)
34.5	0.019
35.5	0.203
36.5	0.568
37.5	1.055
38.5	1.775
39.5	2.703
40.5	4.534
41.5	10.363
42.5	17.579
43.5	26.219
44.5	37.614
45.5	50.578
46.5	65.531
47.5	82.368
48.5	108.534
49.5	149.189
50.5	198.763
51.5	259.6
52.5	300.332

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [2]

Dairy Bat Input Data

********** Input Report **

--------Class: Node--

Name: POND01B   Base Flow(cfs): 0   Init Stage(ft): 42
Group: BASE   Warn Stage(ft): 46
Comment:

Time(hrs)	Stage(ft)
0	42
10	42
10.1	42.5
20	42.5
20.1	43
30	43
30.1	43.5
40	43.5
40.1	44
50	44
50.1	44.5
60	44.5
60.1	45
70	45
70.1	45.5
80	45.5
80.1	45.75
90	45.75
90.1	46
100	46
100.1	46.25
110	46.25
110.1	46.5
120	46.5
120.1	46.75
130	46.75
130.1	47
140	47

--------Class: Node--

Name: POND02   Base Flow(cfs): 0   Init Stage(ft): 42
Group: BASE   Warn Stage(ft): 47
Comment:

Stage(ft)	Area(ac)
40	0.71
45	1.27

```
Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [3]
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Dairy Bat Input Data


********** Input Report ********************************************************
--------Class: Node-------------------------------------------------------------
   Name: TAILWAT    Base Flow(cfs): 0          Init Stage(ft): 37.5
  Group: BASE                                  Warn Stage(ft): 47
Comment:

Time(hrs)     Stage(ft)
0             37.5
24            37.5
48            37.5
96            37.5
--------Class: Node-------------------------------------------------------------
   Name: TEE01      Base Flow(cfs): 0          Init Stage(ft): 42
  Group: BASE                                  Warn Stage(ft): 47
Comment:

Stage(ft)     Area(ac)
40.26         0.2
47            0.2
--------Class: Node-------------------------------------------------------------
   Name: TEE02      Base Flow(cfs): 0          Init Stage(ft): 42
  Group: BASE                                  Warn Stage(ft): 47
Comment:

Stage(ft)     Area(ac)
40.15         0.2
47            0.2
--------Class: Pipe-------------------------------------------------------------

          Name: PIPE01       From Node: POND01    Length(ft): 383
         Group: BASE           To Node: MAN01          Count: 1

                UPSTREAM     DOWNSTREAM               Equation: Average K
      Geometry: Circular     Circular                     Flow: Both
      Span(in): 36           36            Entrance Loss Coef: 0.5
      Rise(in): 36           36                Exit Loss Coef: 0.8
    Invert(ft): 41           40.73             Bend Loss Coef: 0
   Manning's N: 0.01         0.01           Outlet Cntrl Spec: Use dc or tw
  Top Clip(in): 0            0               Inlet Cntrl Spec: Use dn
Bottom Clip(in): 0           0              Stabilizer Option: Level Pool
                                           Stabilizer Tol(ft): 0.1

    Upstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                    1     1

    Downstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                    1     1
```

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [4]

Dairy Bat Input Data

********** Input Report **

--------Class: Pipe--

```
          Name: PIPE02        From Node: MAN01     Length(ft): 345
         Group: BASE            To Node: MAN02          Count: 1

                UPSTREAM      DOWNSTREAM             Equation: Average K
      Geometry: Circular      Circular                   Flow: Both
      Span(in): 36            36           Entrance Loss Coef: 0.1
      Rise(in): 36            36               Exit Loss Coef: 0.3
    Invert(ft): 40.73         40.49            Bend Loss Coef: 0
   Manning's N: 0.01          0.01          Outlet Cntrl Spec: Use dc or tw
  Top Clip(in): 0             0              Inlet Cntrl Spec: Use dn
Bottom Clip(in): 0            0           Stabilizer Option: Level Pool
                                          Stabilizer Tol(ft): 0.1

    Upstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                 1     1

    Downstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                 1     1
```

--------Class: Pipe--

```
          Name: PIPE03        From Node: MAN02     Length(ft): 108
         Group: BASE            To Node: TEE01          Count: 1

                UPSTREAM      DOWNSTREAM             Equation: Average K
      Geometry: Circular      Circular                   Flow: Both
      Span(in): 36            36           Entrance Loss Coef: 0.6
      Rise(in): 36            36               Exit Loss Coef: 0
    Invert(ft): 40.49         40.41            Bend Loss Coef: 0
   Manning's N: 0.01          0.01          Outlet Cntrl Spec: Use dc or tw
  Top Clip(in): 0             0              Inlet Cntrl Spec: Use dn
Bottom Clip(in): 0            0           Stabilizer Option: Level Pool
                                          Stabilizer Tol(ft): 0.1

    Upstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                 1     1

    Downstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                 1     1
```

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [5]

Dairy Bat Input Data

```
********** Input Report ***********************************************************
--------Class: Pipe----------------------------------------------------------------

          Name: PIPE04        From Node: TEE01     Length(ft): 233
         Group: BASE            To Node: TEE02          Count: 1

                UPSTREAM      DOWNSTREAM             Equation: Average K
      Geometry: Circular      Circular                   Flow: Both
      Span(in): 36            36           Entrance Loss Coef: 0.6
      Rise(in): 36            36               Exit Loss Coef: 0
    Invert(ft): 40.41         40.25            Bend Loss Coef: 0
    Manning's N: 0.01         0.01          Outlet Cntrl Spec: Use dc or tw
   Top Clip(in): 0            0              Inlet Cntrl Spec: Use dn
Bottom Clip(in): 0            0           Stabilizer Option: Level Pool
                                          Stabilizer Tol(ft): 0.1


    Upstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                    1     1

    Downstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                    1     1

--------Class: Pipe----------------------------------------------------------------

          Name: PIPE05        From Node: TEE02     Length(ft): 140
         Group: BASE            To Node: MAN03          Count: 1

                UPSTREAM      DOWNSTREAM             Equation: Average K
      Geometry: Circular      Circular                   Flow: Both
      Span(in): 36            36           Entrance Loss Coef: 0.1
      Rise(in): 36            36               Exit Loss Coef: 0.3
    Invert(ft): 40.25         40.15            Bend Loss Coef: 0
    Manning's N: 0.01         0.01          Outlet Cntrl Spec: Use dc or tw
   Top Clip(in): 0            0              Inlet Cntrl Spec: Use dn
Bottom Clip(in): 0            0           Stabilizer Option: Level Pool
                                          Stabilizer Tol(ft): 0.1


    Upstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                    1     1

    Downstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                    1     1
```

```
Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [6]
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Dairy Bat Input Data


********** Input Report ***************************************************
--------Class: Pipe--------------------------------------------------------

          Name: PIPE06        From Node: MAN03      Length(ft): 185
         Group: BASE            To Node: POND02          Count: 1

               UPSTREAM       DOWNSTREAM             Equation: Average K
      Geometry: Circular      Circular                   Flow: Both
      Span(in): 36            36            Entrance Loss Coef: 0.1
      Rise(in): 36            36                Exit Loss Coef: 0.8
    Invert(ft): 40.15         40.02             Bend Loss Coef: 0.7
   Manning's N: 0.01          0.01           Outlet Cntrl Spec: Use dc or tw
  Top Clip(in): 0             0               Inlet Cntrl Spec: Use dn
Bottom Clip(in): 0            0            Stabilizer Option: Level Pool
                                          Stabilizer Tol(ft): 0.1

    Upstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                1     1

    Downstream FHWA Inlet Edge Description:
    Circular Concrete: Square edge w/ headwall                1     1

--------Class: Weir--------------------------------------------------------
    Name: WEIR02              From Node: POND01
   Group: BASE                  To Node: TAILWAT
   Count: 1

Type: Mavis     Flow: Both       Geometry: Rectangular

             Span(in): 600
             Rise(in): 24
           Invert(ft): 45.5
     Control Elev(ft): 45.5
                                      TABLE
      Bottom Clip(in): 0
         Top Clip(in): 0
  Weir Discharge Coef: 3.2
Orifice Discharge Coef: 0.6
```

```
Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [7]
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Dairy Bat Input Data


********** Input Report ***********************************************************
--------Class: Drop Structure----------------------------------------------------
     Name: DROP01          From Node: POND02          Length(ft): 90
    Group: BASE              To Node: TAILWAT              Count: 1

    Outlet Cntrl Spec: Use dc or tw      Inlet Cntrl Spec: Use dn
    Upstream Geometry: Circular      Downstream Geometry: Circular
                               UPSTREAM                DOWNSTREAM
               Span(in): 18                    18
               Rise(in): 18                    18
             Invert(ft): 38                    37.55
            Manning's N: 0.01                  0.01
           Top Clip(in): 0                     0
        Bottom Clip(in): 0                     0

     Entrance Loss Coef: 0.6                     Flow: Both
         Exit Loss Coef: 0.3                 Equation: Aver Conveyance

      Upstream FHWA Inlet Edge Description:
      Circular Concrete: Square edge w/ headwall                1      1
      Downstream FHWA Inlet Edge Description:
      Circular Concrete: Square edge w/ headwall                1      1

 *** Weir 1 of 1 for Drop Structure DROP01 ***                 [TABLE]
   Count: 1                    Bottom Clip(in): 0
    Type: Mavis                   Top Clip(in): 0
    Flow: Both              Weir Discharge Coef: 3.2
Geometry: Rectangular  Orifice Discharge Coef: 0.6

        Span(in): 72                         Invert(ft): 42
        Rise(in): 54                   Control Elev(ft): 42
```

Dairy Bat

********** Node Maximum Comparisons **

(Time units - hours)

Sim Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
*** Node Name: MAN01		Group: BASE							
10YEAR	56.59	45.34	47.00	-0.0065	0.00	46.52	23.45	46.52	23.45
25YEAR	50.45	45.53	47.00	-0.0066	0.00	39.95	24.74	39.95	24.74
100YEAR	45.51	45.74	47.00	-0.0067	0.00	35.22	26.09	35.22	26.09
3772	71.01	44.64	47.00	-0.0062	0.00	72.40	21.11	72.40	21.11
*** Node Name: MAN02		Group: BASE							
10YEAR	56.59	45.34	47.00	-0.0065	0.00	46.52	23.45	46.52	23.45
25YEAR	50.45	45.53	47.00	-0.0066	0.00	39.95	24.74	39.95	24.74
100YEAR	45.51	45.74	47.00	-0.0067	0.00	35.22	26.09	35.22	26.09
3772	71.00	44.64	47.00	-0.0062	0.00	72.40	21.11	72.40	21.11
*** Node Name: MAN03		Group: BASE							
10YEAR	56.58	45.34	47.00	-0.0014	0.00	46.52	23.45	46.52	23.45
25YEAR	50.44	45.52	47.00	-0.0014	0.00	39.95	24.74	39.95	24.74
100YEAR	45.50	45.73	47.00	-0.0014	0.00	35.22	26.09	35.22	26.09
3772	71.00	44.63	47.00	-0.0014	0.00	72.40	21.11	72.40	21.11
*** Node Name: POND01		Group: BASE							
10YEAR	56.89	45.82	46.00	0.0004	2412518.28	37.25	81.96	56.65	51.52
25YEAR	50.16	46.02	46.00	0.0005	2540992.74	37.00	106.86	50.51	82.42
100YEAR	45.61	46.25	46.00	0.0006	2690571.89	37.00	145.35	45.57	126.64
3772	71.08	45.06	46.00	0.0003	1955350.81	33.00	53.76	72.40	21.11
*** Node Name: POND01B		Group: BASE							
10YEAR	130.10	47.00	46.00	0.0139	0.00	0.00	0.00	0.00	0.00
25YEAR	130.10	47.00	46.00	0.0139	0.00	0.00	0.00	0.00	0.00
100YEAR	130.10	47.00	46.00	0.0139	0.00	0.00	0.00	0.00	0.00
3772	130.10	47.00	46.00	0.0139	0.00	0.00	0.00	0.00	0.00
*** Node Name: POND02		Group: BASE							
10YEAR	56.58	45.34	47.00	-0.0014	100714.84	46.52	23.45	56.58	22.03
25YEAR	50.44	45.52	47.00	-0.0014	101607.07	39.95	24.74	50.44	22.36
100YEAR	45.50	45.73	47.00	-0.0014	102646.45	35.22	26.09	45.50	22.73
3772	71.00	44.63	47.00	-0.0014	97276.65	72.40	21.11	71.00	20.72
*** Node Name: TAILWAT		Group: BASE							
10YEAR	0.00	37.50	47.00	0.0000	0.00	56.95	51.17	0.00	0.00
25YEAR	0.00	37.50	47.00	0.0000	0.00	50.19	82.11	0.00	0.00
100YEAR	0.00	37.50	47.00	0.0000	0.00	45.50	126.28	0.00	0.00
3772	0.00	37.50	47.00	0.0000	0.00	71.00	20.72	0.00	0.00
*** Node Name: TEE01		Group: BASE							
10YEAR	56.59	45.34	47.00	-0.0065	0.00	46.52	23.45	46.52	23.45
25YEAR	50.45	45.53	47.00	-0.0066	0.00	39.95	24.74	39.95	24.74
100YEAR	45.50	45.74	47.00	-0.0067	0.00	35.22	26.09	35.22	26.09
3772	71.00	44.64	47.00	-0.0062	0.00	72.40	21.11	72.40	21.11

Dairy Bat

********** Node Maximum Comparisons **

(Time units - hours)

Sim Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
*** Node Name: TEE02		Group: BASE							
10YEAR	56.58	45.34	47.00	-0.0065	0.00	46.52	23.45	46.52	23.45
25YEAR	50.44	45.53	47.00	-0.0066	0.00	39.95	24.74	39.95	24.74
100YEAR	45.50	45.74	47.00	-0.0067	0.00	35.22	26.09	35.22	26.09
3772	71.00	44.64	47.00	-0.0062	0.00	72.40	21.11	72.40	21.11

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [1]

Davie Dairy

********** Node Maximum Comparisons **

(Time units - hours)

Sim Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
*** Node Name: POND01		Group: BASE							
152	0.00	42.00	46.00	0.0000	609124.88	0.00	0.00	0.00	0.00
252	0.00	42.00	46.00	0.0000	609124.88	0.00	0.00	0.00	0.00
352	0.00	42.00	46.00	0.0000	609124.88	0.00	0.00	0.00	0.00
456	0.00	42.00	46.00	0.0000	609124.88	0.00	0.00	0.00	0.00
1223	43.48	42.32	46.00	0.0001	709676.47	25.00	4.82	43.48	3.15
1725	42.58	42.70	46.00	0.0001	841735.43	25.50	11.90	42.66	8.22
2209	43.71	43.10	46.00	0.0002	993100.63	26.50	20.51	43.71	14.14
2736	49.89	43.65	46.00	0.0002	1217711.93	28.00	31.13	49.82	18.22
3164	57.30	44.23	46.00	0.0003	1506922.59	27.50	40.68	57.02	19.62
3772	71.08	45.06	46.00	0.0003	1955350.81	33.00	53.76	72.40	21.11
4324	60.68	45.64	46.00	0.0004	2292673.84	27.50	68.21	60.93	30.21
4780	49.43	45.77	46.00	0.0004	2380833.57	26.25	80.07	49.71	45.11
6950	50.98	46.16	46.00	0.0005	2634896.98	41.50	127.00	50.76	109.26
9620	54.56	46.46	46.00	0.0006	2828935.43	49.25	181.32	54.77	174.06
*** Node Name: POND02		Group: BASE							
152	0.00	42.00	47.00	0.0000	40949.68	0.00	0.00	0.00	0.00
252	0.00	42.00	47.00	0.0000	40949.68	0.00	0.00	0.00	0.00
352	0.00	42.00	47.00	0.0000	40949.68	0.00	0.00	0.00	0.00
456	0.00	42.00	47.00	0.0000	40949.68	0.00	0.00	0.00	0.00
1223	43.59	42.29	47.00	-0.0002	89093.79	43.48	3.15	43.59	2.93
1725	42.40	42.56	47.00	-0.0006	90185.99	42.66	8.22	42.40	8.01
2209	43.68	42.81	47.00	-0.0010	91019.33	43.71	14.14	43.68	13.93
2736	49.75	43.35	47.00	-0.0013	92041.04	49.82	18.22	49.75	17.89
3164	57.69	43.88	47.00	-0.0013	93595.07	57.02	19.62	57.69	19.21
3772	71.00	44.63	47.00	-0.0014	97276.65	72.40	21.11	71.00	20.72
4324	60.86	45.17	47.00	-0.0014	99882.99	44.36	22.29	60.86	21.72
4780	49.65	45.29	47.00	-0.0014	100495.15	39.13	23.16	49.65	21.95
6950	50.69	45.66	47.00	-0.0014	102259.13	40.48	25.48	50.69	22.59
9620	54.69	45.93	47.00	-0.0014	103607.50	41.24	26.52	54.69	23.07

Davie Dairy

********** Basin Summary - 152 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-2
Rainfall Amount (in):	0.15
Storm Duration (hr):	2.58
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	0.00
Flow Max (cfs):	0.00
Runoff Volume (in):	0.00
Runoff Volume (cf):	0

Davie Dairy

********** Basin Summary - 252 ***

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-2
Rainfall Amount (in):	0.25
Storm Duration (hr):	2.96
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	0.00
Flow Max (cfs):	0.00
Runoff Volume (in):	0.00
Runoff Volume (cf):	0

Davie Dairy

*********** Basin Summary - 352 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-4
Rainfall Amount (in):	0.35
Storm Duration (hr):	3.42
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	0.00
Flow Max (cfs):	0.00
Runoff Volume (in):	0.00
Runoff Volume (cf):	0

Davie Dairy

********** Basin Summary - 456 ***

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-4
Rainfall Amount (in):	0.46
Storm Duration (hr):	4.14
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	0.00
Flow Max (cfs):	0.00
Runoff Volume (in):	0.00
Runoff Volume (cf):	0

Davie Dairy

********** Basin Summary - 713 ***

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-4
Rainfall Amount (in):	0.71
Storm Duration (hr):	4.65
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	24.50
Flow Max (cfs):	0.50
Runoff Volume (in):	0.02
Runoff Volume (cf):	96131

Davie Dairy

********** Basin Summary - 1223 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-4
Rainfall Amount (in):	1.22
Storm Duration (hr):	5.68
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	25.00
Flow Max (cfs):	4.82
Runoff Volume (in):	0.16
Runoff Volume (cf):	929124

Davie Dairy

********** Basin Summary - 1725 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-8
Rainfall Amount (in):	1.73
Storm Duration (hr):	7.41
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	25.50
Flow Max (cfs):	11.90
Runoff Volume (in):	0.40
Runoff Volume (cf):	2305451

Davie Dairy

********** Basin Summary - 2209 ***

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-8
Rainfall Amount (in):	2.21
Storm Duration (hr):	9.37
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	26.50
Flow Max (cfs):	20.51
Runoff Volume (in):	0.69
Runoff Volume (cf):	3987242

Davie Dairy

********** Basin Summary - 2736 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-8
Rainfall Amount (in):	2.74
Storm Duration (hr):	11.83
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	28.00
Flow Max (cfs):	31.13
Runoff Volume (in):	1.06
Runoff Volume (cf):	6078754

Davie Dairy

*********** Basin Summary - 3164 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-8
Rainfall Amount (in):	3.16
Storm Duration (hr):	11.00
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	27.50
Flow Max (cfs):	40.68
Runoff Volume (in):	1.38
Runoff Volume (cf):	7932151

Davie Dairy

********** Basin Summary - 3772 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-24
Rainfall Amount (in):	3.77
Storm Duration (hr):	17.90
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	33.00
Flow Max (cfs):	53.76
Runoff Volume (in):	1.86
Runoff Volume (cf):	10662735

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [1]

Davie Dairy

********** Basin Summary - 4324 ***

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-8
Rainfall Amount (in):	4.32
Storm Duration (hr):	11.30
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	27.50
Flow Max (cfs):	68.21
Runoff Volume (in):	2.32
Runoff Volume (cf):	13308368

Davie Dairy

********** Basin Summary - 4780 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-8
Rainfall Amount (in):	4.78
Storm Duration (hr):	9.50
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	26.25
Flow Max (cfs):	80.07
Runoff Volume (in):	2.71
Runoff Volume (cf):	15571549

Davie Dairy

********** Basin Summary - 6950 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-24
Rainfall Amount (in):	6.95
Storm Duration (hr):	30.50
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	41.50
Flow Max (cfs):	127.00
Runoff Volume (in):	4.66
Runoff Volume (cf):	26764702

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [1]

Davie Dairy

********** Basin Summary - 9620 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-24
Rainfall Amount (in):	9.62
Storm Duration (hr):	42.50
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	49.25
Flow Max (cfs):	181.32
Runoff Volume (in):	7.17
Runoff Volume (cf):	41189648

********** Basin Summary - 3772 **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-24
Rainfall Amount (in):	3.77
Storm Duration (hr):	17.90
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	33.00
Flow Max (cfs):	53.76
Runoff Volume (in):	1.86
Runoff Volume (cf):	10662735

```
********** Basin Summary - 10YEAR ***********************************************
---------------------------------------------------------------------------------
***
Basin Name:                    DAIRY
Group Name:                     BASE
Node Name:                    POND01
Hydrograph Type:                  UH

Unit Hydrograph:               UH256
Peaking Factor:               256.00
Spec Time Inc (min):          253.27
Comp Time Inc (min):           15.00
Rainfall File:               FDOT-24
Rainfall Amount (in):           5.00
Storm Duration (hr):           24.00
Status:                       ONSITE
Time of Conc. (min):         1900.00
Lag Time (hr):                  0.00
Area (acres):                1583.00
Vol of Unit Hyd (in):           1.00
Curve Number:                  80.10
DCIA (%):                       0.00

Time Max (hrs):                37.25
Flow Max (cfs):                81.96
Runoff Volume (in):             2.90
Runoff Volume (cf):         16670359
```

********** Basin Summary - 25YEAR **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-24
Rainfall Amount (in):	6.00
Storm Duration (hr):	24.00
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	37.00
Flow Max (cfs):	106.86
Runoff Volume (in):	3.79
Runoff Volume (cf):	21779446

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.21) [1]

********** Basin Summary - 100YEAR **

***

Basin Name:	DAIRY
Group Name:	BASE
Node Name:	POND01
Hydrograph Type:	UH
Unit Hydrograph:	UH256
Peaking Factor:	256.00
Spec Time Inc (min):	253.27
Comp Time Inc (min):	15.00
Rainfall File:	FDOT-24
Rainfall Amount (in):	7.50
Storm Duration (hr):	24.00
Status:	ONSITE
Time of Conc. (min):	1900.00
Lag Time (hr):	0.00
Area (acres):	1583.00
Vol of Unit Hyd (in):	1.00
Curve Number:	80.10
DCIA (%):	0.00
Time Max (hrs):	37.00
Flow Max (cfs):	145.35
Runoff Volume (in):	5.17
Runoff Volume (cf):	29694182

ERD

ENVIRONMENTAL RESEARCH & DESIGN, INC.

WATER QUALITY ENGINEERING
3419 TRENTWOOD BOULEVARD ■ SUITE 102 ■ ORLANDO, FLORIDA 32812
TELEPHONE: (407) 855-9465 FAX: (407) 826-0419

MEMORANDUM **May 15, 2002**

TO: File 02-007
FROM Jeff Herr, P.E. – Project Manager

CC: Dr. Del Bottcher – SWET, Inc.
Bill Berman and Glynn Rutledge – Davie Dairy, Inc.
Bob Whitman – PD&E, Inc.

RE: Davie Dairy BAT Project ACOE Pre-application meeting – May 14, 2002

On May 14, 2002, a pre-application meeting was held for the Davie Dairy BAT project at the ACOE office in Merritt Island, Florida. Those in attendance included Jeff Herr (Environmental Research and Design, Inc.), Dr. Del Bottcher (SWET), Bob Whitman (Peninsula Design and Engineering, Inc.) and Irene Sadowski (Team Leader Merritt Island Regulatory Office ACOE). The following is a brief summary of items discussed during the meeting:

1. Del Bottcher provided an overview of the proposed Davie Dairy BAT project including project history, current stormwater discharges, site hydrology, proposed project goals and objectives, and general project concept.

2. Del explained a sheet pile or earthen dike would be constructed across the existing slough near the sloughs discharge off the Davie Dairy property. It may be necessary to construct earthen berms in upland areas adjacent to the slough or to perform minor excavation adjacent to the slough to increase water storage. Stormwater runoff would be detained in the slough up to several months. Water discharged from the detention area would be treated with aluminum sulfate prior to discharge off site. Water up to 3-4 feet in depth may be present in the middle slough area.

3. Approximately 2 inches of runoff from the project watershed would be detained in the stormwater detention area.

4. The existing slough will not be used for stormwater treatment.

5. The direct wetland impacts are expected to be less than 0.25 acres.

6. Del explained the ecological report completed by Dr. Hall. A copy of Dr. Hall's report is attached with this memo.

7. Irene agreed with the findings outlined in Dr. Hall's report. Irene provided a copy of the ACOE Nationwide 43 Permit Criteria outlined in the Federal Register. A copy of the Nationwide 43 Criteria is attached to this memo. Irene indicated that if the direct project impacts (those jurisdictional areas disturbed for the construction of a retaining wall or

earthen dike) were less than 0.5 acres, the project could be permitted as a Nationwide 43.

8. Irene was not concerned with staging runoff in the Sweet Bay Swamp area to a depth of 3-4 ft. She was concerned about changing hydrology in the Loblolly-bay Swamp.

9. The project will be permitted using the state environmental resource permit application with the basic application and section A completed and submitted. One copy of the permit application is required. No permit fees are required.

10. Irene anticipates the permit being issued within 30-60 days of submittal. Davie Dairy will be the applicant.

11. A surveyed jurisdictional wetland line is only required in jurisdictional areas which will be directly impacted by retaining wall or earthen dike construction. Dr. Hall's approximate jurisdictional limits will be used for all remaining indirectly affected jurisdictional areas.

12. Irene will require wetland species' monitoring at two or three locations on the Davie Dairy property. The purpose of the monitoring will be to demonstrate the project has not adversely affected the slough vegetation. Monitoring will need to be performed for at least a period of 3-5 years.

13. A surveyed jurisdictional wetland line is only required in jurisdictional areas which will be directly impacted by retaining wall or earthen dike construction. Dr. Hall's approximate jurisdictional limits will be used for all remaining indirectly affected jurisdictional areas.

14. In the event adverse wetland impacts are observed during a monitoring event, the applicant will be required to submit a proposal to modify the existing project to eliminate the adverse impact. (i.e. release water at a faster rate to reduce length of inundation.) The project will need to be designed to allow future system adjustments.

15. No mitigations for the direct wetland impacts are required. The water quality enhancement provided by the project will satisfy mitigation requirements.

ERD ENVIRONMENTAL RESEARCH & DESIGN, INC.

WATER QUALITY ENGINEERING
3419 TRENTWOOD BOULEVARD ■ SUITE 102 ■ ORLANDO, FLORIDA 32812
TELEPHONE: (407) 855-9465 FAX: (407) 826-0419

August 27, 2002

Ms. Irene F. Sadowski, Team Leader
Merritt Island Regulatory Office
U.S. Army Corps of Engineers
Jacksonville District
2460 North Courtenay Parkway, Suite 216
Merritt Island, FL 32953

RE: Davie Dairy BAT Project

Dear Ms. Sadowski:

On May 14, 2002, Dr. Del Bottcher, Bob Whitman, and I met with you regarding the Davie Dairy BAT Project. The objective of this project is to detain stormwater runoff to the maximum extent possible on Davie Dairy property and treat excess runoff with an off-line chemical treatment system. The treated water would return to Nubbin Slough and discharge downstream eventually to Lake Okeechobee.

To detain stormwater runoff on Davie Dairy property, an earthen levee will be constructed across Nubbin Slough. The levee will have a 50-ft wide section at elevation 45.5 ft NGVD and will increase in elevation to 48.0 ft NGVD. Stormwater runoff will stage behind the levee in the natural depressional storage areas on-site. A 36-inch HDPE pipe will be constructed from the slough upstream of the levee to three parallel floc settling cells. Treated water will discharge from each of the three floc settling cells through 18-inch HDPE pipes into Nubbin Slough downstream of the levee. Wetland impacts to Nubbin Slough are required for construction of the levee and construction of the 36-inch HDPE inflow pipe and the three 18-inch HDPE outfall pipes.

Three copies of the Environmental Resource Permit Application Section A, an Engineering Analysis with wetland assessment, and Construction Drawings are provided for your review. The Environmental Assessment and Wetland Impact table are provided in #15 of the Engineering Analysis, beginning on page 9. A copy of Dr. David Hall's assessment is attached at the back of the Permit Application. The total wetland impact for this project is 0.40 acres. It is our understanding from the Pre-Application Meeting that as long as the area is less than 0.5 acres, this project can be permitted under the Nationwide 43 Permit Criteria. Although no wetland impacts are anticipated as a result of water storage in the slough, SWET will perform semi-annual monitoring at three locations selected by the Corps along Nubbin Slough on Davie Dairy property each year for a minimum of three years as directed by your office. This monitoring is also described in #15 of the Engineering Analysis.

We appreciate your prompt review of the enclosed Application. Please give me a call if you have any questions or comments throughout your review. SWET would like to begin construction on this project around October 1, 2002.

Sincerely,

Jeffrey L. Herr, P.E.
Vice President - Engineering

cc: Bill Berman - Davie Dairy (w/ 1 copy of Construction Drawings)
Dr. Del Bottcher - SWET (w/ 1 copy of ERP Application and Construction Drawings)

Enclosures: ERP Application

DAIRY\SADOWSKI.827

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION/

WATER MANAGEMENT DISTRICTS/

U.S. ARMY CORPS OF ENGINEERS

JOINT APPLICATION FOR

ENVIRONMENTAL RESOURCE PERMIT/

AUTHORIZATION TO USE SOVEREIGN SUBMERGED LANDS/

FEDERAL DREDGE AND FILL PERMIT

Prepared By

Environmental Research & Design, Inc.
3419 Trentwood Blvd., Suite 102
Orlando, FL 32812
(407) 855-9465

Jeffrey L. Herr, P.E.   No. 36807

SECTION A

FOR AGENCY USE ONLY

ACOE Application #______________
Date Application Received______________
Proposed Project Lat. ____° ____' ____"
Proposed Project Long. ____° ____' ____"

DEP/WMD Application #______________
Date Application Received______________
Fee Received $______________
Fee Receipt #______________

PART 1:

Are any of the activities described in this application proposed to occur in, on, or over wetlands or other surface waters?
_x_ Yes ___ No

Is this application being filed by or on behalf of a government entity or drainage district? __ Yes _x_ No

PART 2:

A. **Type of Environmental Resource Permit Requested (check at least one).**

___ Noticed General - include information requested in Section B.
___ Standard General (single-family dwelling) - include information requested in Sections C and D.
___ Standard General (all other projects) - include information requested in Sections C and E.
___ Individual (single-family dwelling) - include information requested in Sections C and D.
___ Individual (all other projects) - include information requested in Sections C and E.
___ Conceptual - include information requested in Sections C and E.
___ Mitigation Bank (construction) - include information requested in Sections C and F.
(If the proposed mitigation bank involves the construction of a surface water management system requiring another permit defined above, check the appropriate box and submit the information requested by the applicable section.)
___ Mitigation Bank (conceptual) - include information requested in Sections C and F.

B. **Type of activity for which you are applying (check at least one)**

_x_ Construction or operation of a new system, other than a solid waste facility, including dredging or filling in, on or over wetlands and other surface waters.
___ Construction, expansion or modification of a solid waste facility.
___ Alteration or operation of an existing system which was not previously permitted by SWFWMD or DEP.
___ Modification of a system previously permitted by SWFWMD or DEP. Provide previous permit # ______________ and check applicable modification type.
__ Alteration of a system
__ Abandonment of a system
__ Removal of a system
__ Extension of permit duration
__ Construction of additional phases of a system

C. Are you requesting authorization to use Sovereign Submerged Lands?
__ Yes _x_ No
If yes, include the information requested in Section G.

D. For activities in, on or over wetlands or other surface waters, check type of federal dredge and fill permit requested:
__ Individual
__ Programmatic General
__ General
_x_ Nationwide
__ Not Applicable

E. Are you claiming to qualify for an exemption? ___ Yes _x_ No
If yes, provide rule number, if known: ______________

PART 3:

A. OWNER(S) OF LAND		B. ENTITY TO RECEIVE PERMIT (IF OTHER THAN OWNER)	
NAME	William Berman	NAME	Same as Owner
TITLE AND COMPANY	Owner - Davie Dairy, Inc.	TITLE AND COMPANY	
ADDRESS	3105 NE 128th Avenue	ADDRESS	
CITY, STATE, ZIP	Okeechobee, FL 34974	CITY, STATE, ZIP	
TELEPHONE FAX	863/763-2279 863/763-8378	TELEPHONE FAX	

C. AGENT AUTHORIZED TO SECURE PERMIT		D. CONSULTANT (IF DIFFERENT FROM AGENT)	
NAME	Jeffrey L. Herr, P.E.	NAME	Same as Agent
TITLE AND COMPANY	Vice President - Engineering Environmental Research & Design, Inc.	TITLE AND COMPANY	
ADDRESS	3419 Trentwood Blvd., Suite 102	ADDRESS	
CITY, STATE, ZIP	Orlando, FL 32812	CITY, STATE, ZIP	
TELEPHONE FAX	407/855-9465 407/826-0419	TELEPHONE FAX	

PART 4: (Please provide metric equivalent for federally funded projects):

A. Name of project, including phase if applicable: Davie Dairy BAT Project

B. Is this application for part of a multi-phase project?
___ Yes x No

C. Total applicant-owned area contiguous to the project:
3410 ac; ______ ha

D. Total area served by the system: 1596 ac; ______ ha

E. Total impervious area for which a permit is sought:
0 ac; ______ ha

F. Volume of water that the system is capable of impounding:
102.7 ac-ft; ______ m

G. What is the total area of work in, on, or over wetlands or other surface waters?
0.40 ac; ______ ha; ____ sq ft; ______ sq m

H. Total volume of material to be dredged: 0 yd; ______ m

I. Number of new boat slips proposed: 0 wet slips; 0 dry slips

PART 5: PROJECT LOCATION (See Attached Figure A-1):

County(ies): Okeechobee

Section(s): 14 Township: 37S Range: 36E

Land Grant name, if applicable: Not Applicable

Tax Parcel Identification Number: ______

Street address, road, or other location: ______

City, Zip Code, if applicable: ______

PART 6: DESCRIBE IN GENERAL TERMS THE PROPOSED PROJECT, SYSTEM, OR ACTIVITY.

In December 2000, the South Florida Water Management District (SFWMD) selected the SWET Team to complete the Dairy Best Available Technologies Project (C-11652). The project goal is to select, implement, and monitor best available technologies to significantly reduce dairy industry phosphorus exports to the Okeechobee Basin and bring about the most effective and substantial water quality improvements in the shortest possible time. As part of this project, the SWET Team completed a detailed literature review of available technologies, completed a ranking of Okeechobee dairies for participation, completed nutrient assessment for selected dairies, and ranked and selected the most appropriate technology for meeting the District's goal of 40 ppb phosphorus concentration at the edge of the farm. Edge-of-farm treatment (impoundment, water reuse, and chemical flocculation) of runoff was found to be the highest ranked method to reduce phosphorus discharge from the farm to meet the project's goals. Based on these findings, the SFWMD Governing Board authorized SWET to contract with Environmental Research & Design, Inc. (ERD) to design and construct an edge-of-farm treatment system for the Davie Dairy located in Okeechobee, Florida.

Davie Dairy is a 3410-acre dairy located south of S.R. 70 in Okeechobee County, Florida. Approximately 1596 acres of the property, including the active dairy, drain to Nubbin Slough. Nubbin Slough drains to the L-63S Canal which drains into the east side of Lake Okeechobee. Based on previous water quality monitoring, the total phosphorus concentration in the water in Nubbin Slough at the edge of the farm is in the range of 0.2-0.6 mg/l. The proposed edge-of-farm treatment system includes the construction of a levee across Nubbin Slough at elevation 45.5 ft NGVD. Excess runoff will stage upstream of the levee and discharge through a 36-inch HDPE pipe into three floc settling cells. The water flow rate is measured as it passes through the pipe and the appropriate amount of aluminum sulfate is mixed with the inflow water, with the resulting floc settling in the floc settling cell. The treated supernatant will discharge into Nubbin Slough on Davie Dairy property downstream of the constructed levee. The stormwater detention/chemical treatment system is capable of treating all discharges up to and including the peak discharge for a 3.77-inch rain event. An engineering analysis for the edge-of-farm treatment system and construction drawings for the edge-of-farm treatment system are attached to this Permit Application for review.

PART 7:

A. If there have been any pre-application meetings, including on-site meetings, with regulatory staff, please list the date(s), location(s), and names of key staff and project representatives.

A pre-application meeting was held at the Merritt Island ACOE Regulatory Office with Irene Sadowski, Bob Whitman, Del Bottcher, and Jeff Herr on May 14, 2002

B. Please identify by number any MSSW/Wetland Resource/ERP/ACOE Permits pending, issued, or denied for projects at the location, and any related enforcement actions.

Agency	Date	No./Type of Application	Action Taken

C. NOTE: The following information is required for projects proposed to occur in, or, or over wetlands that need a federal dredge and fill permit or an authorization to use state-owned submerged lands. Please provide the names, addresses and zip codes of property owners whose property directly adjoins the project (excluding application) and/or (for proprietary authorizations) is located within a 500-ft radius of the applicant's land. Please attached a plan view showing the owner's names and adjoining property lines. Attach additional sheets if necessary.

1. See Figure A-2

PART 8:

A. By signing this application form, I am applying, or I am applying on behalf of the applicant, for the permit and any proprietary authorizations identified above, according to the supporting data and other incidental information filed with this application. I am familiar with the information contained in this application, and represent that such information is true, complete and accurate. I understand that knowingly making any false statement or representation in the application is a violation of Section 373.430, F.S. and 18 U.S.C. Section 1001. I understand that this application and permit or proprietary authorization issues pursuant thereto, does not relieve me of any obligation for obtaining any other required federal, state, water management district or local permit prior to commencement of construction. I agree, or I agree on behalf of the applicant, to operate and maintain the permitted system unless the permitting agency authorizes transfer of the permit to a responsible operation entity.

William Berman
Typed/Printed Name of Owner, Applicant or Agent — Corporate Title, if applicable

Signature of Owner, Applicant or Agent — Date

B. AN AGENT MAY SIGN ABOVE ONLY IF THE FOLLOWING IS COMPLETED:

I hereby designate and authorize the agent listed above to act on my behalf, or on behalf of my corporation, as the agent in the processing of this application for the permit and/or proprietary authorization indicated above; and to furnish, on request, supplemental information in support of the application. In addition, I authorize the above-listed agent to bind me, or my corporation, to perform any requirement which may be necessary to procure the permit or authorization indicated above.

Typed/Printed Name of Owner or Applicant — Corporate Title, if applicable

Signature of Owner or Applicant — Date

C. PERSON AUTHORIZING ACCESS TO THE PROPERTY MUST COMPLETE THE FOLLOWING:

I either own the property described in this application or I have legal authority to allow access to the property, and I consent, after receiving prior notification, to any site visit on the property by agents or personnel from the Department of Environmental Protection, the Southwest Florida Water Management District and the U.S. Army Corps of Engineers necessary for the review and inspection of the proposed project specified in this application. I authorize these agents or personnel to enter the property as many times as may be necessary to make such review and inspection. Further, I agree to provide entry to the project site for such agents or personnel to monitor permitted work if a permit is granted.

William Berman
Typed/Printed Name of Owner, Applicant or Agent — Corporate Title, if applicable

Signature of Owner, Applicant or Agent — Date

D. I certify that the engineering features of this surface water management system have been designed by me or under my responsible charge and in my professional opinion conform with sound engineering principles and all applicable rules and specifications. I further agree that I or my engineering firm will furnish the applicant/permittee with a set of guidelines and schedules for maintenance and operation of the surface water management system.

By: ______________________
Signature of Engineer of Record

* AFFIX SEAL *

Date: ______________________

Phone: (407) 855-9465

Jeffrey L. Herr — 36807
Name (please type) — FL P.E. No.

Environmental Research & Design, Inc.
Company Name

3419 Trentwood Blvd., Suite 102
Company Address

Orlando, FL 32812
City, State, Zip

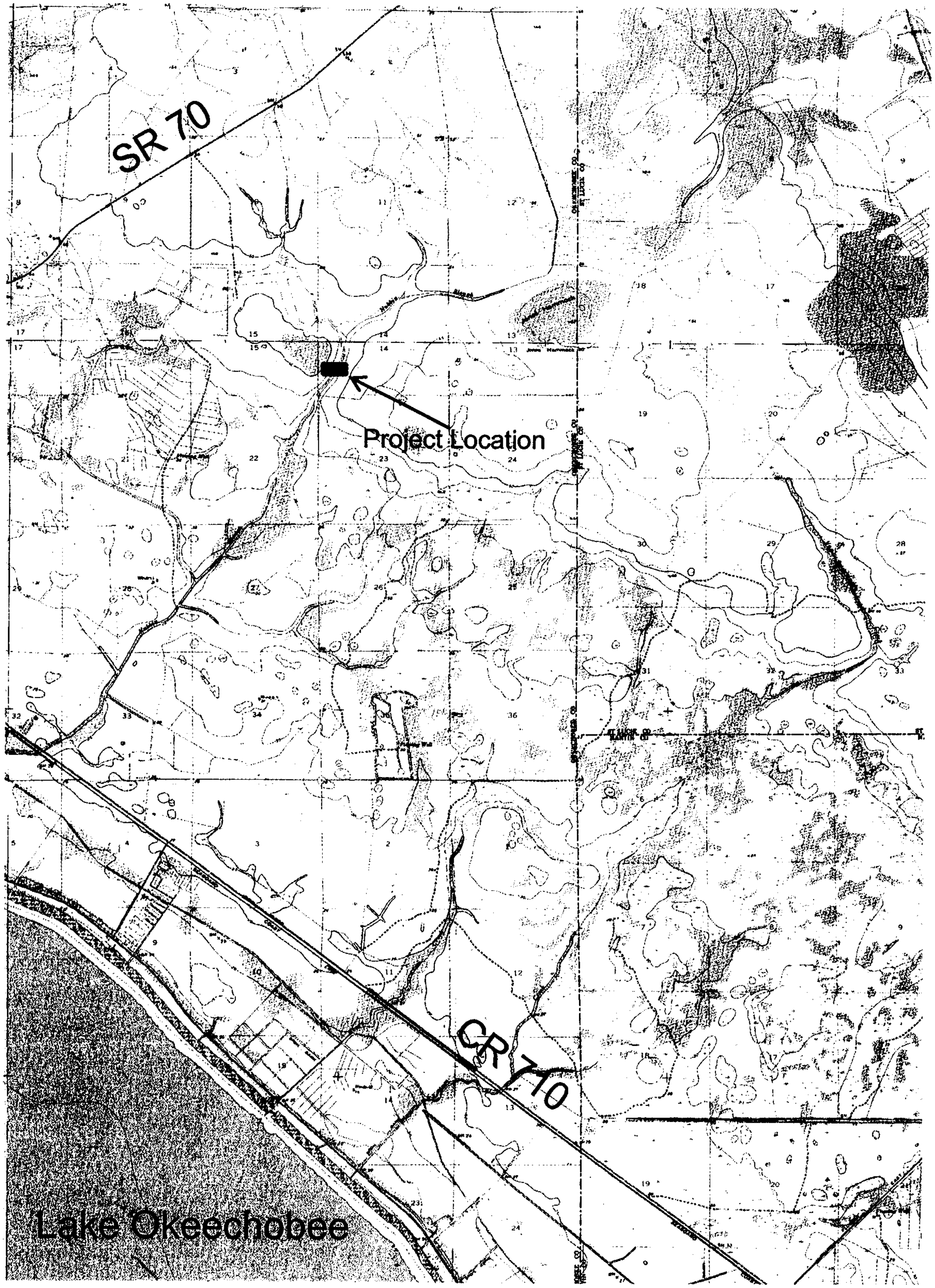


Figure A-1. Project Location Map.

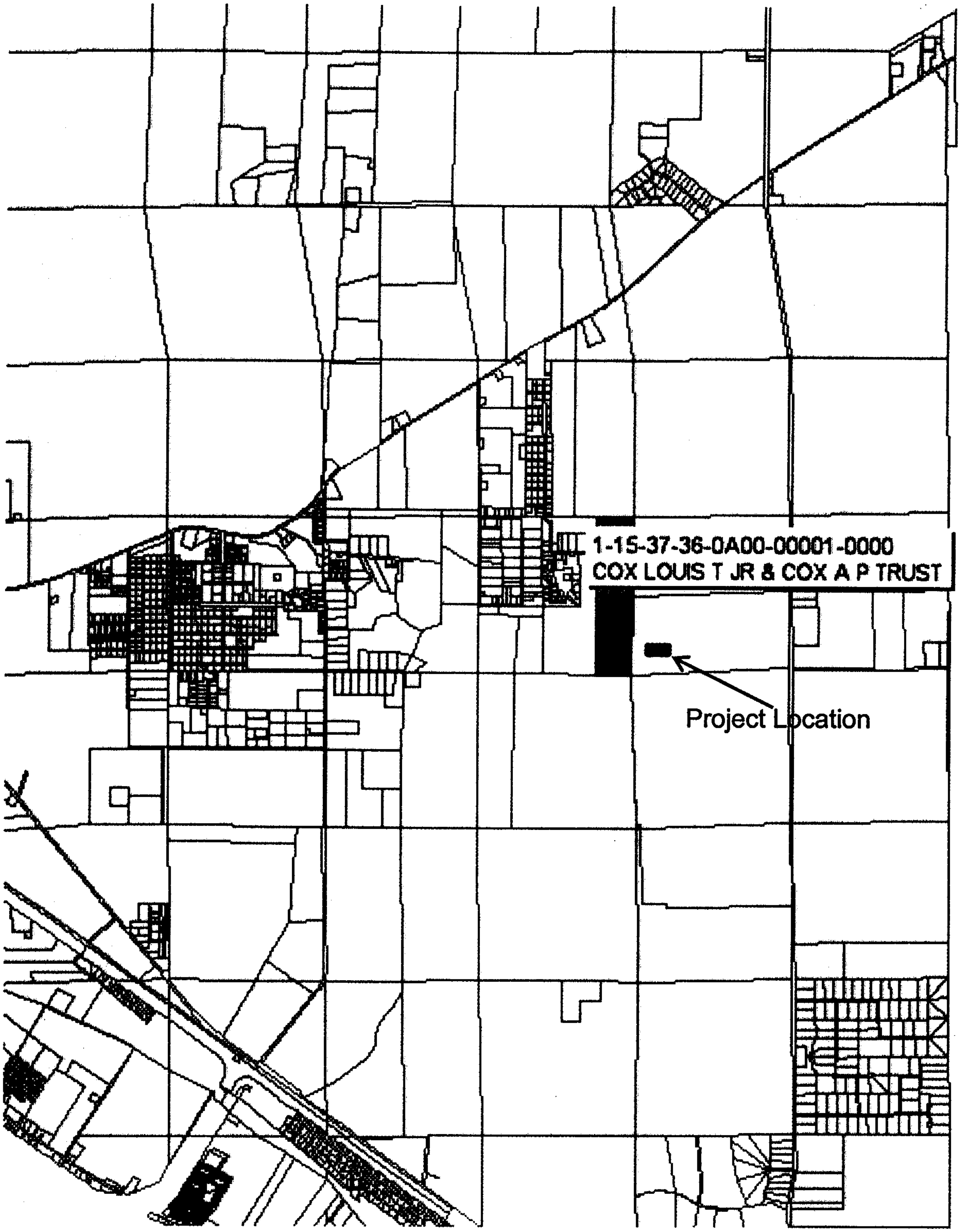


Figure A-2. Adjacent Property Owner Map.

BEST AVAILABLE TECHNOLOGIES
PROJECT FOR DAVIE DAIRY
ENGINEERING ANALYSIS

Prepared By
Environmental Research & Design, Inc.
July 9, 2002 (Revised August 9, 2002)

1. Contributing watershed area includes Basin 2 (687 acres) and Basin 3 (909 acres) = 1596 acres. Off-site area at northeast corner of property - culvert closed. No discharge to Davie Dairy. Off-site area at southwest corner of property - flow diverted around treatment system.

2. Hydrologic parameters developed for three soil conditions - well drained, poorly drained and moderately drained as follows:

HYDROLOGIC PARAMETER	SOIL CONDITION		
	Well Drained	Moderately Drained	Poorly Drained
Area (ac)	1596.0	1596.0	1596.0
non-DCIA CN	43.9	62.0	80.1
DCIA (%)	0.0	0.0	0.0
S (in)	12.78	6.13	2.48

Each of these conditions may occur dependent on antecedent rainfall. Analyzing each of these will provide a range of possible runoff values.

3. Time of concentration for watershed calculated as follows:

Flow Length	=	10,000 ft
Roughness	=	0.30
Rainfall Intensity	=	0.438 in/hr
Slope	=	0.00025 ft/ft
T_c	=	1900 minutes

4. Historic hourly rainfall data obtained from the National Climatic and Data Center CD for the Okeechobee Hurricane Gate Station for the period from 1942-1970 (excluding 1947). Developed the following probability distribution of average annual rainfall events in the watershed for 19 rainfall event ranges. The rainfall interval point is the mean value of events in each range. Each event separated by more than 3 hours of no rainfall is considered a separate event.

RAINFALL EVENT RANGE (in)	RAINFALL INTERVAL POINT (in)	NUMBER OF ANNUAL EVENTS IN RANGE	TOTAL ANNUAL RAINFALL (in)
0.00-0.10	0.04	57.588	2.30
0.11-0.20	0.15	16.751	2.51
0.21-0.30	0.25	9.604	2.40
0.31-0.40	0.35	6.541	2.29
0.41-0.50	0.46	5.747	2.64
0.51-1.00	0.71	14.747	10.47
1.01-1.50	1.22	5.936	7.24
1.51-2.00	1.73	2.874	4.97
2.01-2.50	2.21	1.172	2.59
2.51-3.00	2.74	0.681	1.87
3.01-3.50	3.16	0.302	0.95
3.51-4.00	3.77	0.189	0.71
4.01-4.50	4.32	0.189	0.82
4.51-5.00	4.78	0.038	0.18
5.01-6.00	--	0.000	0.00
6.01-7.00	6.95	0.038	0.26
7.01-8.00	--	0.000	0.00
8.01-9.00	--	0.000	0.00
> 9.01	9.62	0.076	0.73

Total Average Annual Rainfall = 42.93 inches

For period of record, minimum annual rainfall = 23.71 inches (0.51 x average); maximum annual rainfall = 61.24 inches (1.32 x average)

Additional annual rainfall data was provided by Davie Dairy for five District Okeechobee area rainfall stations for the period 1956-2001. The mean annual rainfall for these stations is 46.33 inches. The difference between the Hurricane Station (42.93 inches) and the other five stations is 3.40 inches (7.9%). For estimation of annual runoff volume, the calculated number of annual rainfall events in each range was increased by 7.9%.

5. Used SBUH method to calculate annual runoff volumes for three soil condition. Determined runoff for each of 19 rainfall interval point, multiplied times number of event in each range per year and summed to determine annual runoff volume for the watershed as follows:

RAINFALL INTERVAL POINT (in)	NUMBER OF ANNUAL EVENTS IN RANGE	EVENT RUNOFF DEPTH FOR SOIL CONDITION (in)			RUNOFF VOLUME FOR SOIL CONDITION (ac-ft)		
		Well Drained	Moderately Drained	Poorly Drained	Well Drained	Moderately Drained	Poorly Drained
0.04	62.119	0.00	0.00	0.00	0.00	0.00	0.00
0.15	18.069	0.00	0.00	0.00	0.00	0.00	0.00
0.25	10.360	0.00	0.00	0.00	0.00	0.00	0.00
0.35	7.056	0.00	0.00	0.00	0.00	0.00	0.00
0.46	6.199	0.00	0.00	0.00	0.00	0.00	0.00
0.71	15.907	0.00	0.00	0.02	0.00	0.00	35.62
1.22	6.403	0.00	0.00	0.16	0.00	0.00	138.83
1.73	3.100	0.00	0.04	0.41	0.00	15.80	168.65
2.21	1.264	0.00	0.14	0.70	0.00	22.90	117.56
2.74	0.735	0.00	0.30	1.06	0.26	29.31	103.98
3.16	0.326	0.03	0.46	1.38	1.18	20.10	59.69
3.77	0.204	0.11	0.75	1.86	2.86	20.24	50.45
4.32	0.204	0.21	1.04	2.32	5.80	28.15	62.83
4.78	0.041	0.33	7.11	2.71	1.80	7.11	14.78
---	---	---	---	---	---	---	---
6.95	0.041	1.12	2.76	4.66	6.13	15.07	25.40
---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---
9.62	0.082	2.51	4.85	7.17	27.42	52.90	78.18
				Generated Volume (ac-ft/yr)	45.44	211.57	855.99
				Weighted Basin "C" Value	0.007	0.034	0.139

Using the minimum and maximum annual rainfall from item 4, estimated minimum, average and maximum annual runoff for each soil condition as follows:

RAINFALL	ANNUAL RUNOFF VOLUME FOR SOIL CONDITION (ac-ft)		
	Well Drained	Moderately Drained	Poorly Drained
Minimum	23.1	107.9	--
Average	45.4	211.6	856.0
Maximum	--	279.3	1130

6. At the kick-off meeting, it was stated that the Dairy uses approximately 500,000 gallons of water each day for the washdown of two barns. The used water from each barn discharges into a series of 3 lagoons and is then pumped to a pivot sprayfield. One of the pivot sprayfields is underdrained while the other is not.

   Based on hydrologic modeling summarized in item 5, the coefficient of runoff (C) for the project watershed ranges from 0.007 to 0.139, depending upon antecedent conditions. During dry times of the year the C value is normally low, while during wet times the C value may be higher than 0.139.

   Using a "C" value of 0.139 results in an average daily discharge from the pivot sprayfield of 69,500 gallons/day or about 0.11 cfs on an average annual basis. This equates to an annual discharge of approximately 78 ac-ft. This is assumed to represent an average year. During dry years this volume may be less, and during wet years this volume is expected to be larger. Applying the same factors for minimum annual rainfall (0.51) and maximum annual rainfall (1.32) from item 4, the range of washdown discharge is expected to be from 40-103 ac-ft/yr.

7. The volume of water reaching the detention/chemical treatment system will be the sum of runoff and washdown (assuming groundwater discharge is negligible). The anticipated range of annual discharge based on items 5 and 6 is:

Minimum Rainfall Year	=	(23.1 + 40) ac-ft	=	63.1 ac-ft
Average Rainfall Year	=	(856 + 78) ac-ft	=	934 ac-ft
Maximum Rainfall Year	=	(1130 + 103) ac-ft	=	1233 ac-ft

8. Peak pre-treatment discharge rates and event runoff volumes were modeled using SBUH for each rainfall interval point for each soil condition to provide a range of possible values as follows:

RAINFALL INTERVAL POINT (in)	PEAK DISCHARGE FOR SOIL CONDITION (cfs)			EVENT RUNOFF VOLUME FOR SOIL CONDITION (ft^3)		
	Well Drained	Moderately Drained	Poorly Drained	Well Drained	Moderately Drained	Poorly Drained
0.15	0.00	0.00	0.00	0	0	0
0.25	0.00	0.00	0.00	0	0	0
0.35	0.00	0.00	0.00	0	0	0
0.46	0.00	0.00	0.00	0	0	0
0.71	0.00	0.00	0.49	0	0	94,321
1.22	0.00	0.00	4.82	0	0	929,869
1.72	0.00	1.02	11.75	0	198,132	2,277,008
2.21	0.00	4.01	20.70	0	778,549	4,023,729
2.73	0.07	8.74	31.26	12,890	1,707,582	6,103,607
3.16	0.81	13.78	40.92	157,972	2,687,098	7,979,519
3.77	3.09	21.84	54.15	602,903	4,300,334	10,740,890
4.24	5.80	29.42	66.67	1,130,108	5,740,513	13,008,103
4.78	9.82	38.84	80.73	1,909,643	7,555,346	15,699,435
6.95	31.98	77.20	128.04	6,511,762	16,009,738	26,984,538
9.62	67.29	126.54	182.80	14,564,813	28,098,756	41,527,932

9. Selection of a design storm event is necessary to determine the required detention volume and to size the chemical treatment system and floc settling pond.

At the kick-off meeting, Del indicated the proposed system should treat approximately a 3.5-inch event, producing about 2 inches of runoff. Based on hydrologic modeling completed by ERD, as described in item 5, under poorly drained conditions, a 3.77-inch storm will produce 1.85 inches of runoff in an average annual rainfall year. This storm has a peak discharge of 54.15 cfs and a total event runoff volume of 257 ac-ft. Based on the rainfall probability distribution in item 4, rainfall events exceeding 3 inches in depth occur less than once each average year. Therefore, the selection of the 3.77-inch event for design will result in the treatment of practically all runoff in an average annual rainfall year.

10. The design concept is to detain as much runoff as possible on-site to maximize the potential for infiltration, evaporation, and reuse of water for barn washdown. The detained water would slowly discharge through an alum treatment system as needed to restore the detention volume.

Using the survey information collected along the slough, the following stage/storage values were calculated for the natural system:

ELEVATION (ft NGVD)	INCREMENTAL VOLUME (ac-ft)	CUMULATIVE VOLUME (ac-ft)
34.0	0.00	0.00
35.0	0.05	0.05
36.0	0.20	0.25
37.0	0.57	0.82
38.0	1.06	1.88
39.0	1.78	3.66
40.0	2.70	6.36
41.0	4.53	10.9
42.0	10.4	21.3
43.0	17.6	38.9
44.0	26.2	65.1
45.0	37.6	102.7
46.0	50.6	153.3
47.0	65.5	218.8
48.0	82.4	301.2
49.0	108.5	409.7
50.0	149.1	558.8

Therefore, the slough has a natural storage volume of 102.7 ac-ft at elevation 45.0 ft NGVD and a storage of 558.8 ac-ft at elevation 50.0 ft NGVD.

The natural storage in the slough should be sufficient to provide the required detention volume. An earthen berm and/or sheet pile/concrete weir would be constructed across the slough. A pipe would extend from the slough upstream of the weir to discharge water to the alum treatment system. The water flow rate would be measured by a flow meter producing a 4-20 mA output. The 4-20 mA output would control the speed of the alum and buffer feed pumps to maintain constant chemical doses at different water flow rates.

The alum treated water would enter a floc settling area with sufficient time to allow the floc to settle. The treated supernatant would discharge by gravity pipe into the slough downstream of the weir. Alum floc is approximately 95-99% water. Since there is no sanitary sewer system to receive the wet alum floc, it appears beneficial to dewater the floc to the maximum extent possible and then landspread or take the remaining solids to the municipal landfill several miles from the dairy. Multiple drying cells would be constructed so one cell receives treated water at a time while the other cells are dewatering. A front-end loader or other heavy equipment would be used to remove the somewhat dewatered floc from the drying cells.

HDPE storage tanks would be used to store alum and a buffer (NaOH). The tanks, alum feed equipment, buffer feed equipment, water flow meter electronics, alum flow meter, and miscellaneous items would be stored in a simple enclosure on a concrete pad. Electrical power would need to be extended from the public right-of-way to the facility. Tanker trucks would need to have access to deliver alum and buffer to the facility.

11. Based on jar testing performed by ERD on multiple samples collected at the edge of the farm by Davie Dairy, an alum dose of 10 mg/l as aluminum is sufficient to reduce the total phosphorus concentration to less than 40 ppb. The addition of 50% sodium hydroxide at a dose of 14 mg/l as NaOH was required to develop a larger floc which would settle in several hours. A range of estimated annual chemical requirements for the dairy follows:

RAINFALL CONDITION	WATER VOLUME TREATED (ac-ft)	ALUM REQUIREMENT (gal)	NaOH REQUIREMENT (gal)
Minimum	63.1	3,786	1,199
Average	934	56,040	17,746
Maximum	1,233	73,980	23,427

This assumes no runoff is lost to infiltration, evaporation, reuse, etc. - worst case.

The following are included as attachments:

1. A copy of the hydrologic model input sheet and a portion of the raw data.
2. A plan view of the impoundment.
3. A preliminary cost estimate.
4. A copy of the Construction Bond.
5. A schedule for construction completion.
6. A copy of the permit application to the Army Corps of Engineers.

12. Based on floc settling tests performed by ERD, the estimated floc volume is approximately 0.5% of the treated water volume at 30 days, at an alum dose of 10 mg/l as Al and a sodium hydroxide dose of 14 mg/l as NaOH. A range of estimated annual wet/dried floc volume for the dairy follows:

RAINFALL CONDITION	WATER VOLUME TREATED (ac-ft)	WET FLOC VOLUME AT 30 DAYS (5% solids) (ac-ft)	DRIED FLOC VOLUME (30% solids) (cy)
Minimum	63.1	0.32	86
Average	934	4.67	1,259
Maximum	1,233	6.17	1,664

13. Each settling cell volume is based on providing a minimum detention time for the peak discharge for the design storm event. The design storm event is the 3.77-inch event under poorly drained soil conditions. Based on hydrologic modeling, the peak discharge into the cell for this storm event is 19 cfs. Based on laboratory jar tests, the minimum floc settling time is 3 hours using a combination of alum and sodium hydroxide. Therefore, the minimum settling pond volume is 205,000 ft^3 (4.7 ac-ft)

Each floc settling cell has the following stage/storage relationship:

CELL ELEVATION (ft NGVD)	CUMULATIVE STORAGE (ac-ft)
39.0	0.00
40.0	0.38
41.0	1.21
42.0	2.18
43.0	3.30
44.0	4.65
45.0	6.02

The required volume would occur at el. 44.04 ft NGVD

Based on a total annual water volume of 934 ac-ft in an average year, each cell would receive 311 ac-ft of water per year, producing 1.56 ac-ft of wet floc. It is anticipated that each cell would need to be cleaned an average of approximately once every 2-3 months. Cleaning would be more frequent in the "wet" months and less frequent in the "dry" months.

14. Construction drawings are attached. Construct primary detention weir (earthen berm) across slough at elevation 48.0 ft NGVD with 50-ft section at elevation 45.5 ft NGVD. Include three 42-inch HDPE culverts with aluminum gates for bypass of alum system during extreme storm events.

Construct 36-inch HDPE inflow pipe from slough upstream of primary weir to three floc settling cells (100-ft x 600-ft) downstream of primary weir. Construct alum equipment enclosure with alum pump and controls, buffer pump and controls, water flow meter, alum meter, alum tank, and buffer tank on concrete pad. Construct a separate 36-inch HDPE inflow pipe to each of three settling cells. Construct gate to control flow on each inflow pipe. Construct three settling cells, top-of-bank elevation 45.0 ft NGVD, bottom slopes from 40.0 ft to 39.0 ft NGVD. Construct 6-ft diameter farm riser at downstream end of each settling floc cell with 18-inch HDPE outflow pipe from cell to slough.

Flow will normally pass through a single 36-inch HDPE to alum treatment system and floc settling cell. The water flow rate through the alum system for a 3.77-inch storm will be approximately 19 cfs. Under extreme storms, or if desired for other reason, close gate on 36-inch inflow and open three gates on primary weir.

<u>Environmental Assessment</u>

15. On April 9, 2002, Dr. David W. Hall conducted an environmental survey of Nubbin Slough on Davie Dairy property for Soil and Water Engineering Technology. A copy of Dr. Hall's report is attached to the engineering analysis. The wetlands on the property include a creek, floodplain swamp, and a fringe of marsh. All project construction will be performed at the downstream end of Nubbin Slough adjacent to the Davie Dairy property's west property boundary. Construction will be performed only in the deeply insized creek area with little or no fringing marsh.

In May 2002, Robert Whitman (with Peninsula Design & Engineering, Inc.) delineated the jurisdictional line on the east and west sides of Nubbin Slough in the construction area. These jurisdictional lines are shown on the enclosed construction drawings. Mr. Whitman also identified a seasonal high water elevation of 38.84 ft NGVD downstream of the proposed levee, approximately 450 ft from the fence line. A second seasonal high water elevation of 45.03 ft NGVD was established at approximately elevation 30+00. The location of these seasonal high water identifications are shown on the enclosed surveys. The survey also shows 1-ft contours throughout the work area and upstream along Nubbin Slough. The levee will be constructed to elevation 45.50 ft NGVD. Therefore, the seasonal high water elevation upstream of the levee will be approximately 45.5 ft NGVD. The limits of the seasonal high water elevation of 45.5 ft NGVD are shown on the enclosed survey.

The detained stormwater runoff will stage to approximately station 47+50. This is well downstream of the sensitive Loblolly-Bay swamp identified by Dr. Hall and shown in his report. Although water will stage to elevation 45.5 ft NGVD during the wet season, it will drawdown to a normal water elevation of 41.0 ft NGVD within 10 days following a 3.77-inch rain event. Therefore, water should only be standing to elevation 45.5 ft NGVD for 10 days or less at any given time. Based on the level and duration of inundation, no adverse wetland impacts are anticipated. SWET will perform semi-annual monitoring at three locations along Nubbin Slough on Davie Dairy property each year for a minimum of three years. The purpose of the monitoring will be to demonstrate that the project has not adversely affected the Slough vegetation. Copies of the monitoring reports shall be provided to the ACOE. In the event adverse wetland impacts are observed during a monitoring event, the applicant will submit a proposal to modify the existing project to eliminate the adverse impact (i.e. release water at a faster rate to reduce length of inundation). The project will be designed to allow future system adjustments.

The following table provides a summary of construction-related disturbance to the wetland:

LOCATION	SURFACE AREA DISTANCE (ft^2)
Inflow Pipe	700
Excavation for Sump Area	2,400
Fill for Levee	13,000
Outfall Pipe #1	800
Outfall Pipe #2	600
TOTAL:	17,500 = 0.40 ac

The total direct wetland disturbance for construction of this project is less than 0.5 acres. Based on the Pre-Application Meeting, and a thorough review of the Nationwide 43 Permit Criteria, this project qualifies for permitting as a Nationwide 43 Project.

16. Estimated Annual O&M Costs for a range of annual rainfall conditions follow:

RAINFALL CONDITION	LABOR COST ($)	CHEMICAL COST ($)	POWER COST ($)	RENEWAL AND REPLACEMENT COST ($)	FLOC REMOVAL AND DISPOSAL ($)	TOTAL COST ($)
Minimum	3,120	3,092	600	2,500	1,033	10,345
Average	6,240	45,766	1,800	2,500	15,069	71,375
Maximum	9,360	60,417	2,400	2,500	19,909	85,226

NOTES:
Assumes dewatered floc retained on-site
Alum Cost = $0.50/gallon
NaOH Cost = $1.00/gallon
Floc Removal and Disposal Cost = $2/cy of wet floc volume

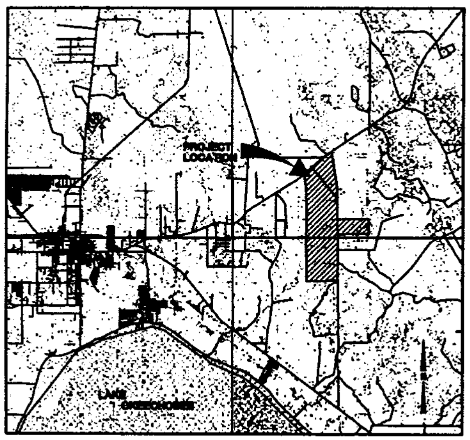
17. Davie Dairy BAT Project - Opinion of Probable Construction Cost

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT COST ($)	TOTAL COST ($)
1.	Clearing and Grubbing	LS	--	--	$ 10,000.00
2.	Earthwork	LS	--	--	135,000.00
3.	Entrance Road	LS	--	--	25,000.00
4.	Floating Turbidity Barrier	LF	50	5.00	250.00
5.	Staked Silt Fence	LF	2,500	1.50	3,750.00
6.	Sodding	SY	8,500	1.75	14,875.00
7.	Seed and Mulch	SY	25,000	0.75	18,750.00
8.	18-inch HDPE	LF	390	25	9,750.00
9.	36-inch HDPE	LF	1,900	28.00	53,200.00
10.	HDPE Manhole	EA	3	3,500.00	10,500.00
11.	18-inch HDPE MES	EA	3	500.00	1,500.00
12.	36-inch HDPE MES	EA	3	1,000.00	3,000.00
13.	Flow Control Gate	EA	3	1,500.00	4,500.00
14.	6-ft Diameter Riser	EA	3	1,000.00	3,000.00
15.	Alum Equipment Shed	LS	--	--	15,000.00
16.	Concrete Pad	SY	150	40.00	6,000.00
17.	6500-gallon HDPE Tank	EA	2	10,000.00	20,000.00
18.	Alum Pump, Buffer Pump, and Panel	LS	--	--	50,000.00
19.	Water Flow Meter	LS	--	--	12,500.00
20.	Alum Flow Meter	LS	--	--	7,500.00
21.	Building Piping	LS	--	--	5,000.00
22.	1-inch PVC Piping	LS	--	--	1,500.00
23.	Concrete Rubble Riprap	LS	--	--	5,000.00
24.	Fence	LF	3,000	2.00	6,000.00
25.	Electrical	LS	--	--	30,000.00
26.	Mobilization/Bonds/Insurance	LS	--	--	5,000.00
				TOTAL:	$ 456,575.00

CONSTRUCTION PLANS FOR

BEST AVAILABLE TECHNOLOGIES PROJECT
for
DAVIE DAIRY

AUGUST 2002



VICINITY MAP
NTS

PREPARED FOR:

SOIL AND WATER ENGINEERING TECHNOLOGY, INC.

CONSTRUCTION PLAN INDEX

PAGE No.	SHEET No.	DESCRIPTION
1	—	COVER SHEET
2	G-1	STANDARDS, ABBREVIATIONS AND GENERAL NOTES
3	C-1	OVERALL PLAN
4	C-2	SITE PLAN
5	M-1	PIPING PLAN
6	D-1	DETAILS

PREPARED BY:

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Environmental Research & Design, Inc.
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JEFFREY L. HERR, P.E., PROJECT MANAGER

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Bob Whitman, Project Manager

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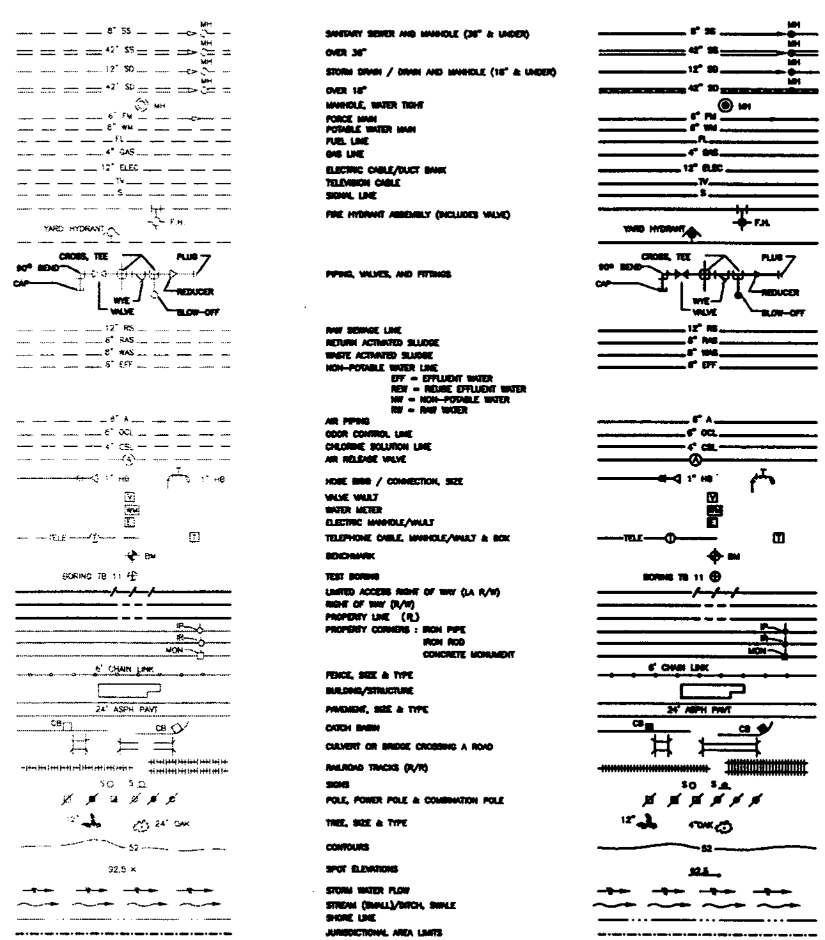
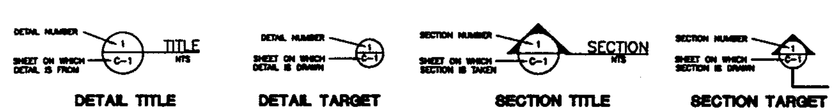
STANDARD SYMBOLS





ABBREVIATIONS

PIPE JOINTS — SYMBOLS

VALVES, FITTINGS, ETC

GENERAL — SYMBOLS

GENERAL — SYMBOLS

GENERAL CONSTRUCTION NOTES

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]

DESIGNED BY: J. L. HERR	REV.	DATE	DESCRIPTION	APP'D. BY
DRAWN BY: L. E. HEIGHT				
CHECKED BY: J. L. HERR				
APPROVED BY: H. H. HARPER				
DATE: AUG. 2002 SCALE: NONE				

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EB# 6244 Water Quality Engineering
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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

STANDARDS, ABBREVIATIONS AND GENERAL NOTES

JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36607
STATE OF FLORIDA

PROJECT No. 02-007

G-1

SHEET 2 OF 6

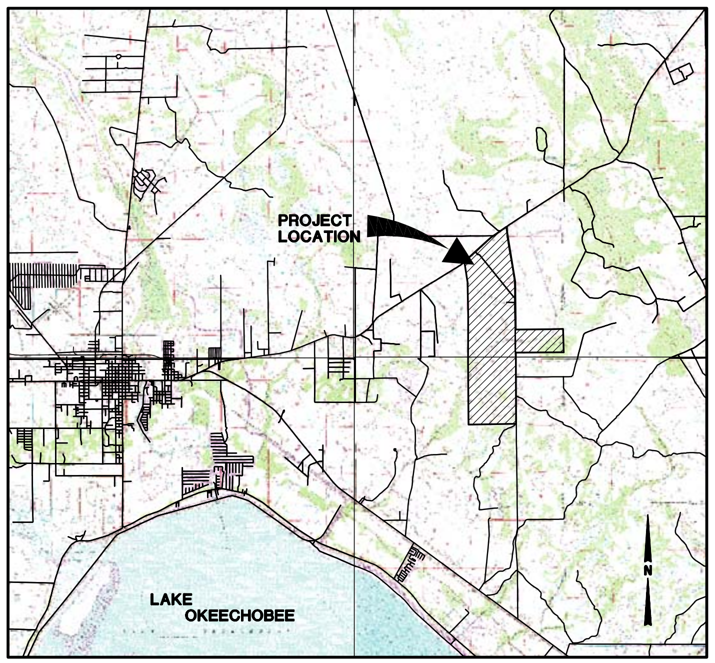
CONSTRUCTION PLANS FOR

BEST AVAILABLE TECHNOLOGIES PROJECT
for
DAVIE DAIRY

DECEMBER 2002

PREPARED FOR:

SOIL AND WATER ENGINEERING
TECHNOLOGY, INC.



VICINITY MAP
NTS

CONSTRUCTION PLAN INDEX

PAGE No.	SHEET No.	DESCRIPTION
1	–	COVER SHEET
2	G–1	STANDARDS, ABBREVIATIONS AND GENERAL NOTES
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4	C–2	DETENTION/CHEMICAL TREATMENT SYSTEM PLAN
5	CS–1	CROSS SECTIONS
6	M–1	BUILDING PIPING PLAN
7	D–1	MISCELLANEOUS DETAILS
8	S–1	FOUNDATION PLAN
9	E–1	ELECTRICAL PLAN
10	E–2	ELECTRICAL DETAILS

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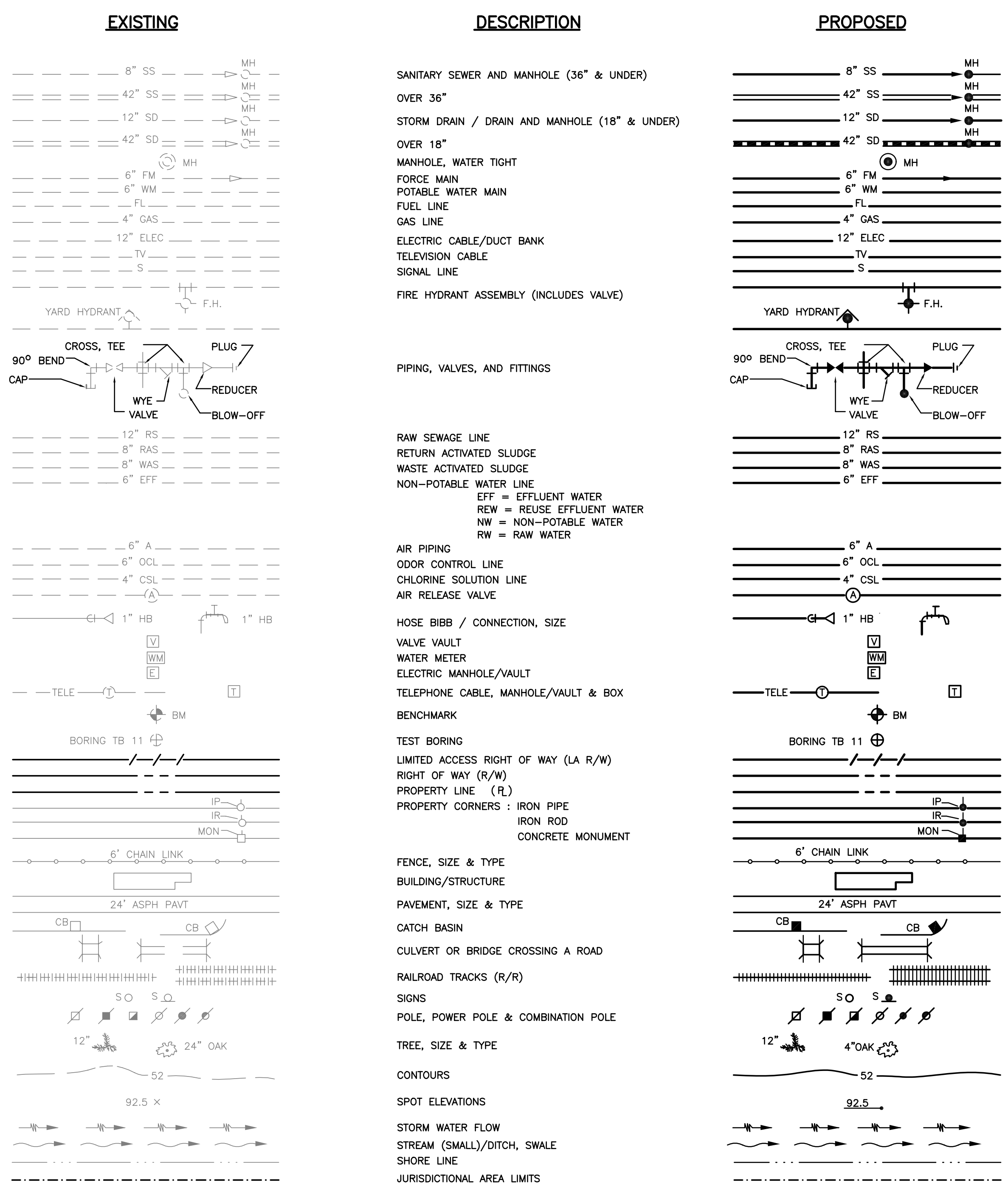
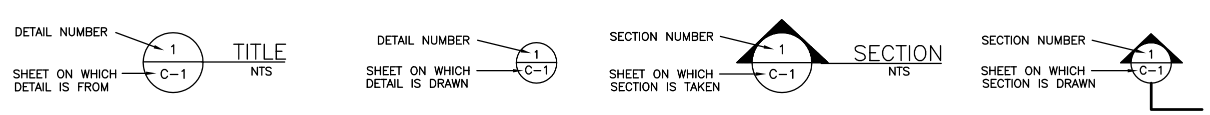
STANDARD SYMBOLS





DETAIL TITLE **DETAIL TARGET** **SECTION TITLE** **SECTION TARGET**

ABBREVIATIONS

PIPE, JOINTS	SYMBOLS
BLACK IRON PIPE	BIP
BLACK STEEL PIPE	BSP
CORRUGATED ALUMINUM PIPE	CAP
CAST IRON	CI
CAST IRON PIPE	CIP
CAST IRON SOIL PIPE	CISP
CONCRETE PRESSURE PIPE	CPP
COPPER PIPE	COP
CORRUGATED METAL PIPE	CMP
DUCTILE IRON PIPE	DIP
DUCTILE IRON	DI
EXPANSION	EXP
FLANGE	FLG
GALVANIZED STEEL PIPE	GSP
JOINT	JT
MECHANICAL JOINT	MJ
PVC COATED RIGID GALVANIZED STEEL	PRGS
POLYVINYLCHLORIDE	PVC
REINFORCED CONCRETE PIPE	RCP
PUSH-ON JOINT	PJ
STEEL PIPE	SP
TIED JOINT	TJ
VITRIFIED CLAY PIPE	VCP
METAL REINFORCED PLASTIC PIPE	MRPP
RESTRAINED JOINT	RJ
WALL SLEEVE	WS
WALL PIPE (WITH WATER STOP)	WP

VALVES, FITTINGS, ETC

AIR CUSHION CHECK VALVE	ACCV
AIR RELEASE VALVE	ARV
BALL CHECK VALVE	BACV
BALL VALVE	BAV
BLIND FLANGE	BF
BURIED GEAR OPERATOR	BGO
BUTTERFLY VALVE	BV
CHECK VALVE	CV
ELECTRIC VALVE ACTUATOR	EVA
ELEVATED GEAR OPERATOR	EGO
FIRE HYDRANT	FH
FITTING	FTG
FLANGED ADAPTOR	FA
FLEXIBLE COUPLING	FC
GATE VALVE	GV
HARNESSED FLANGED COUPLING ADAPTER	HFCA
HYDRAULIC VALVE ACTUATOR	HVA
KNIFE GATE VALVE	KGV
PLASTIC BALL VALVE	PBAV
PLUG VALVE	PV
REDUCER	RED
SILENT CHECK VALVE	SCV

GENERAL

ADJUSTABLE	ADJ.
ANGLE	∠
APPROXIMATE	APPROX.
BENCH MARK	BM
BETWEEN	BTWN.
BREAKER	BKR.
BUILDING	BLDG.
CAPACITY	CAP.
CENTER LINE	℄
CENTER TO CENTER	CC
CLEANOUT	CO
CONCRETE	CONC.
CONDITION	COND.
CONTINUATION	CONT.
CONNECTION	CONN.
CUBIC FOOT	CU. FT.
CUBIC INCH	CU. IN.
CUBIC YARD	CU. YD.
DEGREE	DEG.
DIAMETER	DIA.
DIAGONAL	DIAG.
DIMENSION	DIM.
DISCHARGE	DISC.
DRAWING	DWG.
EACH	EA.
EACH WAY	EW

GENERAL	SYMBOLS
EACH FACE	EF
ELECTRICAL	ELEC.
ELEVATION	EL., ELEV.
EQUIPMENT	EQUIP.
EXISTING	EXIST.
FIBERGLASS REINFORCED PLASTIC	FRP
FINISH	FIN.
FINISH FLOOR	F.F.
FLEXIBLE	FLEX.
FLOOR DRAIN	FD
GALLON	GAL.
GAUGE	GA.
HIGH POINT	HPT
HIGH WATER LEVEL	HWL
HORIZONTAL	HORIZ.
HORSEPOWER	HP
INFLUENT	INF.
INSIDE DIAMETER	ID
INVERT	INV.
LINEAR FOOT	LF
LONG	LG., L.
LOW WATER LEVEL	LWL
LOW POINT	LPT
MANHOLE	MH
MANUFACTURER	MFR.
MATERIAL	MTL.
MAXIMUM	MAX.
MECHANICAL	MECH.
MINIMUM	MIN.
MODIFIED	MOD.
NOMINAL	NOM.
NOT TO SCALE	NTS
NUMBER	NO., #
ON CENTERS	OC
OPERATOR	OPER.
OPTION	OPT.
OPPOSITE	OPP.
OPENING	OPNG.
OR EQUAL	O/E
OUTSIDE DIAMETER	OD
PAVEMENT	PAV'T.
POINT	PT.
POUND	LB.
PRESSURE	PRES.
PROPOSED	PROP.
RADIUS	RAD, R
REQUIRED	REQ'D.
RETURN ACTIVATED SLUDGE	RAS
RETURN EFFLUENT WATER	REW
RIGHT OF WAY	R/W, ROW
ROOM	RM.
REVOLUTIONS PER MINUTE	RPM
SANITARY	SAN.
SECTION	SEC.
SHEET	SH., SHT.
SIDEWALK	SDWK.
SIMILAR	SIM.
SPECIFICATIONS	SPECS.
SQUARE	SQ.
SQUARE FOOT	SQ. FT.
SQUARE INCH	SQ. IN.
SQUARE YARD	SQ. YD.
STAINLESS STEEL	S.S.
STANDARD	STD.
STANDARD DIMENSION RATIO	SDR
STATION	STA.
STORM SEWER	STS
SYMMETRICAL	SYMM.
TEMPORARY	TEMP.
THICK	THK.
THREADED	THD.
TOP OF CONCRETE	TOC
TOP OF SLAB	TOS
TYPICAL	TYP.
UNLESS NOTED OTHERWISE	UNO
VERTICAL	VERT.
VENT	VT.
VENT THROUGH ROOF	VTR
WASTE ACTIVATED SLUDGE	WAS
WATER LEVEL	WL
WEATHERPROOF	WPF.
WIDE	W.
WITH	W/

GENERAL CONSTRUCTION NOTES

1. ALL BENCHMARKS, MONUMENTS, TEMPORARY BENCHMARKS AND OTHER REFERENCE POINTS SHALL BE CAREFULLY MAINTAINED BY THE CONTRACTOR. THE CONTRACTOR SHALL VERIFY ALL PROJECT TEMPORARY BENCHMARKS PRIOR TO SITE CONSTRUCTION AND INFORM THE OWNER/ENGINEER IMMEDIATELY OF ANY DEVIATION.

2. THE CONTRACTOR SHALL COORDINATE THE SUBMISSION OF ALL SUBMITTALS TO THE ENGINEER FOR MATERIALS REVIEW AND APPROVAL.

3. THE CONTRACTOR SHALL FURNISH AND INSTALL ALL FACILITIES AS SHOWN ON THE DRAWINGS, OR AS REASONABLY IMPLIED TO PROVIDE A COMPLETE AND OPERATIONAL DETENTION AND TREATMENT SYSTEM.

4. THE CONTRACTOR SHALL GIVE THE ENGINEER A MINIMUM OF 48 HOURS NOTICE PRIOR TO CONDUCTING FIELD TESTS. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR MODIFYING AND ARRANGING FOR INSPECTIONS BY STATE AND LOCAL GOVERNMENTS AND UTILITY COMPANIES HAVING JURISDICTION.

5. THE CONTRACTOR SHALL MAINTAIN, AT THE JOB SITE, A RECORD COPY OF CONSTRUCTION DRAWINGS AND SPECIFICATIONS ON WHICH ALL FIELD CHANGES ARE TO BE NOTED. THESE "AS-BUILT" DOCUMENTS ARE TO BE MADE AVAILABLE TO ENGINEER DURING CONSTRUCTION.

6. EROSION/SEDIMENTATION CONTROL:
ALL CONTROLS SHALL BE ERECTED PRIOR TO ANY LAND ALTERATION, MAINTAINED DURING CONSTRUCTION AND REMOVED FOLLOWING SOIL STABILIZATION AND FINAL DRESSING. CONTRACTOR IS TO PROVIDE EROSION/SEDIMENTATION CONTROL TO PREVENT SILTATION OF ADJACENT PROPERTY, STREETS, STORM SEWERS AND WATER WAYS. IN ADDITION, CONTRACTOR SHALL PLACE STRAW, MULCH OR OTHER SUITABLE MATERIAL ON GROUND ON AREAS WHERE CONSTRUCTION-RELATED TRAFFIC IS TO ENTER AND EXIT SITE. IF, IN THE OPINION OF THE OWNER AND/OR LOCAL AUTHORITIES, EXCESSIVE QUANTITIES OF EARTH ARE TRANSPORTED OFF-SITE EITHER BY NATURAL DRAINAGE OR BY VEHICULAR TRAFFIC, THE CONTRACTOR IS TO REMOVE AND CLEAN SAID SURFACE TO THE SATISFACTION OF THE OWNER/AGENT AND/OR AUTHORITIES. SEE NOTE 4 SHEET C-1.

7. THE CONTRACTOR SHALL BRING ANY LAYOUT DISCREPANCIES TO THE IMMEDIATE ATTENTION OF THE ENGINEER PRIOR TO CONSTRUCTION.

8. PRIOR TO BEGINNING WORK, THE CONTRACTOR SHALL POST AT THE JOB SITE THE ACOE AND OTHER PERMITS. THE CONTRACTOR SHALL ADHERE TO ALL PERMIT CONDITIONS REGARDING THE INSTALLATION OF PERMITTED FACILITIES.

9. DEWATERING OPERATIONS:
THE CONTRACTOR SHALL BE RESPONSIBLE FOR DEVELOPING A DEWATERING PLAN TO MINIMIZE OFF-SITE DISCHARGE OF SURFACE AND GROUND WATER. THE DEWATERING PLAN SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
MAKING EXCAVATIONS.

10. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED OR SODDED UNLESS SHOWN OTHERWISE ON THE DRAWINGS. SODDING IS REQUIRED ON SLOPES GREATER THAN 5H:1V.

11. ALL SITE PREPARATION SHALL BE IN ACCORDANCE WITH PROJECT SPECIFICATIONS AND PROJECT GEOTECHNICAL CONSULTANT'S RECOMMENDATIONS.

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING STORMWATER CONVEYANCE DURING THE CONSTRUCTION PERIOD, INCLUDING BYPASS PUMPING, IF NECESSARY.

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		REV.	DATE	DESCRIPTION	APP'D. BY
DESIGNED BY:	J. L. HERR				
DRAWN BY:	L. E. HEIGHT				
CHECKED BY:	J. L. HERR				
APPROVED BY:	H. H. HARPER				
DATE: DEC. 2002	SCALE: NONE				

ERD Environmental Research & Design, Inc.
EB# 6244 Water Quality Engineering
3419 Trentwood Blvd • Suite 102 • Orlando, Florida 32812

BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

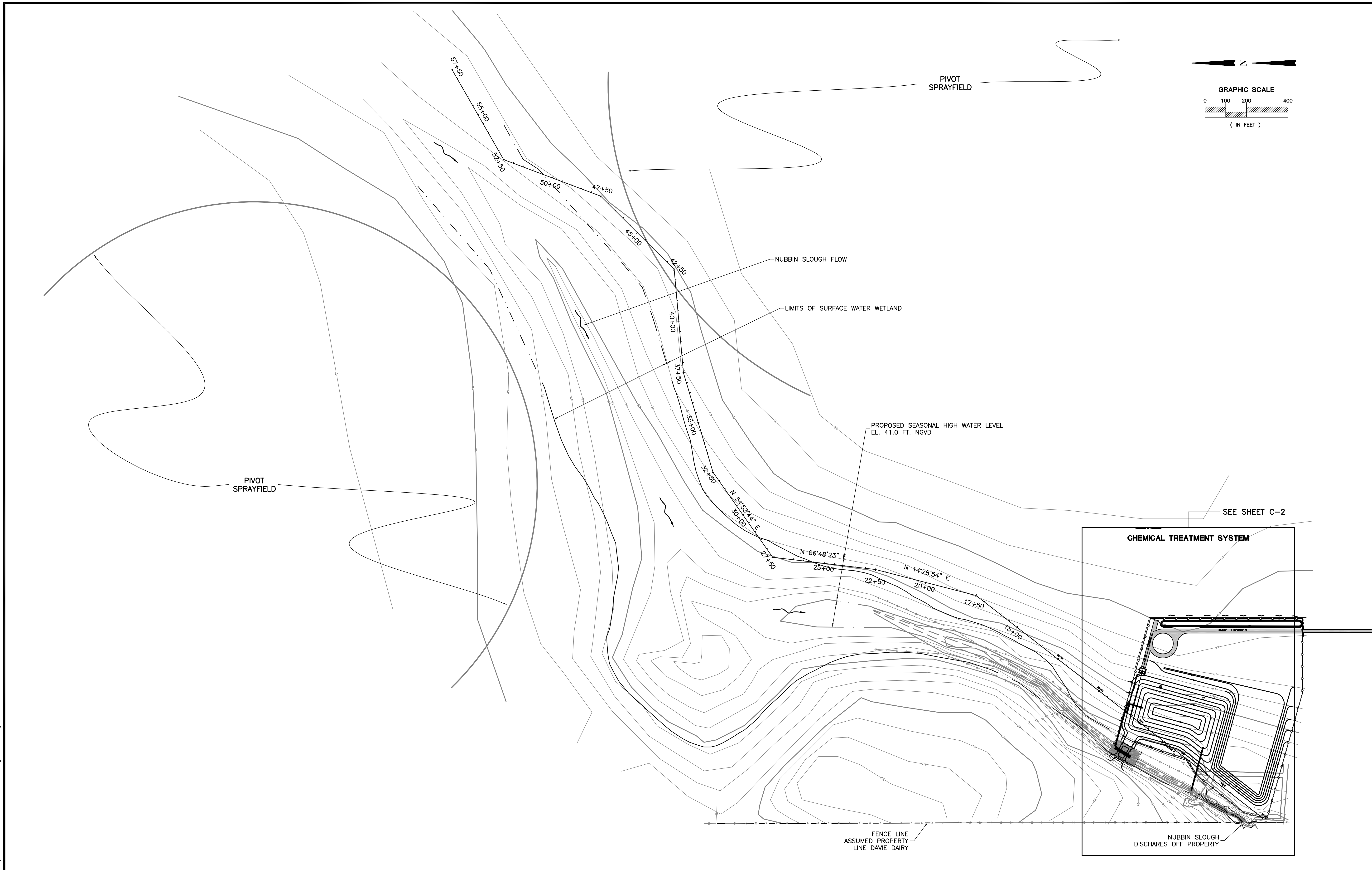
OKEECHOBEE COUNTY, FLORIDA

STANDARDS, ABBREVIATIONS AND GENERAL NOTES

JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36807
STATE OF FLORIDA

PROJECT No. 02-007

G-1



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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

OVERALL PLAN

JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36807
STATE OF FLORIDA

PROJECT No. 02-007

C-1

SHEET 3 OF 10

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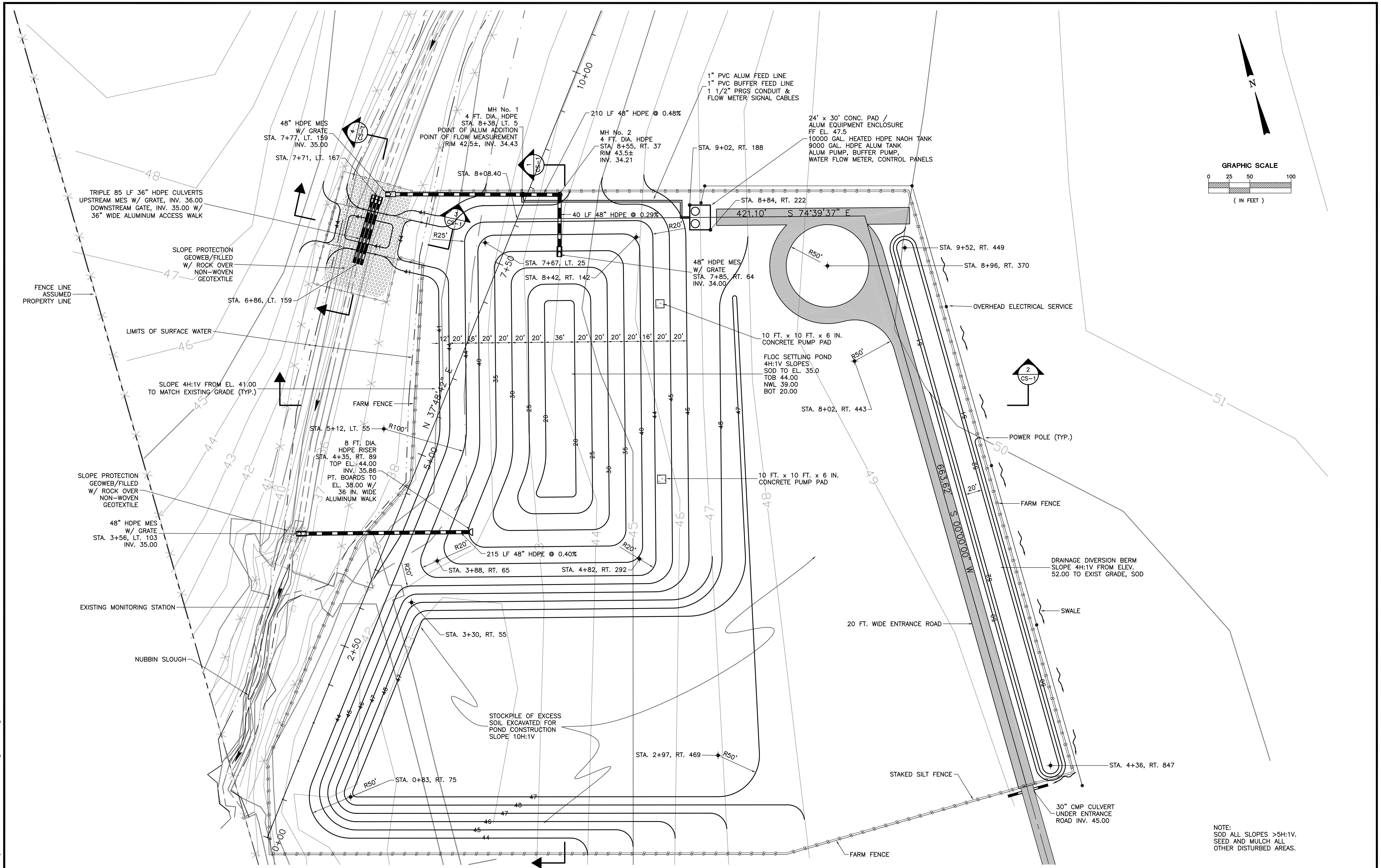

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DATE: DEC. 2002 SCALE: 1"=50'				

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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

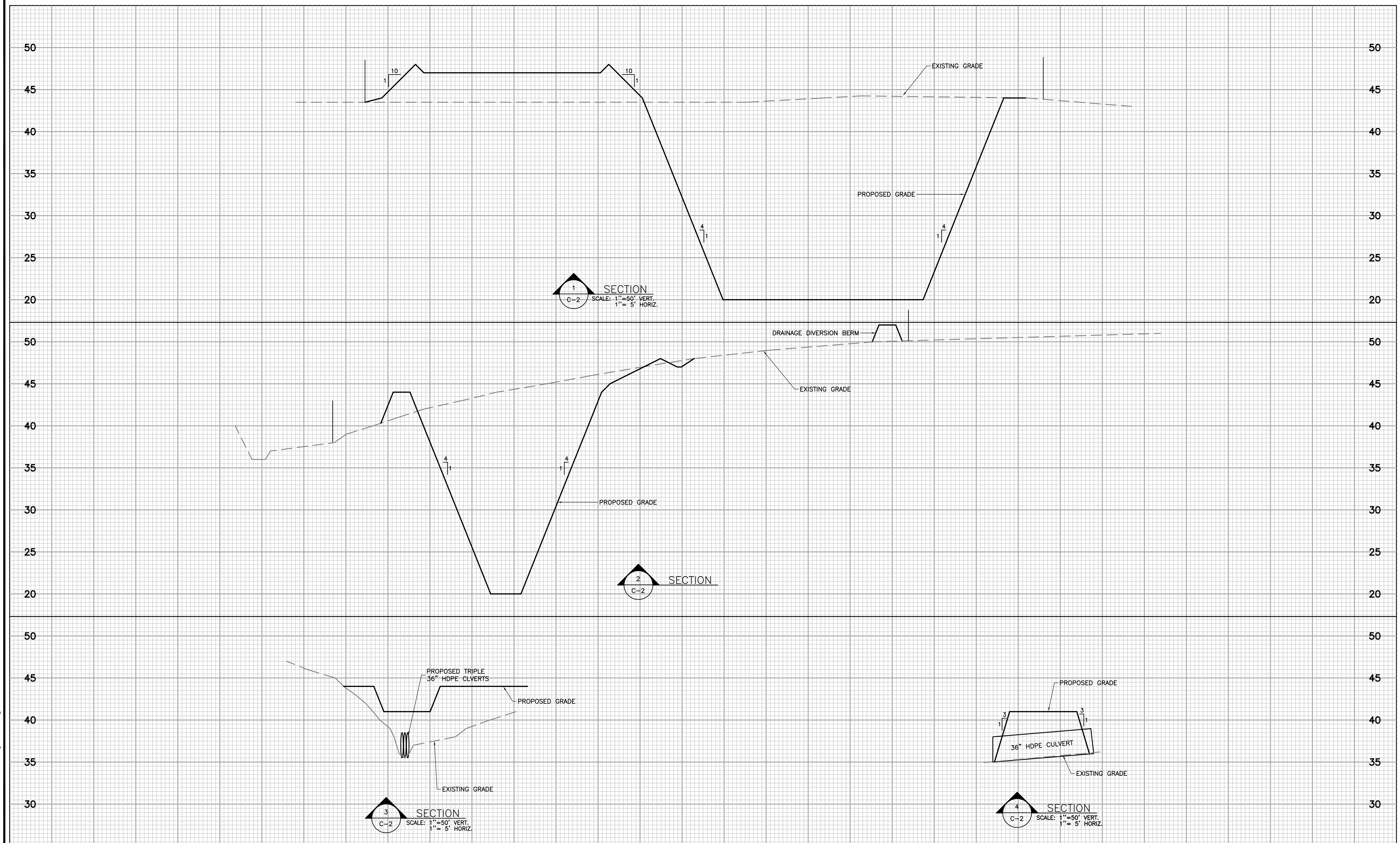
DETENTION/CHEMICAL TREATMENT SYSTEM PLAN

JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36807
STATE OF FLORIDA

PROJECT No. 02-007

C-2

SHEET 4 OF 10



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APPROVED BY: H. H. HARPER					
DATE: DEC. 2002	SCALE: AS SHOWN				

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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

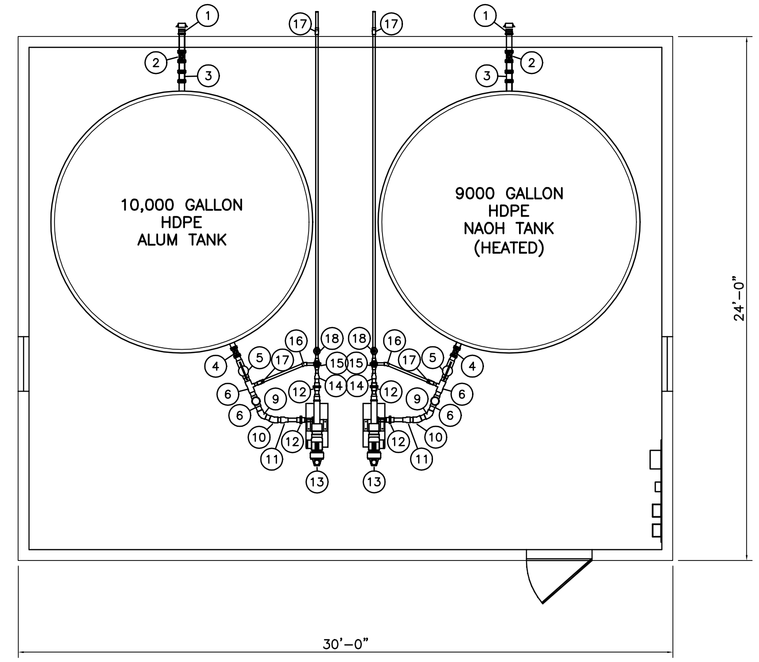
CROSS SECTIONS

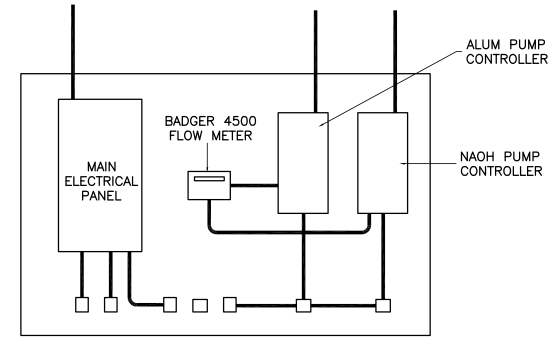
JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36807
STATE OF FLORIDA

PROJECT No. 02-007

CS-1

SHEET 5 OF 10

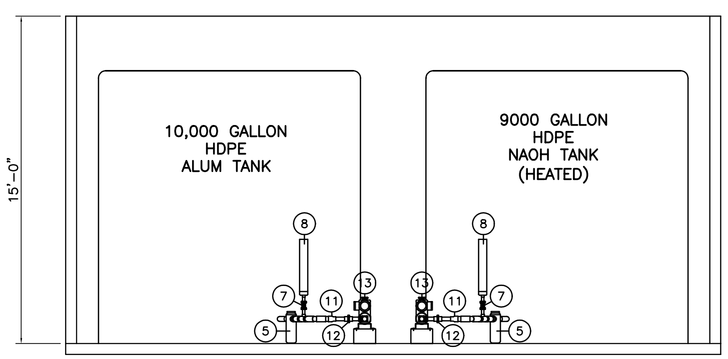


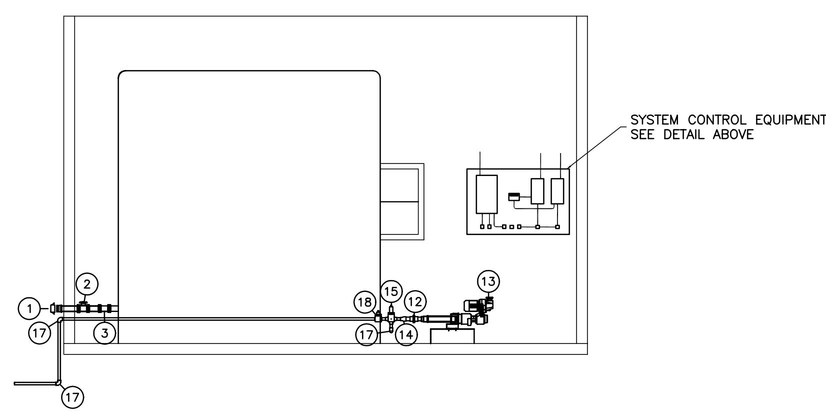


SYSTEM CONTROL EQUIPMENT

FITTING SCHEDULE

REF. NO.	DESCRIPTION	QUAN.
1	3" MALE 316 S.S. CAMLOCK CONNECTOR W/ CAP	2
2	3" 316 S.S. BALL VALVE	2
3	3" PVC CHECK VALVE	2
4	2" 316 S.S. BALL VALVE	2
5	2" PVC BASKET STRAINER	2
6	2" x 1" PVC TEE W/ S.S. FLOOR SUPPORT	4
7	1" PVC TRUE UNION BALL VALVE	4
8	4000cc CALIBRATION CHAMBER	2
9	2" PVC 45° BEND	2
10	2" PVC 22 1/2° BEND	2
11	2"x1-1/2" PVC REDUCER	2
12	1-1/2" PVC TRUE UNION	4
13	ALUM PUMP W/ S.S. SUPPORT	2
14	1-1/2" x1" PVC REDUCER	2
15	1" PVC PRESSURE RELIEF VALVE	2
16	1" PVC 22 1/2° BEND	2
17	1" PVC 90° BEND	10
18	1" PVC BACK PRESSURE VALVE	2





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DATE: DEC. 2002 SCALE: 1/4"=1'

REV.	DATE	DESCRIPTION	APP'D. BY

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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

BUILDING PIPING PLAN

JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36807
STATE OF FLORIDA

PROJECT No. 02-007

M-1

SHEET 6 OF 10

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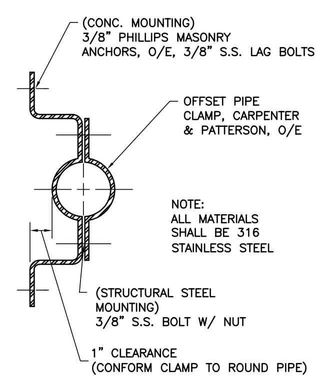
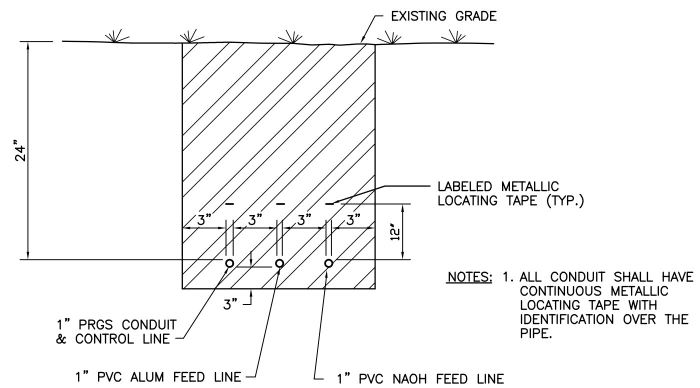


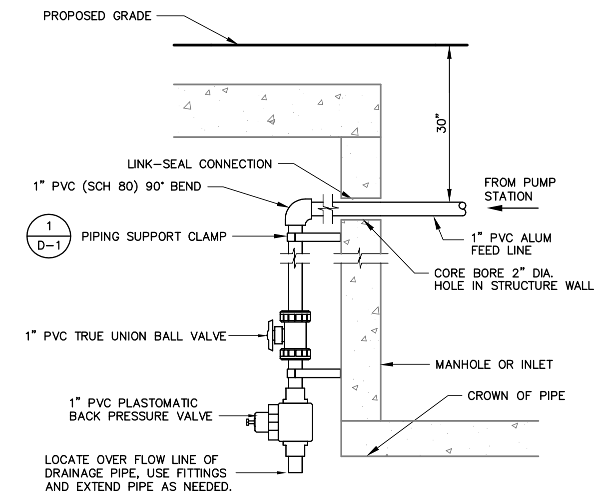
1 / M-1 DETAIL NTS

PIPING SUPPORT CLAMP



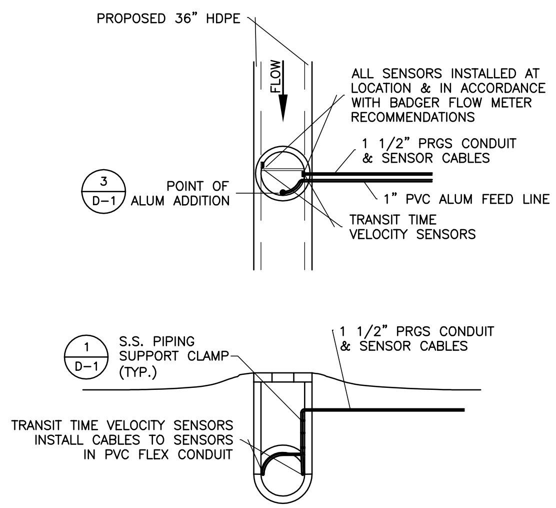
2 / C-2 DETAIL NTS

TRENCHING DETAIL



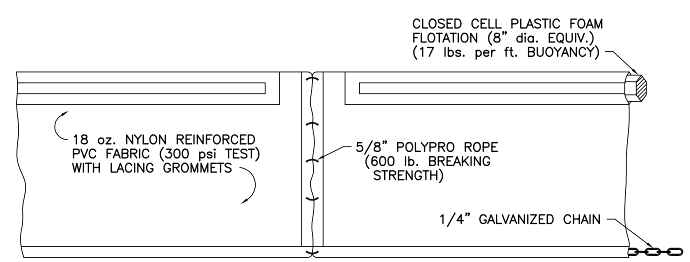
3 / C-2 DETAIL NTS

ALUM ADDITION DETAIL



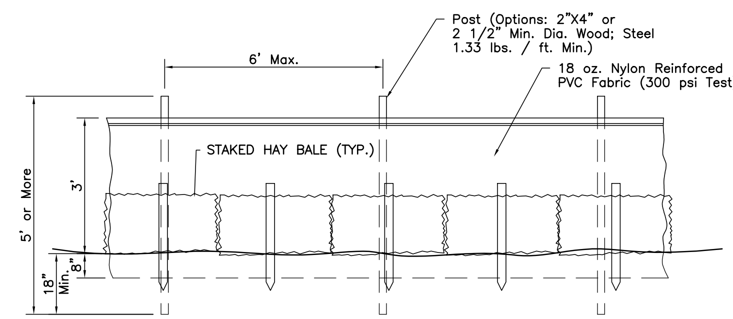
4 / C-3 DETAIL NTS

POINT OF FLOW MEASUREMENT



5 / C-2 DETAIL NTS

FLOATING TURBIDITY BARRIER



6 / C-2 DETAIL NTS

STAKED SILT FENCE

DESIGNED BY: J. L. HERR	REV.	DATE	DESCRIPTION	APP'D. BY
DRAWN BY: L. E. HEIGHT				
CHECKED BY: J. L. HERR				
APPROVED BY: H. H. HARPER				
DATE: DEC. 2002 SCALE: AS SHOWN				

ERD Environmental Research & Design, Inc.
EB# 6244 Water Quality Engineering
3419 Trentwood Blvd • Suite 102 • Orlando, Florida 32812

BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

MISCELLANEOUS DETAILS

JEFFREY L. HERR, P.E.
PROFESSIONAL ENGINEER NO. 36807
STATE OF FLORIDA

PROJECT No. 02-007

D-1

SHEET 7 OF 10

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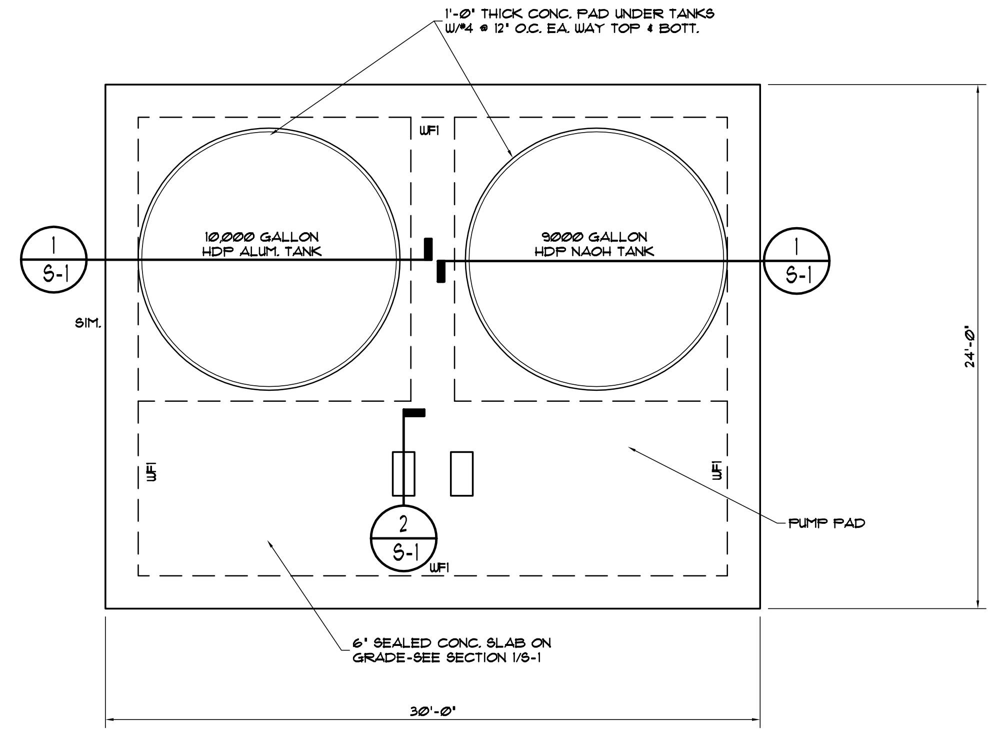
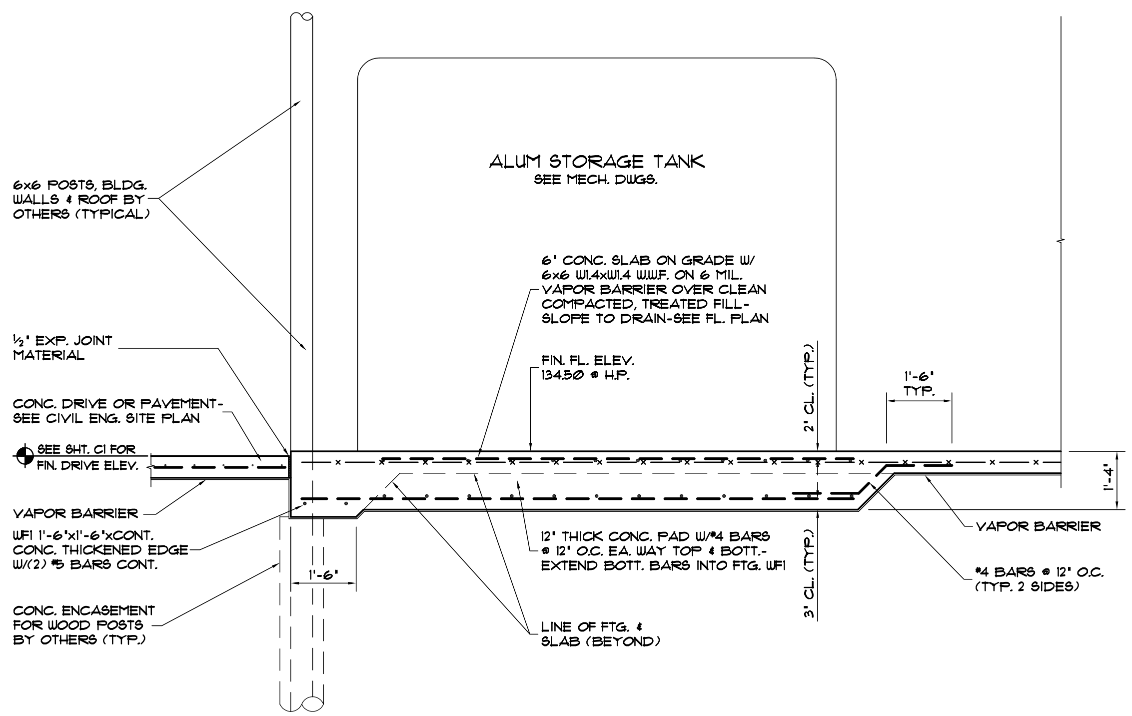


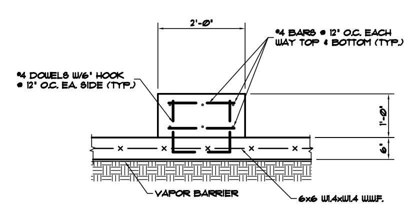
FOUNDATION PLAN

SCALE : ½" = 1'-0"



SECTION 1/S-1

SCALE : ½" = 1'-0"



SECTION 2/S-1

SCALE : ½" = 1'-0"

GENERAL NOTES

ALL DETAILS AND SECTIONS SHOWN ON THE DRAWINGS ARE INTENDED TO BE TYPICAL AND SHALL BE CONSTRUED TO APPLY TO ANY SIMILAR SITUATION ELSEWHERE ON THE PROJECT, EXCEPT WHERE A DIFFERENT DETAIL IS SHOWN.

SHOP DRAWINGS IN THE FORM OF REPRODUCIBLE SEPIAS OF ARCHITECTURAL OR STRUCTURAL DRAWINGS (CONTRACT DOCUMENTS) ARE PROHIBITED WITHOUT EXPRESS WRITTEN PERMISSION FROM ENGINEER.

MANUFACTURERS OF ANY PRE-ENGINEERED, PRE-FABRICATED SYSTEM OR COMPONENT SHALL SUBMIT SHOP DRAWINGS FOR THE ENGINEER/ARCHITECT'S APPROVAL PRIOR TO FABRICATION OR ERECTION OF SYSTEM/COMPONENT. THESE SHOP DRAWINGS SHALL BE SIGNED AND SEALED BY A FLORIDA REGISTERED ENGINEER.

THE BUILDING AND STRUCTURE IS DESIGNED IN ACCORDANCE WITH THE 2001 EDITION OF THE FLORIDA BUILDING CODE. FOLLOW ALL APPLICABLE PROVISIONS FOR ALL PHASES OF CONSTRUCTION.

THE STRUCTURAL INTEGRITY OF THE COMPLETED STRUCTURE DEPENDS UPON THE INTERACTION OF VARIOUS CONNECTED COMPONENTS. PROVIDE ADEQUATE BRACING, SHORING, AND OTHER TEMPORARY SUPPORTS AS REQUIRED TO SAFELY COMPLETE THE WORK.

FOUNDATIONS:

SPREAD FOOTINGS SHALL BEAR ON SOIL COMPACTED TO A DENSITY OF AT LEAST 95% OF MODIFIED PROCTOR MAXIMUM DENSITY (A.S.T.M. D1557). THE SOIL SHALL BE COMPACTED TO THIS DENSITY TO A DEPTH OF AT LEAST TWO FEET BELOW THE BOTTOM OF THE FOOTINGS.

FILL UNDER FLOOR SLABS SHALL BE COMPACTED TO A DENSITY OF AT LEAST 95% OF MODIFIED PROCTOR MAXIMUM DENSITY (A.S.T.M. D1557).

MAXIMUM ALLOWABLE SOIL PRESSURE IS ASSUMED TO BE 2000 POUNDS PER SQUARE FOOT.

IT SHALL BE OWNER'S RESPONSIBILITY TO VERIFY ALLOWABLE SOIL PRESSURE THROUGH THEIR GEOTECHNICAL CONSULTANT.

CONCRETE:

DESIGN OF REINFORCED CONCRETE CONFORMS WITH BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE - ACI 318, LATEST EDITION.

CONCRETE SHALL HAVE AN UNCONFINED COMPRESSIVE STRENGTH OF 3,000 PSI AT 28 DAYS.

GENERAL CONTRACTOR SHALL CHECK ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS FOR OPENINGS, SLEEVES, ANCHORS, HANGERS, SLAB DEPRESSIONS AND ANY OTHER ITEMS RELATED TO CONCRETE WORK, AND SHALL ASSUME FULL RESPONSIBILITY FOR THEIR PROPER LOCATION, BEFORE POURING CONCRETE.

AT OPENINGS IN SLABS OR WALLS, PROVIDE 2 - #6 BARS EACH 6'-0" LONGER THAN WIDTH OF OPENING ON EACH OF 4 SIDES OF OPENINGS, UNLESS SHOWN OTHERWISE.

CONCRETE PROTECTION FOR REINFORCING BARS SHALL BE AS FOLLOWS:

FOOTINGS	3" CLEAR, BOTTOM AND SIDES, 2" CLEAR, TOP
WALLS	2" CLEAR U.N.O., OUTSIDE FACE, 1-1/2" CLEAR, INSIDE FACE
SLABS	3/4" CLEAR

DESIGN MIXES:

PROVIDE NORMAL WEIGHT CONCRETE WITH THE FOLLOWING PROPERTIES:

3000 PSI 28-DAY COMPRESSIVE STRENGTH, 480 LBS. TYPE I PORTLAND CEMENT PER CU.YD. MINIMUM, W/C RATIO, 0.58 MAXIMUM (NON-AIR ENTRAINED), 0.46 MAXIMUM AIR ENTRAINED. NO FLY ASH OR OTHER POZZOLAN IS PERMITTED. SLUMP LIMIT 3" TO 5".

REINFORCING STEEL:

ALL REINFORCING STEEL SHALL BE NEW BILLET STEEL CONFORMING TO A.S.T.M. A615-GRADE 60. ALL DETAILING AND ACCESSORIES SHALL CONFORM TO TYPICAL DETAILS SHOWN IN THE "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES ACI 315, LATEST EDITION".

ALL CONTINUOUS VERTICAL OR HORIZONTAL BARS IN FOOTINGS, FOUNDATIONS WALLS, SLABS AND OTHER CONCRETE SHALL BE LAP-SPLICED, WHERE NECESSARY OR DESIRABLE, BY WIRING TOGETHER IN CONTACT. LENGTH OF ALL LAPS SHALL BE 48-BAR DIAMETERS OR 2'-0" MINIMUM, WHICHEVER IS GREATER (EXCEPT AS NOTED BY DRAWINGS). ALL BARS AT END OF CONT. FTGS OR BEAMS SHALL BE CONT. TO FAR SIDES OF INTERSECTING ELEMENTS.

DESIGN LOADS:

LIVE LOADS: ROOF: 20 PSF

WIND LOADS: VELOCITY 130 MPH (3 SECOND GUST)

PARTIALLY ENCLOSED BUILDING

IMPORTANCE FACTOR: 1.0

EXPOSURE: B

MKT ENGINEERS
STRUCTURAL ENGINEERS
2265 LEE ROAD. SUITE 123
WINTER PARK, FL. 32789
TEL. (407) 628-8555
FAX (407) 644-6516
MKT PROJ. No. 02961

DESIGNED BY: K TOLIA	REV.	DATE	DESCRIPTION	APP'D. BY
DRAWN BY: J MIX/R BRYANT				
CHECKED BY: K TOLIA				
APPROVED BY: K TOLIA				
DATE: DEC. 2002 SCALE: AS SHOWN				

ERD Environmental Research & Design, Inc.
EB# 6244 Water Quality Engineering
3419 Trentwood Blvd • Suite 102 • Orlando, Florida 32812

BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

FOUNDATION PLAN

KISHORE D. TOLIA, P.E.
PROFESSIONAL ENGINEER NO. 18092 STATE OF FLORIDA

PROJECT No. 02-007

S-1

SHEET 8 OF 10

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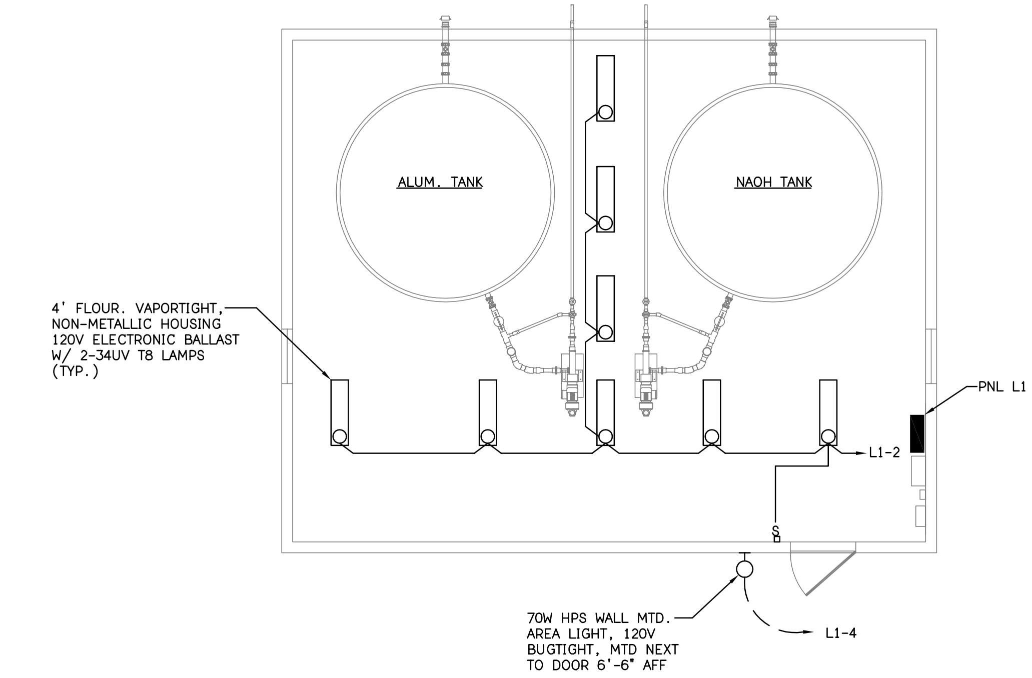
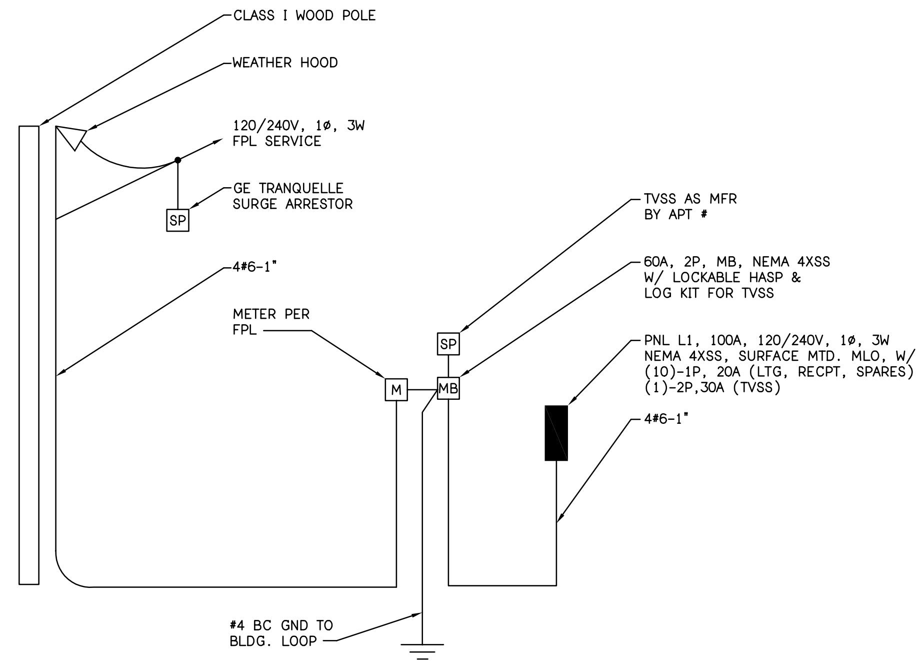
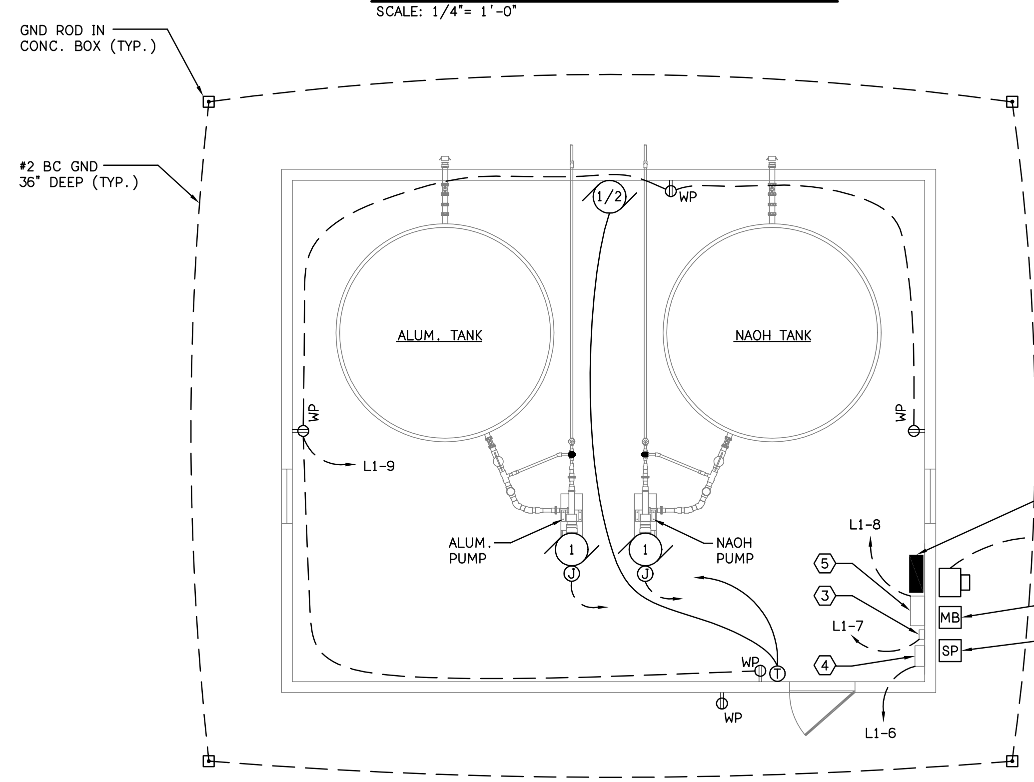


CHEMICAL BLDG.-LIGHTING PLAN

SCALE: 1/4"= 1'-0"



POWER RISER

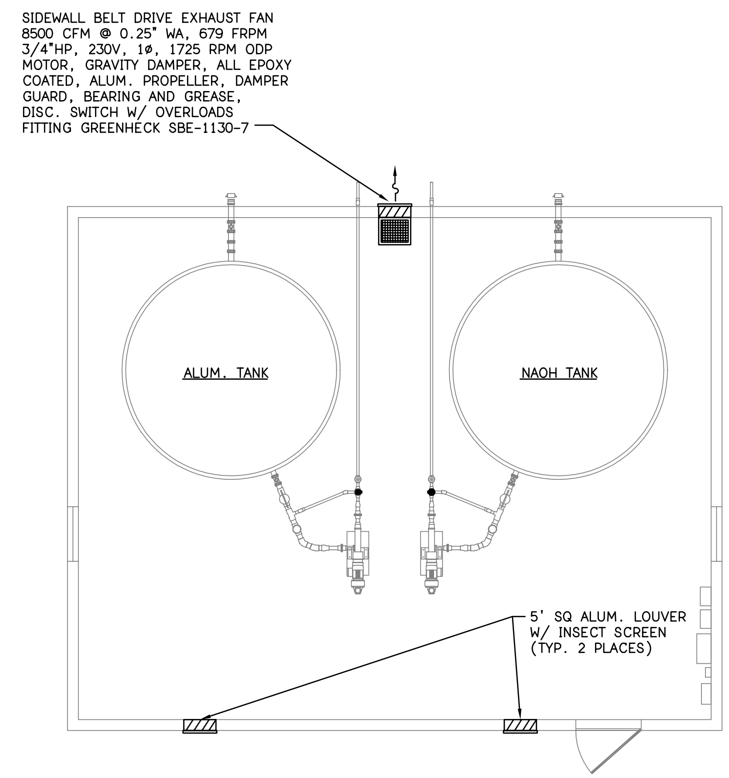


SHEET NOTES

1. 3#10, 7#14-3/4" TO ALUM. CONTROLLER
2. 3#10, 7#14-3/4" TO NAOH CONTROLLER
3. ALUM CONTROLLER
4. NAOH CONTROLLER
5. FLOW INTEGRATOR

CHEMICAL BLDG. POWER PLAN

SCALE: 1/4"= 1'-0"



CHEMICAL BLDG.-VENTILATION

SCALE: 1/4"= 1'-0"

SYMBOLS

- HOME RUN TO PANELBOARD. NO. OF ARROWS INDICATE NO. OF CIRCUITS, HASH MARKS INDICATE NO. OF #12 AWG. CONDUCTORS. NO HASH MARKS INDICATE 2 #12 CONDUCTORS.
- CONDUIT CONCEALED IN WALL OR ABOVE CEILING.
- CONDUIT CONCEALED IN OR BELOW FLOOR OR UNDERGROUND.
- CONDUIT RUN EXPOSED. RUN PARALLEL OR PERPENDICULAR TO STRUCTURE OR WALL.
- FLEXIBLE CONDUIT WITH EQUIPMENT CONNECTION.
- DS DIAPHRAGM SEAL

ABBREVIATIONS

A	AMPERES
ACP	ALUM CONTROL PANEL
AFF	ABOVE FINISH FLOOR
AIC	ASYMMETRICAL INTERRUPTING CURRENT
BC	BARE COPPER
BKR	BREAKER
BLDG	BUILDING
CAB	CABINET
CIR	CIRCUIT
CONT	CONTROL
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
DS	DISCONNECT SWITCH
EC	EMPTY CONDUIT
ELEC	ELECTRICAL
EM	EMERGENCY
ENCL	ENCLOSURE
ETM	ELAPSE TIME METER
EXIST	EXISTING
FRP	FIBERGLASS
GEN	GENERATOR
GND	GROUND
HOA	HAND-OFF-AUTOMATIC
HP	HORSEPOWER
HPS	HIGH PRESSURE SODIUM
J	J-BOX
KCMIL	THOUSAND CIRCULAR MILS
KVA	KILOVOLT-AMPERES
LS	LIMIT SWITCH
LSCP	LIFT STATION CONTROL PANEL
LTG	LIGHTING
MAX	MAXIMUM
MTG	MOUNTING
MB	MAIN BREAKER
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MIN	MINIMUM
MTD	MOUNTED
NEC	NATIONAL ELECTRIC CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURES ASSOCIATION
PC	PHOTO-CONTROL
PNL	PANEL
PRGS	PVC COATED RIGID STEEL CONDUIT
PS	PRESSURE SWITCH
RGS	RIGID GALVANIZED STEEL
RS	RAPID START
RECPT	RECEPTACLE
SV	SOLENOID VALVE
SP	SURGE PROTECTOR
TYP	TYPICAL
UG	UNDERGROUND
UL	UNDERWRITERS LABORATORIES
V	VOLT
VAC	VOLTS ALTERNATING CURRENT
W	WIRE
WP	WEATHER PROOF
XMFR	TRANSFORMER

GENERAL NOTES

1. ALL WORK SHALL COMPLY WITH N.E.C. AND LOCAL CODES.
2. INSTALL BOND WIRE IN ALL RACEWAYS PER N.E.C.
3. DO NOT SCALE THE ELECTRICAL DRAWINGS. REFER TO THE CIVIL MECHANICAL AND STRUCTURAL DRAWINGS FOR DETAILED LOCATION OF ALL PIPING AND EQUIPMENT.
4. THE CONTRACTOR SHALL VERIFY EXACT LOCATION OF TERMINAL BOXES, PANELBOARDS, CONDUITS, CONTROL PANELS ETC., AGAINST SHOP DRAWINGS BEFORE STUBBING UP CONDUITS.
5. EXPOSED FLEXIBLE CONDUIT SHALL NOT BE ALLOWED UNLESS FOR CONDUIT BETWEEN MOTOR AND J-BOX.
6. CONTRACTOR SHALL PROVIDE ADDITIONAL PULLBOXES WHERE REQUIRED BY THE NEC AND/OR TO MAKE A WORKABLE INSTALLATION.
7. CONDUIT ENTRY INTO ELECTRICAL EQUIPMENT SHALL BE DIRECTLY BELOW OR ABOVE AND BE LOCATED EQUALLY SPACED FROM EQUIPMENT CENTERLINE.
8. ALL CONDUITS AND BOXES SHOWN CONCEALED SHALL BE CONCEALED. NO EXCEPTIONS. CONDUITS AND BOXES EXPOSED WILL BE REMOVED AT NO ADDITIONAL COST.
9. ALL DEVICE PLATES AND COVERS SHALL MATCH.
10. ALL BOXES, ENCLOSURES, RACEWAYS AND STRAPS SHALL BE PLASTIC OR FRP. ALL FASTENERS SHALL BE EITHER FRP OR STAINLESS STEEL.
11. ALL CONDUIT EXPOSED BELOW THE CONTROL PANELS IN THE ALUM BUILDING SHALL BE PAINTED TO MATCH THE WALLS.
12. ALL BOXES, ENCLOSURES, RACEWAYS AND STRAPS SHALL BE PAINTED TO MATCH THE WALL COLOR.
13. COORDINATE THE LOCATION OF SERVICE POLE AND DETAILS WITH TAMPA ELECTRIC COMPANY DURING BIDDING.

EMI consulting specialties, inc.
ELECTRICAL-MECHANICAL-INSTRUMENTATION
(407) 359-0747

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DESIGNED BY: WCH					
DRAWN BY: JMK					
CHECKED BY: WCH					
APPROVED BY: WCH					
DATE: DEC. 2002	SCALE: 1/4"=1'				

ERD Environmental Research & Design, Inc.
EB# 6244 Water Quality Engineering
3419 Trentwood Blvd ∘ Suite 102 ∘ Orlando, Florida 32812

BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

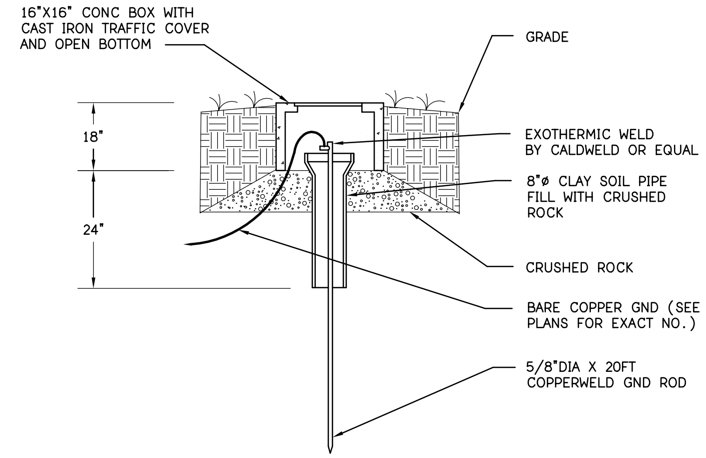
ELECTRICAL PLAN

WILLARD C. HOANSHLT, P.E.
PROFESSIONAL ENGINEER NO. 42593
STATE OF FLORIDA

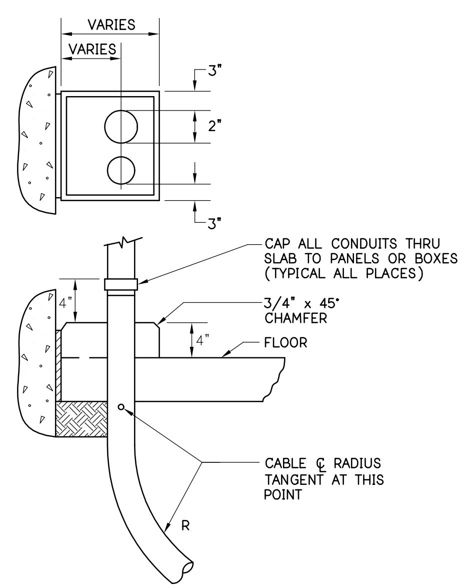
PROJECT No. 02-007

E-1

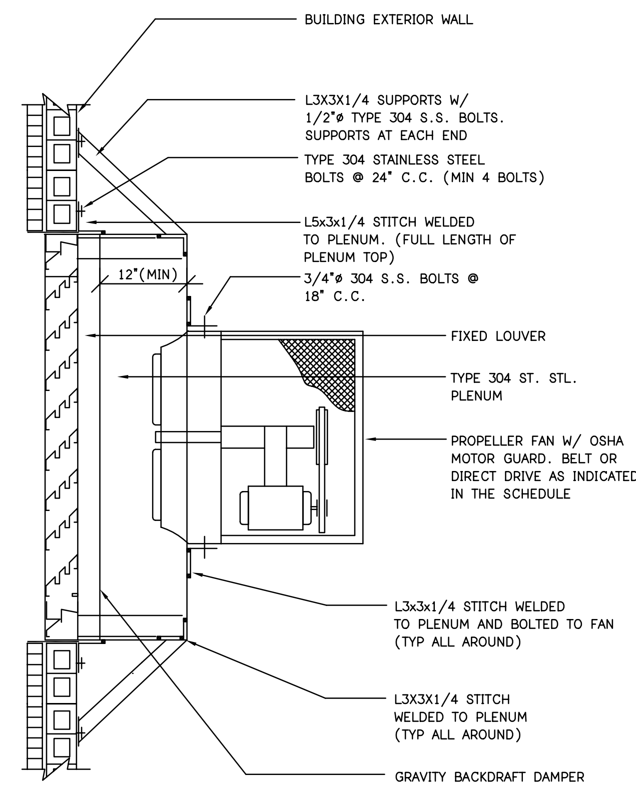
SHEET 9 OF 10



SERVICE GROUND ROD AND WELL



TYPICAL CONDUIT THRU SLAB



WALL MOUNTED EXHAUST FAN

EMI consulting specialties, inc.
ELECTRICAL–MECHANICAL–INSTRUMENTATION
(407) 359–0747

DESIGNED BY: WCH	REV.	DATE	DESCRIPTION	APP'D. BY
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APPROVED BY: WCH				
DATE: DEC. 2002 SCALE: NONE				

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EB# 6244 Water Quality Engineering
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BEST AVAILABLE TECHNOLOGIES PROJECT for DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

ELECTRICAL DETAILS

WILLARD C. HOANSHLT, P.E.
PROFESSIONAL ENGINEER NO. 42593
STATE OF FLORIDA

PROJECT No. 02–007

E-2

SHEET 10 OF 10

Training/Education
Environmental Permitting
Wetland Studies
Plant Population Studies
Expert Witness Testimony
Plant Identification

DAVID W. HALL, PH.D.
Environmental Consultant
Forensic Botanist

Quality Assurance
Forensic Botany
Environmental Siting
Land Management
Environmental Inventories

SOIL & WATER ENGINEERING TECHNOLOGY, INC.

DAVIE DAIRY

OKEECHOBEE COUNTY, FLORIDA

30 April 2002

On 9 April 2002, Dr. David W. Hall conducted an environmental survey for Soil and Water Engineering Technology, Inc. at the Davie Dairy in Okeechobee County, Florida, located on the west side of Berman Road, approximately 7 miles east of Okeechobee, 3 miles south of Highway 70, in Section 14, Township 37 South, Range 36 East. The property consists of approximately 3,410 acres. This survey included surveying certain wetlands along Nubbin Slough to determine how the plants in the wetlands would react to various levels and periods of flooding.

OVERVIEW

The upland areas on the property have been cleared, converted into pastures and are being utilized for grazing dairy cows and related activities. The wetlands in this section of the property contain a creek, a floodplain swamp and a fringe of marsh.

WETLAND VEGETATION

Nubbin Slough in this section has three sources: the northernmost branch receives water from section 11, the west branch from a neighboring farm in section 15, the east branch from Jones Hammock in section 13. On Davie Dairy the northern portion of the Slough flows through a floodplain swamp with a narrow fringe of marsh along the outer margins. The southern end of the Slough is deeply incised with little or no fringing marsh. The Slough flows off the Dairy into section 22. The fence at the west property line where the Slough crossed it was utilized as the project end.

Floodplain Swamp - The floodplain swamp is in the center of the Slough through which the stream flows from the north and west branches.

North branch - The overwhelmingly dominant species in this habitat is Sweetbay with an understory of Blackgum, Red Maple, Swampbay, Dahoon Holly, Lizard's-tail, Virginia Chain Fern, Spreading Tri-vein Fern, and Poison-ivy.

3666 N.W. 13th Place Gainesville, Florida 32605 Telephone (352) 375-1370 Fax (352) 377-2729

East branch - The east branch is dominated by Loblolly-bay with some Cabbage Palm. Herbaceous species are: Cinnamon Fern, Dimorphic Chain Fern, Swamp Fern, and Maidencane. Primrose-willow an exotic shrub species is scattered.

Marsh - The marsh extends as a variable width marginal fringe around the swamp. Dominant species are: Long's Sedge, Tropical Soda Apple, Surinam Sedge, Bog Hemp, Water Penny-wort, Dwarf St. John's-wort, Fire Weed, Arrow-leaf Sida, Sand Blackberry, Dog Fennel, Sawgrass, Virginia Chain Fern, Bermuda Grass, Small-leaf Climbing Fern, Wild Grape, Water Hemlock, Limpo Grass and Balsam-apple. The upper edge of the marsh is defined by a very few Live Oak trees and primarily by a slight scarp.

Gully - The incised gully at the south end has rather steep sides and is about six feet deep. Most of the bank is covered with herbaceous plants: Bahia Grass, Soft Rush, Coinwort, Spreading Day-flower, Bushy Broom Grass, Dotted Smartweed, Pokeweed, White Head Broom, Para Grass and Caesar Weed. A narrow floodplain at the upper edge of the bank in some places has a few woody Elderberry, Cabbage Palm, Blackgum, Primrose-willow, Slash Pine, Wax-myrtle and Brazilian Pepper Tree.

ANALYSIS

Sweetbay Swamp

The trees (Sweetbay with an understory of Blackgum, Red Maple, Swampbay, Dahoon Holly) in the swamp could withstand elevated water levels of three to four feet for at least several weeks. Water marks on trees in the swamp indicate that the water reaches approximately three feet higher than present on a regular basis. During periods of heavy rain water easily reaches four to five feet above the present level for periods of several weeks. The common herbaceous species (Lizard's-tail, Virginia Chain Fern, Spreading Tri-vein Fern, and Poison-ivy) easily survive long periods of submergence with underground runners or by reestablishing after the water returns to normal levels. Seeds and spores of the herbaceous plants float and ultimately find dry spots to germinate on hummocks in swamps and along marsh margins. The surviving plants provide an ample seed source for reestablishment.

Loblolly-bay Swamp

Loblolly-bay would be adversely affected by long periods of standing water. This species likes seepage and having soils periodically wet at the surface. Standing water for any extended period could be expected to cause death to the trees or would leave them in declining health. The herbaceous species would move outwards and upwards by spores and seeds and reestablish upon return to normal conditions. Those species with rhizomes could endure longer flooding.

Marsh

No species in the fringing marsh would be adversely affected in the long term by extended periods of standing water. The seeds and propagules will move to the shallow margin and reestablish. Herbaceous species constantly move up and down the margins to accommodate variations in water levels. Some species with rhizomes would survive in place.

SUMMARY

The wetlands along Nubbin Slough within section 14 on Davie Dairy proposed for water retention appear to be able to sustain higher water levels for longer periods of time with little or no damage to the ecosystem with the exception of that portion of the east branch just west of Berman Road. Prolonged flooding of the vegetation of the eastern two-thirds of the east branch could eventually change the dominant species from Loblolly-bay to Sweetbay which is able to withstand longer and deeper flooding.

Sincerely,

David Hall

David W. Hall

cc: File

APPENDIX C – Dry Lake Dairy EOF Design Documents

Part 1. August, 2002 Draft Implementation Plan
Part 2. September Supplement to Implementation – Description of Operation and Costs
Part 3. Updated Construction drawings
Part 4. Construction Specifications

ENGINEERING & WATER RESOURCES, INC.

851 Johnson Avenue, Suite 214, Stuart, Florida 34994
Phone: (772) 781-6408 Fax: (772) 781-6409 Web: ewr1.com

Dry Lake Dairy Edge of Farm Treatment System Design

Introduction

The Dry Lake Dairy is situated on 1241 acres on the North side of SR98 about 5 miles northwest of Okeechobee, Florida. The High Intensity Area (HIA) comprises about 30 acres on the south end of the property and includes the feed barns, milking parlor and waste storage ponds (WSPs) for primary water quality treatment. The remaining 1211 acres includes pastures, a sprayfield for effluent from the WSPs, and a few cooling ponds for the cows. The Edge of Farm Treatment System is intended to capture stormwater runoff from the 1211 acres in an impoundment and treat it to reduce phosphorus concentrations prior to discharging offsite.

Criteria used in conceptualizing the design included impoundment location with respect to existing topography and water management system components, impoundment size and location with respect to current use by the landowner for grazing or hayfields, minimization of operation and maintenance costs to the landowner, and minimization of capital cost to implement. Based on these criteria and through discussions with the landowner, the location chosen was at the existing offsite discharge point (KREA 32B) on the southwest side of the dairy. Once the location was established, preliminary design of the system began with four primary goals:

1. Maximize the ability to capture the “first flush” of each storm event which carries the heaviest sediment and phosphorus loading.
2. Utilize a “natural treatment system” with different wetland communities and varying pockets of deeper and shallower water to maximize settling of sediments, organics and colloidal solids, and provide for as much plant uptake of nutrients as possible.
3. Provide a “chemical treatment system” at the end to achieve the phosphorus concentration goal, but minimize the operational cost of this component by maximizing the natural treatment system.
4. Implement an “operational system” for stormwater management to reduce offsite discharge to the greatest extent practicable. During many storm events, offsite discharge may be eliminated entirely.

Preliminary Impoundment Design

Sizing the impoundment was based on capturing as much of the first 2 inches of runoff from a single storm event as possible. The contributing area to the impoundment excludes the HIA so the net drainage area is 1211 acres which equates to a runoff volume of 1211 acres x 2 inches of runoff = 201.8 acre-feet. To keep the impoundment classified as “minor” under SFWMD permitting criteria, the maximum allowable depth of storage in the impoundment is 4 ft so the optimum impoundment area is 201.8 acre-feet / 4 feet = 50.5 acres.

Calculation of runoff rates were made based on rainfall amounts and using the SCS runoff equation developed by Victor Mockus and others and presented in the U.S. Soil Conservation Service's *National Engineering Handbook,* Section 4, "Hydrology." The predominant soil type is Myakka-Immokalee (hydrologic group B/D) with a soil moisture holding capacity (S) of 0.05 in/in (0.6 in/ft). The seasonal high water table is 1.5 ft below ground making the maximum wet season retention 0.6 in/ft x 1.5 ft = 0.9 in of water. The storm event associated with 2 inches of runoff calculated from the equation $Q_r = C_r \times (P-0.2S)^2 / (P+0.8S)$ is P = 5.8 inches where: Q_r is the rainfall amount in inches corrected for depressional storage in the pastures, C_r is the runoff correction factor for ponding taken from Figure D-17, page D-22 in the SFWMD Basis of Review, Surface Water Design Aids, and S is the soil moisture holding capacity. The value of C_r was taken to be 0.4 using a ponding area of 20% of the total and a rainfall event less than 7 inches. The return period for 5.8 inches of rain in one day is about once every 10 years based on Figure C-4, page C-6 of the SFWMD Basis of Review.

Inflow Pump Station Design is based on the SFWMD procedure for runoff rate calculations on page D-5 of the Surface Water Design Aids in the Basis of Review. Using the topography data collected, the slope of the property is ~2.5 ft per mile and the runoff length from the farthest point to the impoundment is ~1 mile. The minimum rainfall amount in the runoff curves in the BOR is 7" so to estimate a curve for 5.8" of precipitation a regression analysis was done using the curves for higher precipitation values with the same slope and runoff length. To prevent the regression from returning a negative value for a positive rainfall event, the initial point of 1" of rainfall and 0.1 csm was used to account for soil storage and "train" the regression. The regression equation was then used to determine a peak runoff rate of 54.8 csm which when multiplied by 0.4 to account for ponding gives a specific peak runoff rate of 21.8 csm. The runoff area is 1211 acres making the peak runoff 41.2 cfs. Using the conversion 448.8 gpm/cfs, the lift pump capacity at 10 ft of head would be 18,500 gpm which equates to a removal rate of 0.8 in/day. The inflow pump station will be located on the main drainage ditch on the northwest corner of the impoundment.

Treatment efficiency will be defined as the percentage of runoff captured in the impoundment, all of which will be treated through the impoundment and chemical treatment system prior to discharge off-site. To determine treatment efficiency, a hydrologic model was developed and calibrated against ~40 years of rainfall data (October 1, 1960 to May 1, 2000) recorded at the Okeechobee County Airport. The model incorporates soil storage, depth to water table, area and depth of impoundment, drainage area, ponding, evapotranspiration, pump capacity and treatment time. It is a dynamic model to allow the user to vary parameters such as impoundment size and depth and pumping capacity. A printout showing the input area with model results and a small amount of raw data is shown in the attachments.

Impoundment optimization is a function of maximizing treatment efficiency while minimizing the area taken out of production for the landowner, capital cost of construction, and operation and maintenance costs to the landowner. A preliminary boundary for the impoundment was drawn in AutoCAD 2000i with a 1-meter digital ortho-quad (DOQ) from USGS and using existing farm roads, borrow pits and ditches to help define the extents of the impoundment. Onsite review of the preliminary layout was conducted with the landowner, farm managers, construction contractor and design team. During the field review, the landowner expressed some concern with the location of the eastern boundary impacting one of the pastures and cooling ponds utilized on a daily basis by the dairy operation. The boundary was revised to make the impoundment longer and narrower, excluding these areas and incorporating a piece of the HIA dike system into the southeast corner. The revised impoundment boundary was sent to the landowner for approval. The area of the impoundment was determined to be 54.5 acres which is slightly more than the original estimated storage requirement. The model was run using this area with a pump capacity of 0.8 in/day and varying the depth of the impoundment from 1.5 feet to 4.0 feet. The model is very sensitive to the runoff factor which accounts for ponding and returned unrealistically high treatment efficiencies. The runoff factor was increased to 0.6 and the results of these simulations are shown in Table 1 below.

Area (acres)	Depth of Storage (feet)	Pump Capacity (in/day)	Runoff Stored (inches)	Runoff Bypassed (inches)	Percent Treated
54.5	1.5	0.8	246.7	78.8	75.9
54.5	2.0	0.8	263.9	61.7	81.2
54.5	2.5	0.8	277.1	48.4	85.1
54.5	3.0	0.8	285.8	39.7	87.9
54.5	3.5	0.8	291.1	34.4	89.6
54.5	4.0	0.8	291.1	34.5	89.7

Table 1

Impoundment Redesign

A construction cost estimate was made on the revised preliminary impoundment design after receiving approval of the landowner to proceed. The initial cost estimate provided by the contractor was $755,277 which significantly exceeded the project budget. A redesign effort was undertaken to reduce construction costs eliminating or modifying the following components:

1. The original design of the impoundment included a center dike to separate it into two compartments. This was intended to allow the use of different types of wetland communities in each of the compartments to maximize settling of sediments, organics and colloidal solids, and provide for plant uptake of nutrients as well as providing excellent habitat for various types of wildlife. Grading within the impoundment was to be done where required to improve the sheetflow effect but also to provide some deeper pockets for wetland communities that require more frequent inundation of water. This component of the design was eliminated saving approximately $31,500.
2. The original design included a limerock "biofilter" dike consisting of large limestone rocks built up around the Chemical Treatment System intake structure. This dike was intended to provide a foundation for the build up of algae mats to further treat the water as it seeped through the biofilter dike prior to being chemically treated. This component was eliminated with a cost savings of approximately $96,900.
3. Numerous scenarios were run through the hydrologic model in a effort to minimize costs while achieving at least 80% efficiency. Parameters that were varied included area of impoundment, depth of water, and pump capacity all of which represent significant cost components. The results of these model runs are shown in Table 2 below with the scenario that was selected highlighted. This scenario includes reducing the size of the impoundment to 48.1 acres, reducing the design water level in the impoundment from 4.0 feet to 2.5 feet, and reducing the pump capacity from 0.8 inches/day to 0.6 inches/day. These modifications resulted in a cost savings of approximately $116,100.

4. The exterior side slopes of the dike were changed from 3:1 to 2:1 (horizontal:vertical) and the sitework including cleaning ditches and adding control structures to allow more flexibility in stormwater management were eliminated resulting in a cost savings of approximately $37,200.
5. Various system components such as the culvert/riser design, chemical treatment system intake structure design, and pump station design were simplified with a cost savings of approximately $55,700

Area (acres)	Depth of Storage (feet)	Pump Capacity (in/day)	Runoff Stored (inches)	Runoff Bypassed (inches)	Percent Treated
54.5	1.5	0.6	241.1	81.1	75.2
54.5	2.0	0.6	258.8	66.8	79.7
54.5	2.5	0.6	268.3	57.2	82.4
54.5	3.0	0.6	272.7	52.8	83.8
54.5	3.5	0.6	277.5	48.1	85.4
54.5	4.0	0.6	278.4	47.1	85.8
48.1	1.5	0.8	233.5	92.1	71.8
48.1	2.0	0.8	255.4	70.2	78.5
48.1	2.5	0.8	270.0	55.6	83.2
48.1	3.0	0.8	278.7	46.9	85.6
48.1	3.5	0.8	287.4	382	88.2
48.1	4.0	0.8	291.2	34.4	89.6
48.1	2.5	0.5	257.8	67.8	79.4
48.1	2.5	0.6	265.0	60.5	81.6
48.1	2.5	0.7	268.0	57.5	82.6
48.1	2.5	0.8	270.0	55.6	83.2

Table 2

The total reduction in cost through the redesign process was approximately $337,400. Although the amount of runoff captured and treated is less than the original design, it represents a cost reduction of approximately 45% over the original design.

Natural Treatment System Design

The inflow from the pump station to the impoundment will be directed to a distribution ditch along the north side of the impoundment which will then overflow via a distribution weir at a constant elevation to promote sheetflow into the impoundment. During construction of the dike, various areas of the impoundment will be panned to level them out while some lower areas will be dug out to create pockets of deeper water. This will promote development of different types of wetland communities within the impoundment to maximize nutrient uptake by the plants. A plug will be placed in the main ditch running northeast to southwest through the impoundment to prevent short-circuiting the sheetflow effect.

The external ditch around the impoundment will serve three functions:

1. Capture stormwater from the pastures immediately around the impoundment.
2. Provide a potential source of water for future reuse on the dairy.
3. Provide an emergency bypass during major storm events where the impoundment has reached it's maximum capacity and the inflow pump shuts off.

Culverts with risers and flashboards will be placed in each of the two connections between Dry Lake Dairy and Milking R Dairy to the east to prevent transfer of stormwater between the dairies.

Chemical Treatment System Design

Sizing the settling basins for the chemical treatment system is based on the volume of the detention pond at 2.5 feet of depth (120.3 ac-ft) and a bleed-down time of 12 days. This converts to an average treatment rate is 5.1 cfs or 2289 gpm. Chapter 4 of *"Water Quality & Treatment"* (3rd Edition, AWWA, 1971) recommends the detention time within a settling basin to be 2 – 4 hours minimum for "well-coagulated" water. A detention time of 6 hours was selected to allow additional time for short-circuiting and basin stability so the detention volume required is 6 hrs. x 5.1 cfs x 3600 sec/hr = 110,160 ft^3. The design depth of the settling basins is 4 ft making the area (A) required for the settling basins = 110,160 ft^3 / 4 ft = 27,540 ft^2 or 0.63 acres. The dimensions of the settling basins are set to maintain a maximum flow-through velocity of 0.5 feet/minute which is recommended as the minimum by *"Water Quality & Treatment"* (3rd Edition, AWWA, 1971). This is equivalent to 0.008 ft/second so with a depth of 4 ft., the width of the basin W = 5.1 cfs / (0.008 ft/sec x 4 ft) = 159.4 feet (set to 160 feet). The length L = A/W = 27,540 ft^2 / 160 ft = 172 feet. Two settling basins will be used to allow one to be out of service for cleaning when necessary. For ease of construction and to accommodate the existing topography and layout of the impoundment, each basin will be set to 100 feet wide by 200 feet long. This will maximize the detention time and minimize the flow through velocity in the settling basins.

Alum injection and mixing will occur through the use of a combination of gravity flow and a static mixing device. This will be accomplished by injecting Alum ($Al_2(SO_4)_3$) into the water immediately after is passes through an orifice just before it moves through a static mixer mounted in the culvert just downstream of the orifice. The injection will be accomplished by using a "misting" system placed just downstream of the orifice to inject the alum through numerous small jets into the flow stream. The inflow device to the sedimentation basins is designed as a single 48 inch wide by 10 foot high aluminum cmp riser with an 18 inch x 40 foot long discharge culvert ending in a tee. Each leg of the tee is 20 feet long and terminates below the water level into each of the two sedimentation basins. The riser will have an inflow pipe from the impoundment directing water towards a slide gate mounted in the riser and set at an elevation designed to regulate the flow rate. The tee in the culvert will help dissipate the velocity as the water moves out into the sedimentation basins.

Design of the slide gate is based on a flow rate of 5.1 cfs at the lowest available head passing through the orifice created by the slide gate. The approach of using an orifice is based on the difference between the orifice equation and a weir flow equation. The orifice flow equation is a function of head raised to the 0.5 power while the weir equation is a function of head raised to the 1.5 power. The orifice equation results in a smaller range of flow rates over the design head range allowing for better control of the alum injection process. The resulting flow rates vary from the minimum 5.1 cfs to approximately 8.0 cfs at the maximum design head of 2.5 feet. The slide gate will be a 4-foot wide by 6-foot high aluminum screw gate set into the riser. The actual width of the flow area through the gate is 3.5 feet and the gate opening will be 1.0 feet. A 0.5-foot high board will be placed in the bottom of the riser preventing discharge below elevation 31.5 feet. A detail of the structure will be included in the construction drawings.

The static mixer consists of 4 "fins" mounted at cross angles to each other inside of the culvert. The theoretical horsepower of the mixer is 0.85 HP with an estimated pressure drop of 0.43 PSI which equates to a head loss of 0.99 feet across the mixer. The velocity gradient (G-factor) is approximately 1682 sec^{-1} at 20^{o} C and a mean pipe velocity of 4.3 fps. It is anticipated that velocities actually achieved in the field will be less than this due to flow control migrating from inlet control at the orifice to outlet control in the discharge pipe fairly early in the discharge event due to head losses in system. A detail of the static mixer will be included in the construction drawings.

The Alum mixing rate is based on a stoichiometric ratio of 1.0 mg/l Alum removing 0.8 mg/l Phosphorus and a treatment efficiency of 15%. The P-loading rate at 1 mg/l of P x 2289 gpm x 8.34x 10^{-6} lb/gal/mg/l is 0.019 lb P / min. The Alum concentration is 4.4% at a weight of 11.1 lb/gal. This means the Alum feed rate should be (0.019 lb P/min) / (0.8 lb P/lb Alum) / 15% / 4.4% / (11.1 lb/gal) = 0.3 gpm of Alum injected into the flow stream. The amount of Alum required to treat a 2" runoff event would be 0.3 gpm x 12 days x 24 hrs/day x 60 min/hr = 5,184 gallons to be stored on site. This will be done using two-5,000 gallon storage tanks located just outside the impoundment at the southwest corner.

The outlet from each of the settling basins will be sized to carry the design volume but at a very low flow rate to prevent scouring in the settling basins due to high velocities. To achieve this, a maximum velocity of 1 fps is achieved with a 60" x 8 ft high riser and 100 ft of 36" diameter cmp culvert from each of the two settling basins. This outfalls to the external ditch on the west side of the impoundment which can then be discharged offsite or recirculated for use on the dairy depending on conditions.

Operation System Design

The inflow pump station will be controlled by a float system which will include on/off control on the upstream side based on stages in the inflow ditch and an off control on the downstream side designed to shut the pump down when the stage in the impoundment reaches 2.5 ft. When the impoundment is full and the pump shuts off, any additional stormwater runoff will be re-routed around the north and west side of the impoundment and discharged offsite at the current outfall point to Turkey Slough This outfall will consist of a 60" x 8 ft high riser with a 36" diameter cmp culvert. Under most circumstances, this outfall will be set to prevent any offsite discharge and allow local stormwater runoff captured in the external ditch to be routed around and pumped into the impoundment for treatment. An emergency outflow from the impoundment to the exterior borrow ditch will be placed on the east side of the impoundment with an overflow elevation set ~2 ft below the top of the levee.

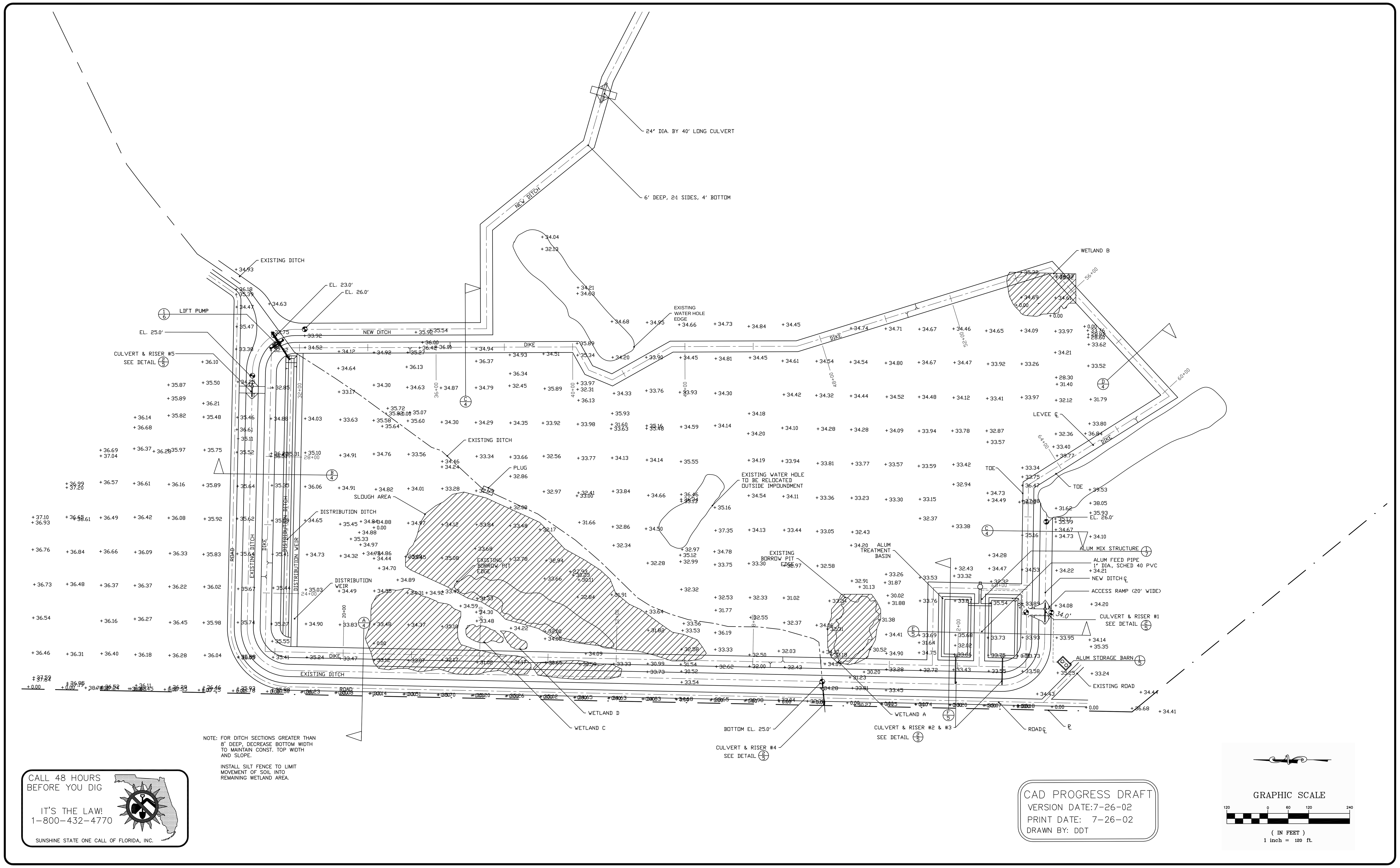
A ditch will be dug from the east side of the milking barns north around the HIA and connected to the external ditch on the east side of the impoundment. This will allow for capturing additional stormwater runoff from this area of the dairy. As mentioned earlier, culverts with risers and flashboards will be placed in each of the two connections between Dry Lake Dairy and Milking R Dairy to prevent interchange of stormwater between the dairies.

Dry Lake Dairy BAT Project

Hydrologic Model Version 1.2

Soil Hold Cap	0.6	inches/foot	Start Discharge at	0.750	of Max Volume	Runoff Area	1162.9	acres	Pond Volume	1443.0 ac-inches / 120.3 ac-feet
Start Depth	1.5	feet	Pump Capacity	0.60	inches/day	Runoff Factor	0.60		Treat Time	12.0 days
Start Volume	1082.25	ac-in	Design Pond Depth	2.5	feet	Pond Area	48.1	acres		

Date	Rainfall, in	ET, in.	Avail Soil Store(S), in.	Curve No. CN	Runoff (Q) inches	Adjusted Q inches	Pumped to Storage inches	Water Bypassed inches	Water In Basin ac-in	Water Treated inches	Treat? y=1 n=0	logic test
Record Sum:	**1899.77**	**2128.27**			**542.583**	**325.550**	**265.03**	**60.52**		**265.75**		% Treated **81.6**
10/1/1960		0.13	0.9	91.7	0.000	0.000	0.00	0.00	1082.3	0.10	1	TRUE
10/2/1960		0.13	1.0	90.7	0.000	0.000	0.00	0.00	961.9	0.10	1	TRUE
10/3/1960	0.5	0.13	1.2	89.6	0.050	0.030	0.03	0.00	842.0	0.10	1	TRUE
10/4/1960	0	0.13	0.9	91.7	0.000	0.000	0.00	0.00	756.7	0.10	1	TRUE
10/5/1960	0	0.13	1.0	90.7	0.000	0.000	0.00	0.00	636.3	0.10	1	TRUE
10/6/1960	0	0.13	1.2	89.6	0.000	0.000	0.00	0.00	516.0	0.10	1	TRUE
10/7/1960	0.1	0.13	1.3	88.6	0.022	0.013	0.01	0.00	395.7	0.10	1	TRUE
10/8/1960		0.13	1.3	88.2	0.000	0.000	0.00	0.00	290.7	0.10	1	TRUE
10/9/1960		0.13	1.5	87.2	0.000	0.000	0.00	0.00	170.3	0.10	1	TRUE
10/10/1960	0.61	0.13	1.6	86.3	0.045	0.027	0.03	0.00	50.5	0.00	1	FALSE
10/11/1960	0.1	0.13	1.1	89.8	0.016	0.010	0.01	0.00	82.0	0.00	0	FALSE
10/12/1960	0.1	0.13	1.2	89.5	0.018	0.011	0.01	0.00	93.2	0.00	0	FALSE
10/13/1960	0	0.13	1.2	89.1	0.000	0.000	0.00	0.00	105.4	0.00	0	FALSE
10/14/1960	0	0.13	1.3	88.1	0.000	0.000	0.00	0.00	105.3	0.00	0	FALSE
10/15/1960		0.13	1.5	87.1	0.000	0.000	0.00	0.00	105.2	0.00	0	FALSE
10/16/1960		0.13	1.6	86.1	0.000	0.000	0.00	0.00	105.0	0.00	0	FALSE
10/17/1960	0.22	0.13	1.7	85.2	0.010	0.006	0.01	0.00	105.1	0.00	0	FALSE
10/18/1960	0	0.13	1.7	85.8	0.000	0.000	0.00	0.00	112.1	0.00	0	FALSE
10/19/1960	0.17	0.13	1.8	84.8	0.022	0.013	0.01	0.00	112.1	0.00	0	FALSE
10/20/1960	0	0.13	1.8	85.0	0.000	0.000	0.00	0.00	127.3	0.00	0	FALSE
10/21/1960	0.3	0.13	1.9	84.1	0.003	0.002	0.00	0.00	127.4	0.00	0	FALSE
10/22/1960	0	0.13	1.7	85.3	0.000	0.000	0.00	0.00	129.6	0.00	0	FALSE
10/23/1960	0	0.13	1.9	84.4	0.000	0.000	0.00	0.00	129.5	0.00	0	FALSE
10/24/1960	0	0.13	2.0	83.5	0.000	0.000	0.00	0.00	129.4	0.00	0	FALSE
10/25/1960	0	0.13	2.1	82.6	0.000	0.000	0.00	0.00	129.2	0.00	0	FALSE
10/26/1960	0	0.13	2.2	81.7	0.000	0.000	0.00	0.00	129.1	0.00	0	FALSE



NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: 2&3C
Designed By: B.R.M.
Drawn By: D.D.T.
Checked By:
Verify Scale:
0 1
1 Inch

Date:

DRY LAKE DAIRY

Engineering & Water Resources, Inc.
851 Johnson Avenue, Suite 214, Stuart, Florida 34994
Phone: (772)781-6408 Fax: (772) 781-6409 Web: www.ewr1.com
License Number: 00008586

EDGE OF FARM TREATMENT

STORMWATER IMPOUNDMENT

H. Scale: 1"=120'
V. Scale: N/A
Date: 23-MAY-02

Sheet
3B

Rock-A-Way, Inc.

P.O. Box 669

Okeechobee, FL 34973

"WE MOVE THE EARTH TO SATISFY OUR CUSTOMERS"

(863) 763-3143 CG C003425 Fax (863) 763-6875

PROPOSAL "4"

SUBMITTED TO : E. W. R. INC. **31-JAN-03**

PROJECT TITLE: EDGE OF FARM TREATMENT

JOB SITE : DRY LAKE DAIRY

ED TO QUOTE YOU ON THE FOLLOWING WORK:

1	EXTERIOR EARTHEN DIKE	36,613	CCY	$1.37	$50,160.00
2	INTERIOR EARTHEN DIKE	5,134	CCY	$2.00	$10,268.00
3	GRUB DIKE FOOTPRINT & COMPACT	8.14	AC	$945.00	$17,692.30
4	EXTERNAL DITCH	46,700	CCY	$0.70	$32,690.00
5	4" CONC. OVERFLOW STR.	1	LS	$11,861.20	$11,861.20
6	SHELL RD. W GRUBBING ETC.	3,840	LF	$8.91	$34,214.40
7	DISTRIBUTION DITCH	4,025	CCY	$1.50	$6,037.00
8	DISTRIBUTION WEIR	800	CCY	$1.00	$800.00
9	CIUVERTS # 1 & 2	2	EA	$6,118.42	$12,236.84
10	CIUVERTS # 3 & 4	2	EA	$19,273.64	$38,547.28
14	ALUM MIXING STRUCTURE	1	LS	$25,862.36	$25,862.36
15	SEED & MULCH DOT SPEC.	20	AC	$1,210.00	$24,200.00
16	BARB WIRE FENCE 4 STRAND	7,500	LF	$2.00	$15,000.00
			IMPOUNDMENT		**$279,569.38**
21	ALUMINUM PUMP CAN	1	LS	$9,582.94	$9,582.94
22	CONCRETE SPLASH PAD (32 X 20)	1	LS	$6,193.71	$6,193.71
23	CONCRETE PAD (22 X 10 X 8")	1	LS	$3,972.22	$3,972.22
24	DE-WATERING	1	LS	$9,950.00	$9,950.00
25	EXCAVATION FILL & COMPACT	1	LS	$6,305.00	$6,305.00
26	PUMP GEARHEAD SHAFT	1	LS	$234.00	$234.00
27	DIESEL ENGINE W / STAND & CONTR(	1	LS	$72,637.57	$72,637.57
28	AUTO START / STOP CONTROLS	1	LS	$942.50	$942.50
29	DISCHARGE PIPE ASSY.	1	LS	$526.50	$526.50
30	POLE BARN	1	LS	$4,200.00	$4,200.00
			PUMP STATION		**$114,544.44**
31	CONCRETE PAD	1	LS	$9,887.94	$9,887.94
32	POLE BARN	1	LS	$13,540.00	$13,540.00
33	POLY TANK, 5,000 GAL.	2	EA	$4,934.23	$9,868.46
34	ALUM FEED PUMP	2	EA	$1,575.97	$3,151.94
35	ELECTRIC CONTROLS	1	LS	$2,301.00	$2,301.00
36	POWER FEED, SINGLE PHASE	1	LS	$2,730.00	$2,730.00
37	1" SCH-40 PVC FEED LINE	400	LF	$5.04	$2,016.00

38	MISC. PLUMBING ETC.	1	LS	$3,510.00	$3,510.00
			ALUM FEED SYSTEM		**$47,005.34**
41	DITCH CONST. 6'DEEP, 6'BOTTOM	2,600	LF	$2.60	$6,760.00
42	RISER CULVERT 18" X 8' X 40' LONG	1	EA	$6,440.96	$6,440.96
44	CULVERT 18"(24"?) X 40' LONG	1	EA	$2,464.33	$2,464.33
45	RELOCATE WATER HOLE & SHADE	1	LS	$5,648.24	$5,648.24
46	RELOCATE WATER TROUGH & W/L	1	LS	$1,924.00	$1,924.00
			SITEWORK		**$23,237.53**
					$464,356.69
	MANDATORY CUTS TO STAY WITHIN BUDGET (to be identified prior to construction)				**$16,000.00**
				Final Budget	**$448,356.69**

Bond No. SSB373259
Executed in 3 Counterparts

SUBCONTRACT LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That **Farm Construction Group (A Joint Venture of Curren Electric Company, Inc. and Rock-A-Way, Inc.), 2308 S Parrott Avenue, Okeechobee, Florida 34974 (863) 763-3143**
(Here insert the name and address, or legal title, of the Subcontractor)

(hereinafter called the "Principal"), as Principal, and **RLI Insurance Company**
a corporation duly organized under the laws of the State of **Illinois** (hereinafter called Surety), are held and firmly bound unto
Engineering and Water Resources, Inc.
851 Johnson Avenue Suite 214, Stuart, Florida 34994 (772) 781-6408
(Here insert the name and address, or legal title, of the General Contractor)

as Obligee, hereinafter called Obligee, in the amount of
FIVE HUNDRED THOUSAND AND 00/100
Dollars (**$500,000.00**), for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated **06/11/2002** entered into a subcontract with Obligee for **SFWMD Contract No.C-11652, Best Available Technology Project: Edge of Farm Treatment Facility Dry Lake Dairy, Okeechobee, Florida**
in accordance with drawings and specifications prepared by **Engineering and Water Resources, Inc.**
which subcontract is by reference made a part hereof, and is hereafter referred to as the subcontract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, That if the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the subcontract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

(1) A claimant is defined as one having a direct contract with the Principal for labor, material, or both, used or reasonably required for use in the perfomance of the contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the subcontract.

(2) The above-named Principal and Surety hereby jointly and severally agree with the Obligee that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Obligee shall not be liable for the payment of any costs or expenses of any such suit.

(3) No suit or action shall be commenced hereunder by any claimant,
   (a) After the expiration of one (1) year following the date on which Principal ceased work on said subcontract it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.
   (b) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

(4) The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder.

Signed and sealed this **21st** day of **June**, **2002**.

Farm Construction Group (SEAL)
(Principal)

By: E. James Curren Jr.

RLI Insurance Company

By: Leslie M. Donahue
Leslie M. Donahue

Attorney in Fact & Florida Licensed Resident Agent
Inquiries: (407) 786-7770

Witness

Bond No. SSB373259
Executed in 3 Counterparts

SUBCONTRACT PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

Farm Construction Group (A Joint Venture of Curren Electric Company, Inc. and Rock-A-Way, Inc.),
That 2308 S Parrott Avenue, Okeechobee, Florida 34974 (863) 763-3143
(Here insert the name and address, or legal title, of the Subcontractor)
(hereinafter called the "Principal"), as Principal, and RLI Insurance Company
a corporation duly organized under the laws of the State of Illinois (hereinafter called Surety), are held and firmly bound unto
Engineering and Water Resources, Inc.
851 Johnson Avenue Suite 214, Stuart, Florida 34994 (772) 781-6408
(Here insert the name and address, or legal title, of the General Contractor)
as Obligee, hereinafter called Obligee, in the amount of
FIVE HUNDRED THOUSAND AND 00/100
Dollars ($500,000.00), for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated 06/11/2002 entered into a subcontract with Obligee for SFWMD Contract No.C-11652, Best Available Technology Project: Edge of Farm Treatment Facility, Dry Lake Dairy, Okeechobee, Florida
in accordance with drawings and specification prepared by Engineering and Water Resources, Inc.,
which subcontract is by reference made a part hereof, and is hereinafter referred to as the subcontract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, That, if Principal shall promptly and faithfully perform said subcontract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Whenever Principal shall be, and be declared by Obligee to be in default under the subcontract, the Obligee having performed Obligee's obligations thereunder:

(1) Surety may promptly remedy the default subject to the provisions of paragraph 3 herein, or;
(2) Obligee after reasonable notice to Surety may, or Surety upon demand of Obligee may arrange for the performance of Principal's obligation under the subcontract subject to the provisions of paragraph 3 herein;
(3) The balance of the subcontract price, as defined below, shall be credited against the reasonable cost of completing performance of the subcontract. If completed by the Obligee, and the reasonable cost exceeds the balance of the subcontract price, the Surety shall pay to the Obligee such excess, but in no event shall the aggregate liability of the Surety exceed the amount of this bond. If the Surety arranges completion or remedies the default, that portion of the balance of the subcontract price as may be required to complete the subcontract or remedy the default and to reimburse the Surety for its outlays shall be paid to the Surety at the times and in the manner as said sums would have been payable to Principal had there been no default under the subcontract. The term "balance of the subcontract price," as used in this paragraph, shall mean the total amount payable by Obligee to Principal under the subcontract and any amendments thereto, less the amounts heretofore properly paid by Obligee under the subcontract.

Any suit under this bond must be instituted before the expiration of two years from date on which final payment under the subcontract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Obligee named herein or the heirs, executors, administrators or successors of the Obligee.

Signed and sealed this 21st day of June, 2002.

Farm Construction Group (SEAL)
(Principal)

By: E. Jam... Curren Jr.

RLI Insurance Company

By: Leslie M. Donahue
Leslie M. Donahue

Attorney in Fact & Florida Licensed Resident Agent
Inquiries: (407) 786-7770

[illegible signature]
Witness

RLI SURETY DIVISION

POWER OF ATTORNEY
RLI Insurance Company

A Division of RLI Insurance Company
P.O. Box 3967
Peoria, IL 61612-3967

Know All Men by These Presents:

That this Power of Attorney is not valid or in effect unless attached to the bond which it authorizes executed, but may be detached by the approving officer if desired.

That **RLI Insurance Company**, an Illinois corporation, does hereby make, constitute and appoint:
JEFFREY W. REICH, SUSAN L. REICH, KIM E. NIV, TERESA L. ROBINSON, LESLIE M. DONAHUE,
PATRICIA L. SLAUGHTER, J. GREGORY MACKENZIE, JOINTLY OR SEVERALLY

in the City of ALTAMONTE SPRINGS, State of FLORIDA its true and lawful Agent and Attorney-in-Fact, with full power and authority hereby conferred, to sign, execute, acknowledge and deliver for and on its behalf as Surety, the following described bond.

Any and all bonds, undertakings, and recognizances in an amount not to exceed Ten Million Dollars ($10,000,000) for any single obligation.

The acknowledgment and execution of such bond by the said Attorney-in-Fact shall be as binding upon this Company as if such bond had been executed and acknowledged by the regularly elected officers of this Company.

The **RLI Insurance Company** further certifies that the following is a true and exact copy of the Resolution adopted by the Board of Directors of **RLI Insurance Company**, and now in force to-wit:

"All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the company by the President, Secretary, any Assistant Secretary, Treasurer, Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, and Assistant Secretary, or the Treasurer, may appoint Attorneys-in-Fact or Agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

IN WITNESS WHEREOF, the **RLI Insurance Company** has caused these presents to be executed by its President with its corporate seal affixed this 29th day of April, 2002.

RLI INSURANCE COMPANY CORPORATE SEAL ILLINOIS

RLI Insurance Company

By: Jonathan E. Michael
President

State of Illinois
County of Peoria } SS

On this 29th day of April, 2002, before me, a Notary Public, personally appeared Jonathan E. Michael, who being by me duly sworn, acknowledged that he signed the above Power of Attorney as the aforesaid officer of the **RLI Insurance Company** and acknowledged said instrument to be the voluntary act and deed of said corporation.

By: Cherie L. Montgomery
Notary Public

"OFFICIAL SEAL"
CHERIE L. MONTGOMERY
COMMISSION EXPIRES

CERTIFICATE

I, the undersigned officer of **RLI Insurance Company**, a stock corporation of the State of Illinois, do hereby certify that the attached Power of Attorney is in full force and effect and is irrevocable; and furthermore, that the Resolution of the Company as set forth in the Power of Attorney, is now in force. In testimony whereof, I have hereunto set my hand and the seal of the **RLI Insurance Company** this 21st day of June, 2002.

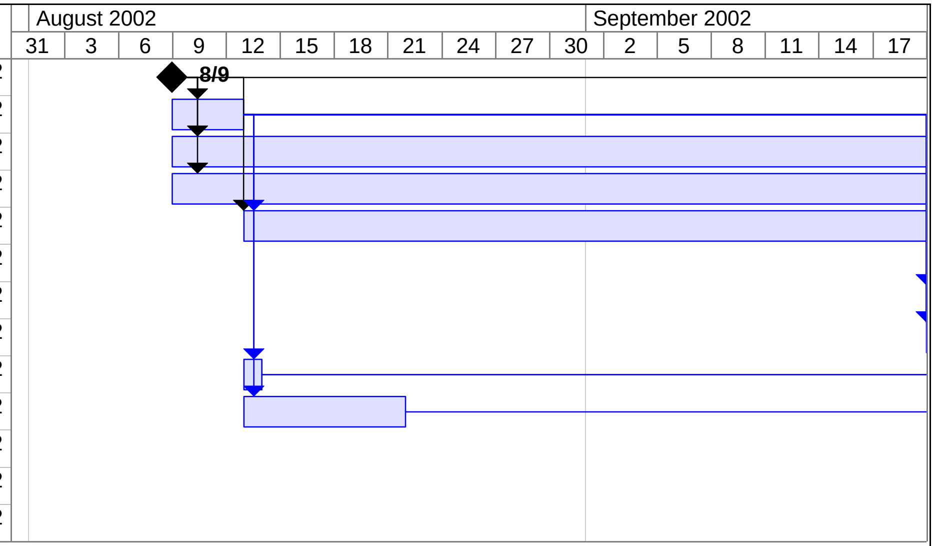
RLI Insurance Company

By: Jonathan E. Michael
President

0922656020204

A0059001

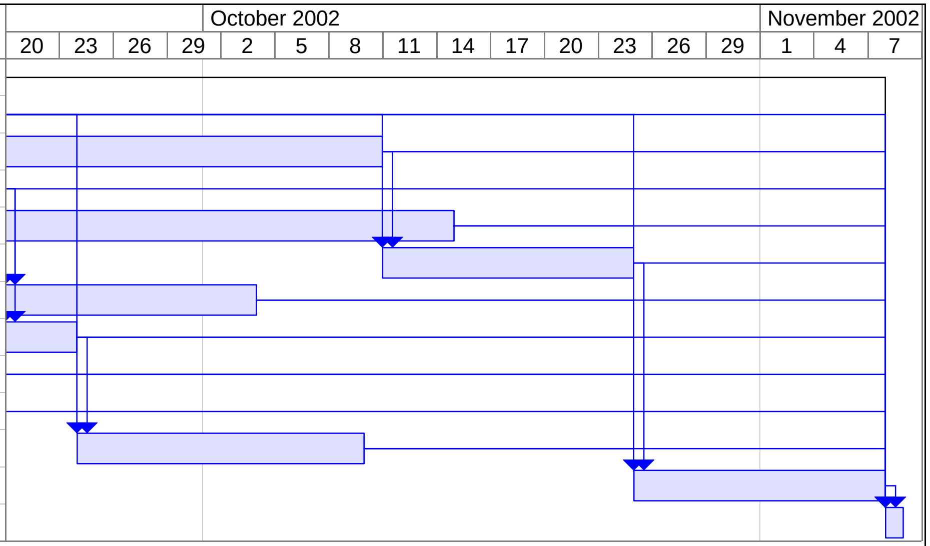
ID	Task Name	Duration	Start	Finish
1	Notice to Proceed	0 days	Fri 8/9/02	Fri 8/9/02
2	Mobilize	2 days	Fri 8/9/02	Mon 8/12/02
3	Order Pump	45 days	Fri 8/9/02	Thu 10/10/02
4	Order Culverts and Risers	30 days	Fri 8/9/02	Thu 9/19/02
5	Dike Construction	45 days	Tue 8/13/02	Mon 10/14/02
6	Pump Station Construction	10 days	Fri 10/11/02	Thu 10/24/02
7	Culvert Installations	10 days	Fri 9/20/02	Thu 10/3/02
8	Alum Structure Installation	2 days	Fri 9/20/02	Mon 9/23/02
9	Relocate Cattle Cooling Pond	1 day	Tue 8/13/02	Tue 8/13/02
10	Replace Fencing	7 days	Tue 8/13/02	Wed 8/21/02
11	Alum Storage Building/Electric Service	12 days	Tue 9/24/02	Wed 10/9/02
12	Shellrock Road	10 days	Fri 10/25/02	Thu 11/7/02
13	Construction Certificaton	1 day	Fri 11/8/02	Fri 11/8/02



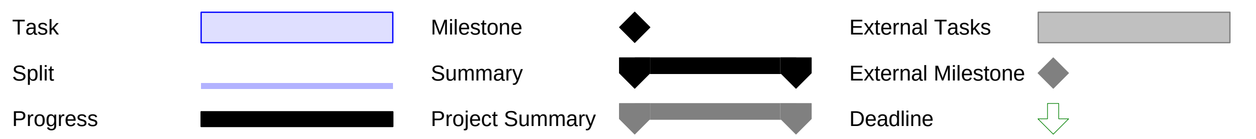
Project: Construction Schedule
Date: Fri 8/2/02

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

ID	Task Name	Duration	Start	Finish
1	Notice to Proceed	0 days	Fri 8/9/02	Fri 8/9/02
2	Mobilize	2 days	Fri 8/9/02	Mon 8/12/02
3	Order Pump	45 days	Fri 8/9/02	Thu 10/10/02
4	Order Culverts and Risers	30 days	Fri 8/9/02	Thu 9/19/02
5	Dike Construction	45 days	Tue 8/13/02	Mon 10/14/02
6	Pump Station Construction	10 days	Fri 10/11/02	Thu 10/24/02
7	Culvert Installations	10 days	Fri 9/20/02	Thu 10/3/02
8	Alum Structure Installation	2 days	Fri 9/20/02	Mon 9/23/02
9	Relocate Cattle Cooling Pond	1 day	Tue 8/13/02	Tue 8/13/02
10	Replace Fencing	7 days	Tue 8/13/02	Wed 8/21/02
11	Alum Storage Building/Electric Service	12 days	Tue 9/24/02	Wed 10/9/02
12	Shellrock Road	10 days	Fri 10/25/02	Thu 11/7/02
13	Construction Certificaton	1 day	Fri 11/8/02	Fri 11/8/02



Project: Construction Schedule
Date: Fri 8/2/02



DRY LAKE DAIRY
EDGE OF FARM TREATMENT SYSTEM
DAIRY BEST AVAILABLE TECHNOLOGY PROJECT

OPERATING DESCRIPTION AND COSTS
September 4, 2002

1. System Description

A. Drainage Locations

The Dry Lake Dairy property encompasses 1241.5 acres. Core dairy operations, including feed barns, milking parlor, high intensity areas, lagoons and waste storage pond account for approximately 30 acres. The remaining 1211 acres consist of pastures, hayfields, land application areas and farm worker houses. Several existing ditches located throughout the farm collect surface water runoff. The primary discharge point, designated KREA 32B, is located just north of the southwest corner of the farm. Two other minor discharge points are located on the southeast, KREA49A, and northeast, KREA 32C, corners. These locations are shown in Figure 6-1 of the Dry Lake ANMA prepared by SWET, Inc., which is attached to this report.

B. Surface Water Management

The edge of farm treatment system selected for this dairy consists generally of a traditional surface water management system followed by chemical treatment. It includes 2600 feet of ditch, a 48-acre aboveground surface water impoundment, a 13,200 gpm drainage lift pump, an alum feed/mixing unit and final settling basin. The system, located just upstream of KREA 32B, has been designed to capture a long-term average 82% of the surface water runoff from the remaining 1163 acres (1211 minus 48) of farm. In order to enhance the capture of runoff, the plan also proposes to stop Dry Lake's discharge through KREA 49A by installing a flashboard riser at the property line. Components of the system are shown in construction drawings, dated August 14, 2002, prepared by EWR. Technical specifics of the system design were presented previously to SWET in an implementation plan report.

C. Chemical Treatment System

Water collected in the impoundment is held until the design holding capacity is achieved. At that time, a treatment cycle would be initiated discharging water through a chemical feed/mixing system to a two-compartment, 1.2-acre settling basin. Treated water would exit the end of the settling basin through overflow risers and out of KREA 32B. The capacity of the alum feed/mixing system has been selected to reduce the phosphorus concentration in the treated water to 40 ppb. Based on initial jar tests conducted by DB Environmental, copy attached, the chemical cost is the only real constraint to achieving a desired level of treatment. More on this is reported in following paragraphs. Based on the rainfall data analyzed by EWR's hydrographic model, the 18% long-term average bypassed water results from major storm events at or above the twenty-five year, three-day frequency. During these events, the edge of farm system would be used to capture as much of the first flush as possible, bypassing the rest of the storm runoff. It has generally been found that the worst runoff quality is found in the first flush of runoff. Accordingly, if the system is operated in sync with anticipated rainfall patterns, we can qualitatively expect overall mass reductions of phosphorus to exceed that predicted by an 82% long-term average capture rate.

2. **System Operation**

A. Surface Water Runoff Collection

Excess rainfall travels by sheet flow to existing on-farm drainage ditches. Based on the site topography, we know that most of the water collected by the ditches travels southerly and discharges offsite at KREA 32B and KREA 49A. A flashboard riser and new ditch work will re-route runoff from the KREA 49A discharge to the surface water impoundment located just upstream of KREA 32B. A new 13,200 gpm lift pump will deliver the water to a 48-acre above ground impoundment with a design holding capacity of 120 acre-feet.

The lift pump station will be equipped with automatic start-stop level controls so that it will automatically pump runoff into the impoundment whenever the ditch water level rises to elevation 29.25 feet NGVD. The pump will shut off when the ditch water level returns to elevation 28.75 feet. The ground surface at the pump control point is 32.75 feet, allowing four feet of ditch freeboard at shutoff. Another level control transducer will be mounted within the impoundment to tell the pump to shut off when the impoundment is full. Should the high water level control fail to function, an emergency overflow spill way will return the excess water back to the farm ditch system.

During very high rainfall conditions when the rate of runoff exceeds the pump capacity or the impoundment becomes full, the water will rise in the pump station feed ditch. When the feed ditch water level rises to elevation 30.75 it will begin discharging over the flashboard riser weir into the bypass ditch and ultimately offsite through KREA 32B. EWR's hydrologic model, which uses 40 years of rainfall data for the Okeechobee vicinity, predicts that the proposed system will capture at least 82% of the runoff on a long-term basis. Capture rates can be enhanced with experience by adjusting the bypass overflow elevation and/or the fill/empty protocol.

Automatic operation of diesel pump stations has become very reliable and is used a lot by South Florida's agricultural community. However, the system operator must verify that the system is functioning properly by routinely recording impoundment water levels and pump operating hours, and manually testing the level controls. Fluids and filters must be changed at the frequency recommended by the engine and pump manufacturers.

B. Storage Impoundment

The 48-acre aboveground impoundment has a design maximum water holding depth of 2.5 feet (elevation 36.5 feet NGVD). The impoundment dikes are designed to allow three feet of freeboard when the water level is at the design depth. At that level, 120 acre-feet of water can be stored. This is equivalent to storing 1.2 inches of runoff from the entire 1163-acre watershed. EWR's hydrologic model indicated that increasing the storage capacity within the limits of the project budget did not appreciably increase the long-term average capture rate.

Also, the model indicates that the discharge of water from the impoundment to the chemical treatment basin should commence when the basin is 75% full to optimize the amount of water captured. This is true because the system's ability to capture runoff is enhanced during periods of extremely wet weather by keeping a portion of the design basin capacity available for storage. Accordingly, there could be two impoundment operating schedules. The dry season schedule (November - May) would utilize the full 2.5 feet of storage, as the probability of large rainfall events during that period would be quite low. The wet season schedule (June - October) would call for initiation of a treatment cycle at 75% full.

As the dikes are not very high, their side slopes can be mowed with the tractor on the top of dike using a "bat-wing" mower. In this mode, one of the wings would be lowered over the side of the dike to cut the grass on the side slope. Accordingly, 2:1 side slopes seem appropriate for this application and they are less expensive to construct than a dike with milder sides.

C. Chemical Treatment

The system operator would keep a log of the impoundment water level by reading a staff gage after each rainfall event. Following the appropriate operating schedule discussed above, a treatment cycle would be initiated by turning on the chemical feed pumps and opening the slide gate in the mixing structure. The mixing structure was designed to hydraulically limit the flow rate through the mixer from 8 cfs at the maximum impoundment level and 5.1 cfs at the minimum level. The chemical feed would be adjusted to match the water flow rate with a float valve that is opened and closed with a simple ball float mechanism. The alum pumps are simple centrifugal agricultural chemical feed pumps and, as such, can operate over the anticipated range of feed rates.

Once initiated, the treatment cycle would normally continue until the basin is empty. This would take about 12 days. However, operational experience might dictate a varying cycle, depending on rainfall levels and water quality. The key component to cost effectively treating the water is to obtain phosphorus readings on the raw and finished water at the commencement and during treatment.

The two-compartment settling basin has a design residence time of at least six hours and a depth of 4 feet. The basin dimensions were chosen to minimize scour of the settled floc by limiting the horizontal velocity and allow the floc to settle to the basin bottom prior to discharge of the water from the basin. As floc accumulates the horizontal velocity will increase and the settling time will decrease. During an average year, floc will accumulate to a depth of about 0.4 feet if distributed evenly over the basin. However, it is anticipated that the floc will want to accumulate near the mixer outlets and be progressively transported toward the basin outlets by scour. Operational experience is absolutely necessary to find the best sludge removal schedule. Accordingly, we suggest a preliminary sludge removal frequency of once per year, knowing that the protocol must be evaluated and adjusted based on experience.

Sludge would be removed from the settling basin with a long reach hydraulic hoe about one month prior to the end of the dry season when groundwater levels are lowest and the sludge is the driest. Excavated sludge would be piled on the 10-foot buffer strip between the excavated portion of the settling basin and its dike. The sludge would be allowed to dry further for about 30 days. At that time it would be loaded onto trucks for hauling to a suitable disposal site. There are several practical options available for disposal of the sludge, such as land spreading or direct burial. However, we understand the only option currently acceptable to all reviewing agencies is disposal to a municipal landfill.

3. **Quantity of Sludge Generated**

A. Sludge Amount

Based on removing 2 ppm of phosphorus by adding 35 ppm of aluminum, and treating 649.3 ac-ft of water/year, 36.2 dry tons of precipitate would be produced/year on a long-term average. Assuming the floc can be dewatered onsite to 5% solids, the estimated wet weight would be 724 tons/year. Using a specific weight of 63 lb/cf, this would equate to 851 cubic yards per year.

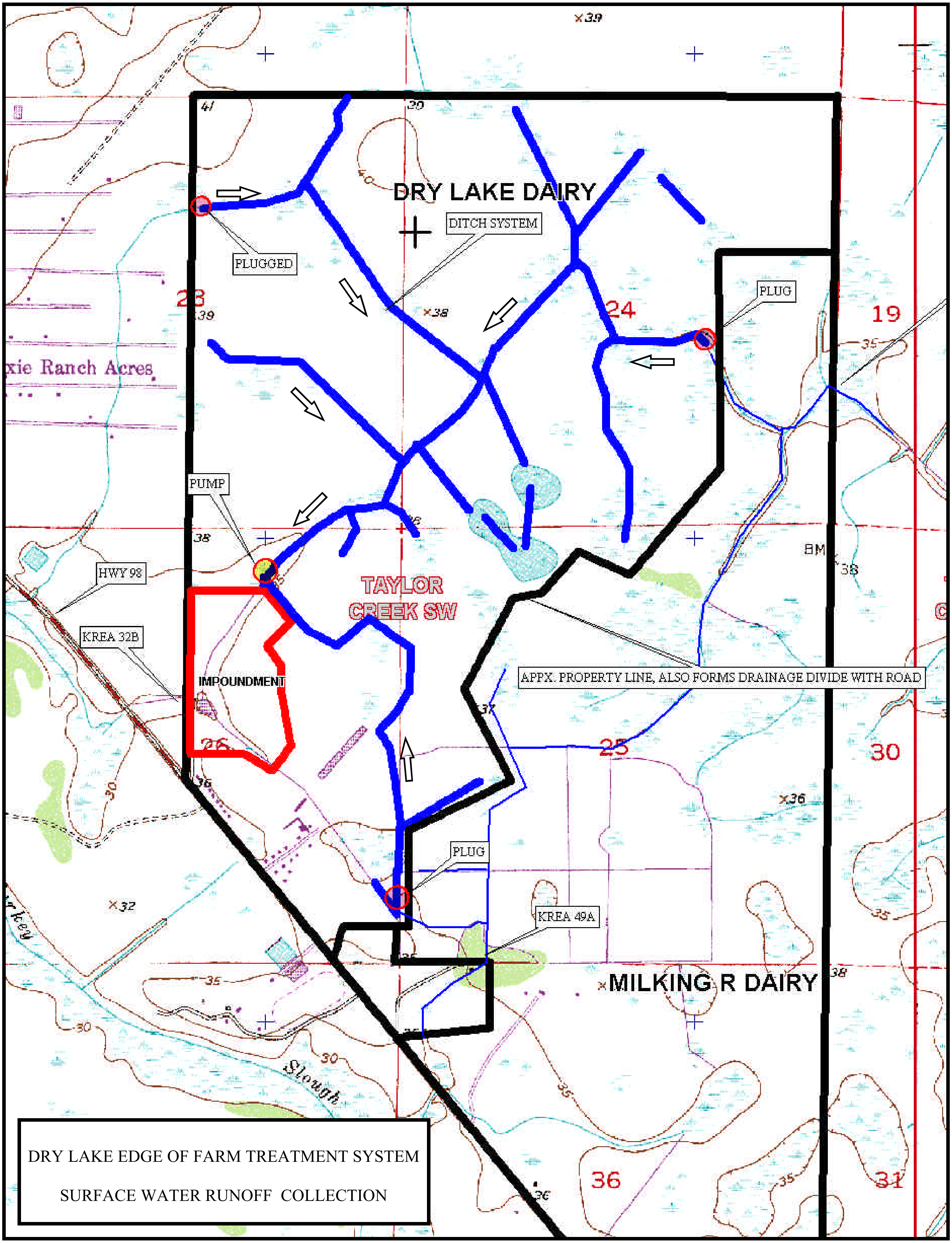
It is very important to note that the actual amount of alum consumed and sludge generated could be somewhat different than indicated by the preliminary jar tests. We suspect that after the water is allowed to reside in the impoundment for an extended period of time its chemical characteristics will change.

B. Variability Based on Rainfall

The quantities presented so far are based on a long-term average over a 40-year period of rainfall record. Annual rainfall amounts vary considerably and so will the amount of water treated, alum used, sludge generated and cost to operate. Based on the period of record, the lowest rainfall year would result in treating 50% of the average and the highest would result in treating 150%. Accordingly, the treated water quantity would range from 325 ac-ft/yr to 974 ac-ft/yr. Likewise, sludge production would be expected to range from 426 cubic yards to 1461 cubic yards per year.

4. Operating Costs

Costs to operate the system based on the long-term average quantities summarized above are listed in the attached Spreadsheet No. 1. Referring to the spreadsheet, by far the most expensive portion of the annual operating cost is for the purchase of Alum. The recently conducted jar tests indicate that an alum dose of 35 ppm as aluminum is necessary to reduce the initial 2.0-ppm phosphorus concentration to 40 ppb. This dosage is considerably higher than expected and the laboratory believes it may be due to the high color content and alkalinity of the water sample. This represents a huge ongoing expense to the dairy. Accordingly, we recommend that after a year or two of operational experience is acquired additional funds be allocated to explore biological and/or chemical pre-treatments to reduce the alum requirement.



DRY LAKE EDGE OF FARM TREATMENT SYSTEM

SURFACE WATER RUNOFF COLLECTION

DRY LAKE DAIRY EDGE OF FARM TREATMENT SYSTEM
DAIRY BEST AVAILABLE TECHNOLOGY PROJECT

SPREADSHEET NO. 1 - LONG-TERM AVERAGE OPERATING COSTS
29-Aug-02

Item No.	Description of Item	Unit Cost, $/	Quantity/Yr	Annual Cost, $
1	Lift Pump Diesel Fuel	1.00/gal	651 gal	651
2	Lift Pump Oil & Filter	50/change	4 changes	200
3	Alum Pump Electricity	0.07/kwh	1134 kwh	79
4	Aluminum Sulphate	0.50/gal	126197 gal	63,099
5	Sludge Excavation	3.00/cy	851 cy	2,553
6	Sludge Loading	1.00/cy	851 cy	851
7	Sludge Hauling	2.50/cy	851 cy	2,128
8	Landfill Tipping Fee	20/load	85 loads	1,700
9	Dike Mowing	100/cut	12 cuts	1,200
10	Repairs	1,000/yr	1 yr	1,000
10	Labor to Operate	5,000/yr	1 yr	5,000
				$78,460

SPREADSHEET NO. 2 - VARIABILITY OF OPERATING COSTS

Rainfall Condition	Sludge Generated cubic yards/year	Operating Cost, $/year		
		Fixed	Variable	Total
Low	426	1200	38,630.00	39,830
Average	851	1200	77,260.00	78,460
High	1461	1200	115,890.00	117,090

Environmental

Results of Alum Jar Test on Dry Lake Dairy

Received 25 gallons of sample water on August 1, 2002. Initial alkalinity = 204 mg $CaCO_3$/L; initial pH = 7.24; initial total P concentrations = 1.99 mg/L.

1. Preliminary Alum Dosage Studies in Beakers with 0.1 L of Sample (August 3, 2002)

	Alum Dosage in mg Al/L					
	0	10	15	20	25	30
No Added Alkalinity	Initial pH 7.35	Initial pH 7.26 Final pH 6.76	Initial pH 7.26 Final pH 6.59	Initial pH 7.25 Final pH 6.40	Initial pH 7.24 Final pH 6.16	Initial pH 7.26 Final pH 5.99
$2.5x10^{-4}$ M Alkalinity Added (10 mg NaOH/L)	Initial pH 7.25 Inter. PH 7.64	Initial pH 7.25 Inter. pH 7.56 Final pH 6.85	Initial pH 7.25 Inter. pH 7.70 Final pH 6.68	Initial pH 7.24 Inter. pH 7.52 Final pH 6.43		Initial pH 7.42 Inter. pH 7.87 Final pH 6.20

Notes: Beginning pH standards at 21:30 were 10.24, 7.00, and 4.01. Ending pH standards were 10.09, 6.90, and 3.90 at 23:00. The titrant was 0.1 N NaOH, which required 0.25 mL into a 0.1L of sample volume to yield a final concentration of $2.5x10^{-4}$ M (10 mg NaOH/L). The *Final pH* in the *No Added Alkalinity* row is after the alum is added. The *Intermediate pH* in the *Alkalinity Added* row is the pH after the NaOH is added, and the *Final pH* is after the alum is added.

Conclusions: For the *No Added Alkalinity* alum dosages, there was a gradual increase in a fine floc which imparted turbidity but did not remove any of the color and was suspended after 24 hours of settling time. Starting at the 25 mg Al/L dose, large flocs removed color, which settled fast (~ 30 min), with more color removed at the 30 than the 25 mg Al/L dosage. The same occurred in the Alkalinity Added treatments, but the advantage of adding the alkalinity was a higher pH (>6.0) at the 30 mg Al/L dosage.

2. Final Alum Dosage Studies in Jars with 2.0 L of Sample (August 5-7, 2002)

Operating Conditions: rpm = 300; water temperature = 22.5-25.5°C. Size of square reactor cubes = 13.8 cm x 13.8 cm. Depth of water in the reactor cubes = 10.5 cm.

Treatment*		Repl	Alum or NaAl	Floc Size	Settling Rate (cm/min)	Floc Thick. (cm)	pH		Total P (mg/L)
Al	NaOH					Δt=24h	Δt=4h	Δt=24h	Δt=24h
0	0	A	-	None	-	-	7.88	8.25	1.76
0	0	B	-	None	-	-	8.05	8.16	1.54
20	0	A	Alum	Fine	0	0	6.98	7.25	1.55
20	0	B	Alum	Fine	0	0.1	6.75	7.16	1.17
25	0	A	Alum	Med	0.4	0.2	6.68	7.07	0.213
25	0	B	Alum	Med	0.2	0.3	6.56	6.98	0.324
30	0	A	Alum	Coarse	0.4	0.3	6.48	6.87	0.032
30	0	B	Alum	Coarse	0.2	0.4	6.42	6.71	0.094
35	0	A	Alum	Coarse	0.4	0.5	6.16	6.78	0.024
35	0	B	Alum	Coarse	0.2	0.6	6.25	6.61	0.035
0	10	A	-	None	-	-	8.12	8.27	1.71
0	10	B	-	None	-	-	8.02	8.27	1.49
20	10	A	Alum	Fine	0	0	7.00	7.41	1.48
20	10	B	Alum	Fine	0	0	6.90	7.57	1.18
25	10	A	Alum	Coarse	0.4	0.3	6.74	7.15	0.200
25	10	B	Alum	Coarse	0.3	0.5	6.65	7.11	0.211
30	10	A	Alum	Coarse	0.3	0.7	6.39	6.81	0.049
30	10	B	Alum	Coarse	0.3	0.5	6.49	6.72	0.042
0	15	A	-	None	-	-	8.34	8.43	1.60
0	15	B	-	None	-	-	8.28	8.12	1.76
20	15	A	Alum	Fine	0	0.3	7.15	7.17	0.416
20	15	B	Alum	Fine	0	0	6.86	7.30	1.74
25	15	A	Alum	Coarse	0.3	0.6	6.85	7.00	0.332
25	15	B	Alum	Med	0.2	0.4	6.62	7.00	0.290
30	15	A	Alum	Coarse	0.3	0.8	6.45	6.88	0.043
30	15	B	Alum	Coarse	0.3	0.4	6.40	6.93	0.044
0	0	A	-	None	-	-	7.89	8.08	1.65
0	0	B	-	None	-	-	7.61	7.76	1.79
20	0	A	NaAl	Fine	0.05	0.4	8.89	8.75	0.221
20	0	B	NaAl	Fine	0.05	0.4	8.67	8.76	0.174
25	0	A	NaAl	Fine	0.05	0.4	9.00	8.85	0.204
25	0	B	NaAl	Fine	0.05	0.5	8.91	8.90	0.149

* All units are mg/L.

Conclusions: The higher than expected alkalinity and pH in the raw water obviated the need for adding bases such as NaOH or Na aluminate. The high initial alkalinity and pH were also partially responsible for the high concentrations of alum (30-35 mg/L) needed to achieve effective coagulation and P removal, although the high dissolved organic matter also contributed. Four- and 24-hour pH values were above 6.0, which is the cutof for aluminum toxicity concerns.

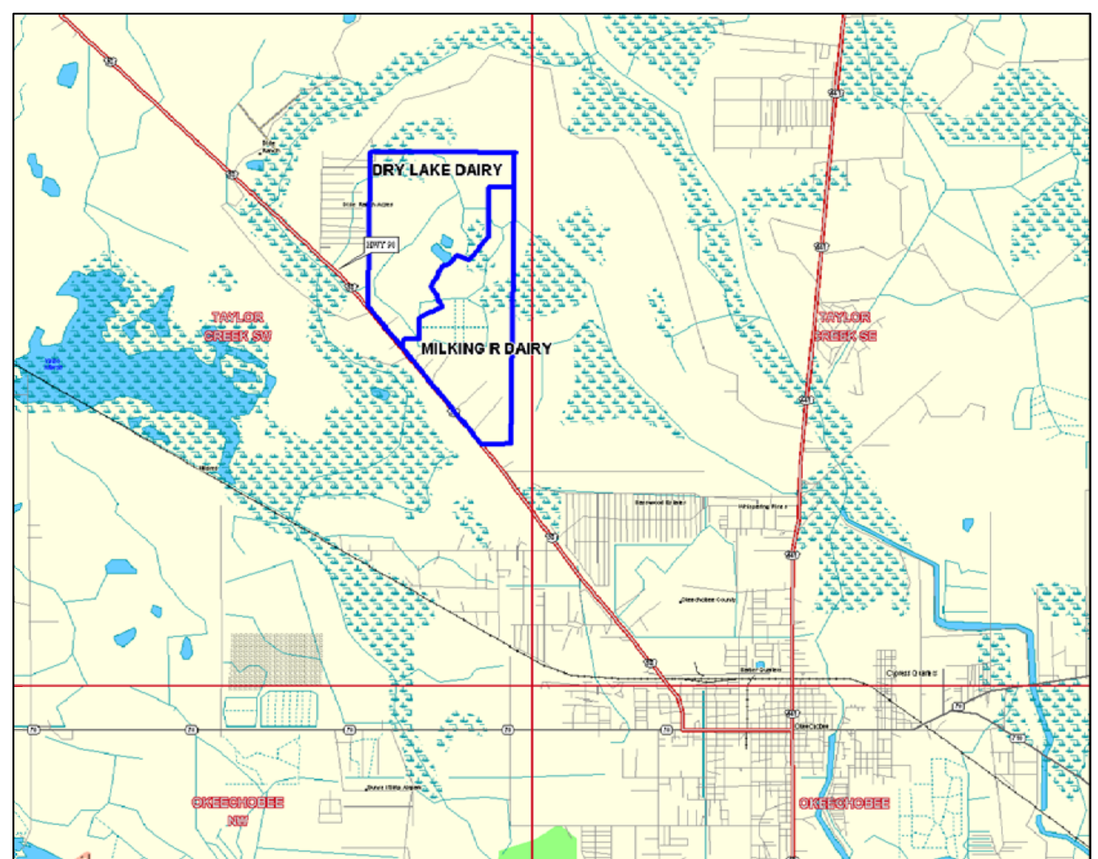
CONSTRUCTION PLANS & SPECIFICATIONS

FOR THE

DRY LAKE DAIRY
EDGE OF FARM TREATMENT SYSTEM

Okeechobee County, Florida

Section 23-26, Township 36 South, Range 34 East



SHEET INDEX

1	*COVER SHEET*
2	*AERIAL PHOTOGRAPH*
3A	*STORM WATER IMPOUNDMENT W/ AERIAL*
3B	*STORM WATER IMPOUNDMENT*
4	*STORM WATER TREATMENT, SECTION DETAILS*
5	*STORM WATER TREATMENT, SECTION DETAILS*
6	*PUMP STATION*
7	*ALUM MIXING STRUCTURE*
8	*EMERGENCY OVERFLOW*

JANUARY 7, 2003

VERSION DATE: 01-07-03
PRINT DATE: 01-07-03
DRAWN BY: DDT

CONSTRUCTION PLANS AND SPECIFICATIONS FOR THE DRY LAKE DAIRY - EDGE OF FARM TREATMENT JANUARY 7, 2003

Engineering & Water Resources, Inc.
851 Johnson Avenue, Suite 214, Stuart, Florida 34994
Phone: (772)781-6408 Fax: (772) 781-6409 Web: www.ewr1.com
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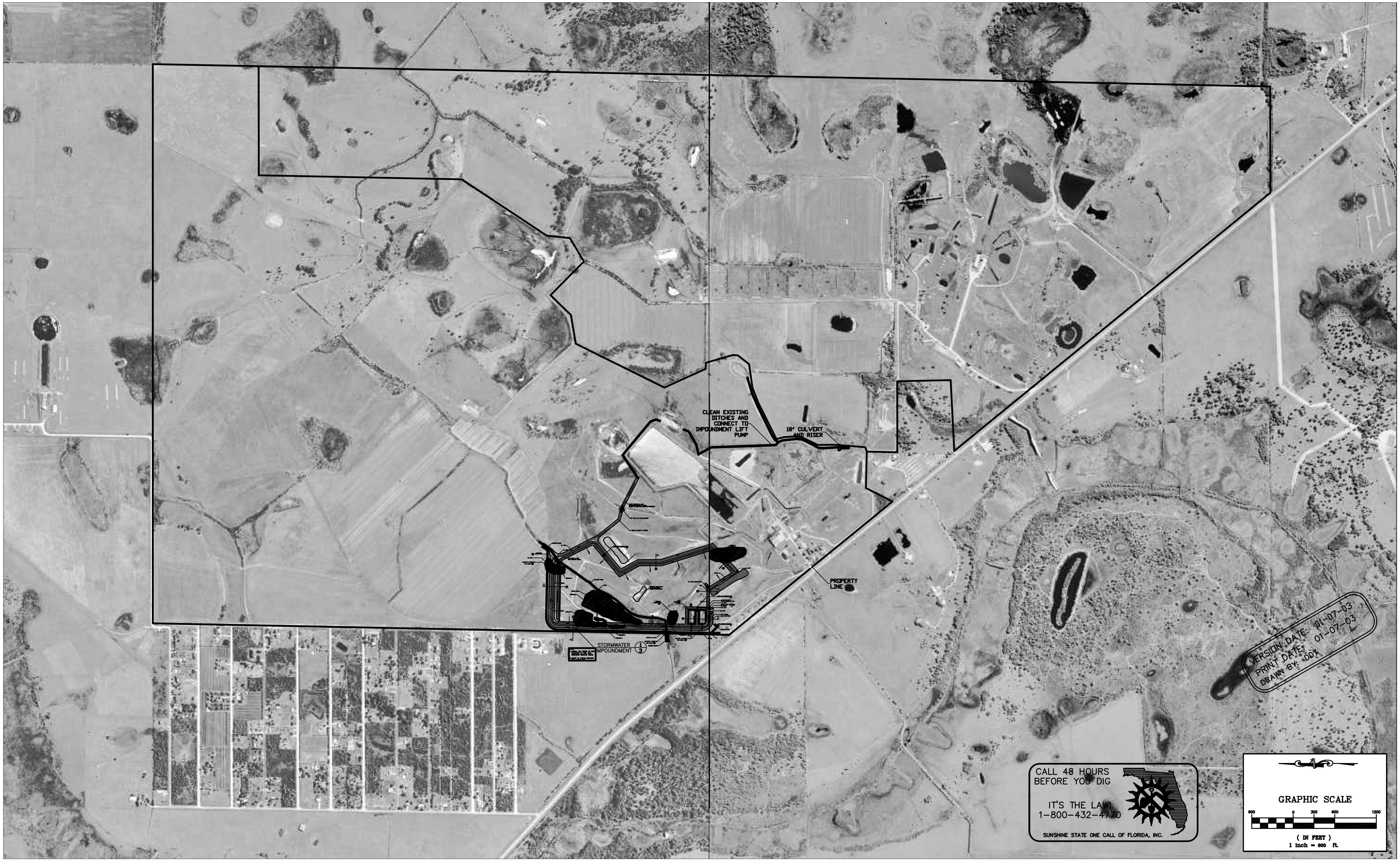

NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: 2&3C
Designed By: B.R.M.
Drawn By: D.D.T.
Checked By: B.R.M.
Verify Scale: 0 1 Inch 1

Date:

DRY LAKE 1 DAIRY

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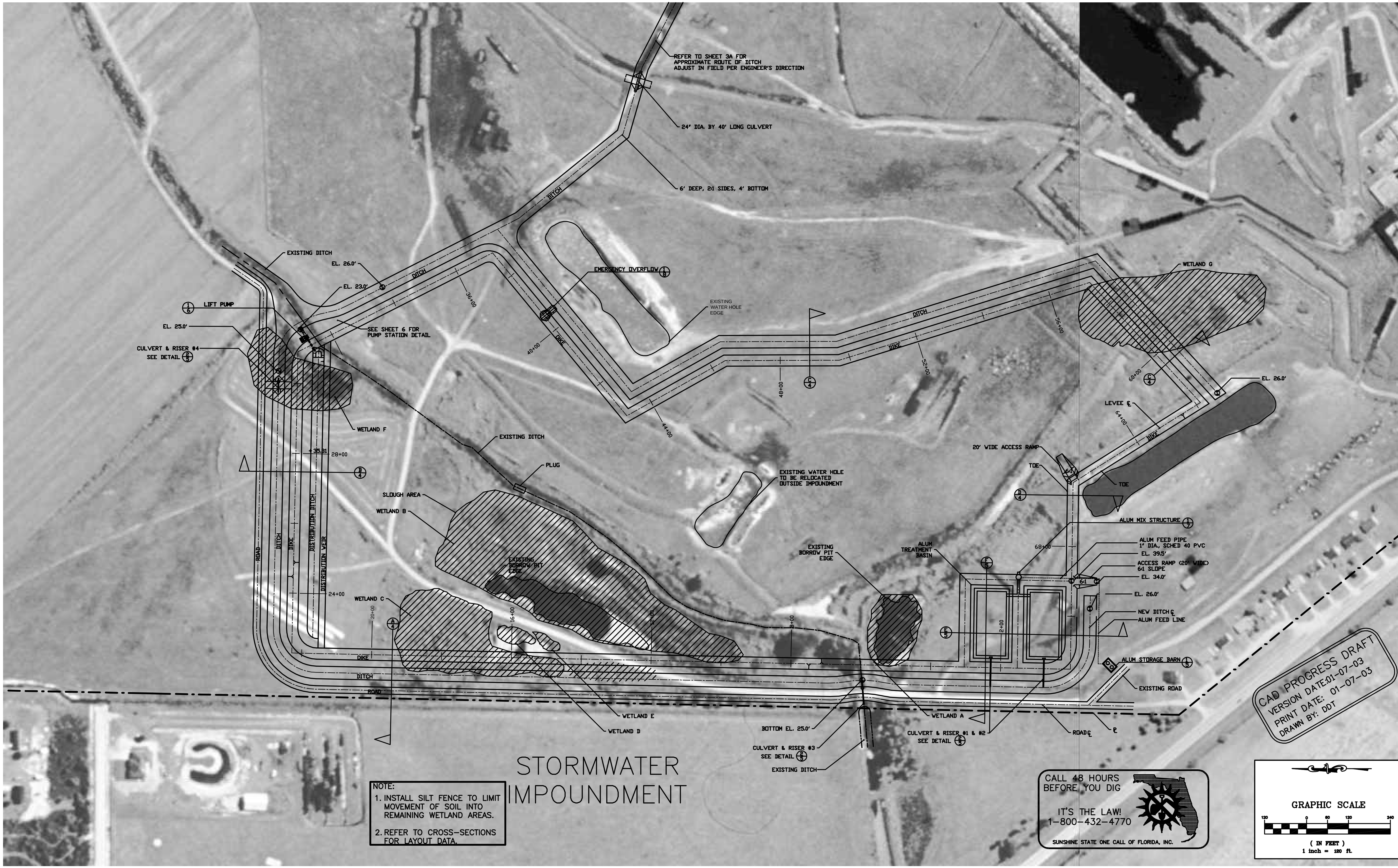
EDGE OF FARM TREATMENT

AERIAL PHOTOGRAPH
SOURCE: USGS DIGITAL ORTHO QUAD. 2-14-99

H. Scale: 1"=600'
V. Scale: N/A
Date: 23-MAY-02

Sheet
2



NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: 2&3C
Designed By: B.R.M.
Drawn By: D.D.T.
Checked By:
Verify Scale: 0 1 Inch

Date:

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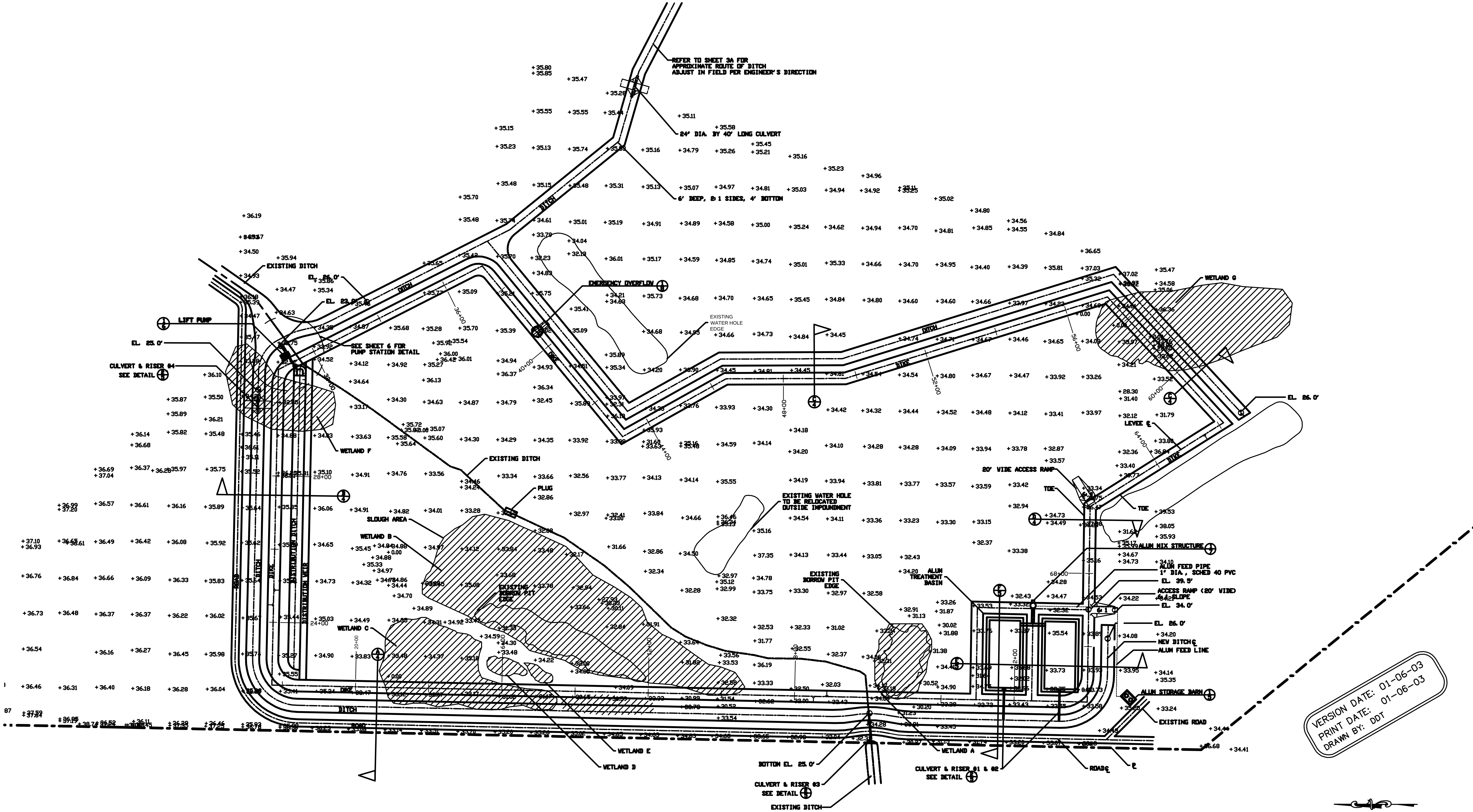
EDGE OF FARM TREATMENT

STORMWATER IMPOUNDMENT

H. Scale: 1"=120'
V. Scale: N/A
Date: 23-MAY-02

Sheet
3A



VERSION DATE: 01-06-03
PRINT DATE: 01-06-03
DRAWN BY: DDT

NOTE:

1. INSTALL SILT FENCE TO LIMIT MOVEMENT OF SOIL INTO REMAINING WETLAND AREAS.
2. REFER TO CROSS-SECTIONS FOR LAYOUT DATA.

LEGEND

- CENTER LINE
- PROPERTY LINE
- WETLAND

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NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: 2&3C
Designed By: B.R.M.
Drawn By: D.D.T.
Checked By:
Verify Scale: 0 1 Inch 1

Date:

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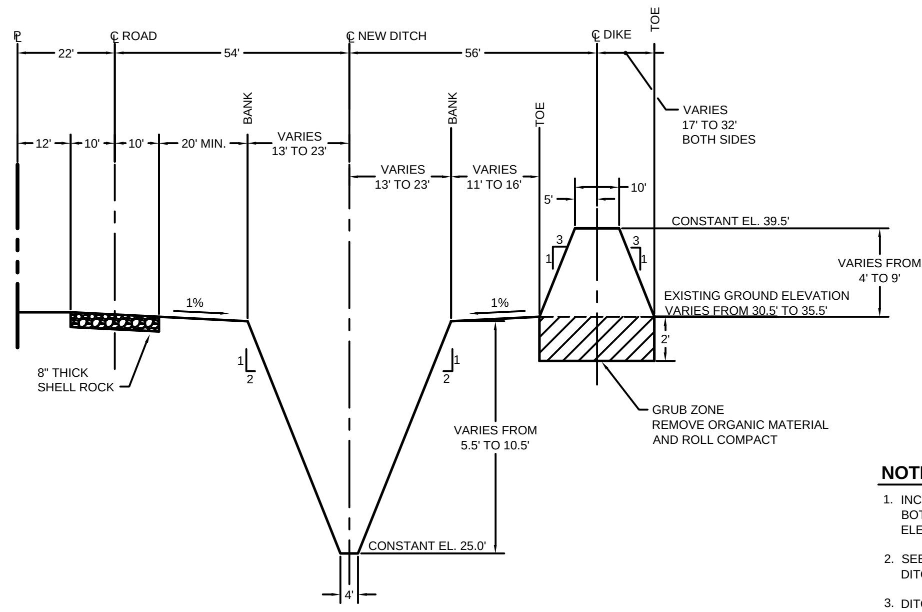
EDGE OF FARM TREATMENT

STORMWATER IMPOUNDMENT

H. Scale: 1"=120'
V. Scale: N/A
Date: 23-MAY-02

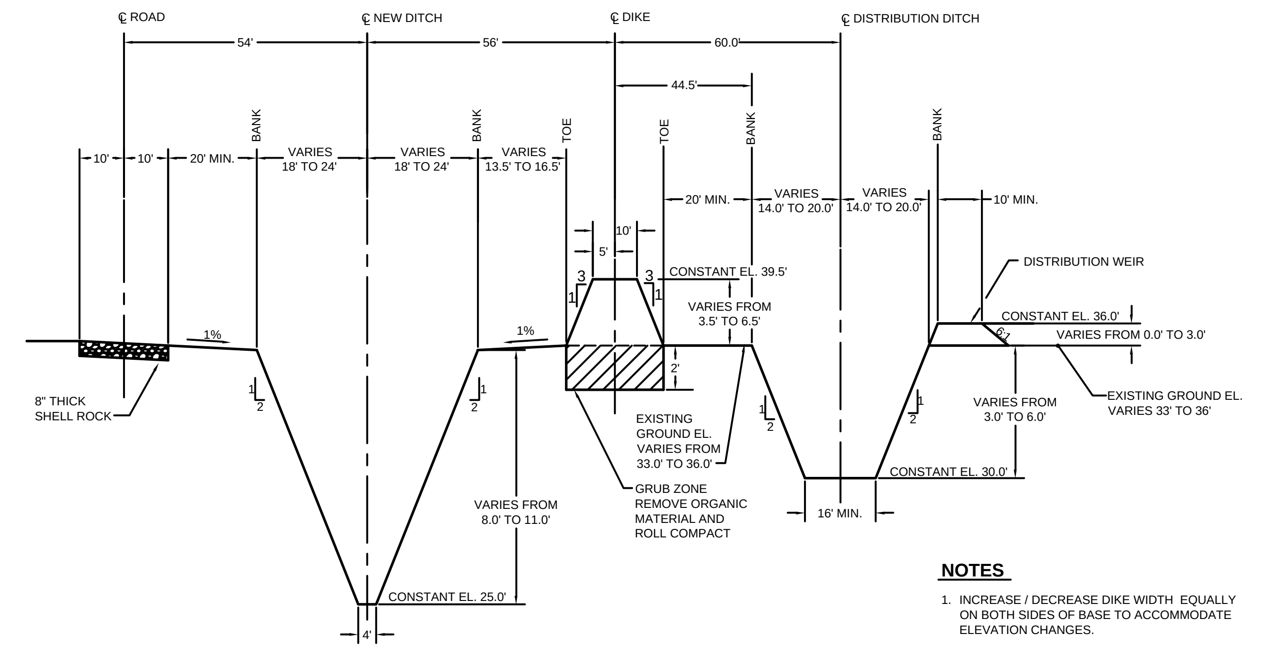
Sheet
3B



DIKE SECTION A (A/4)

NOTES

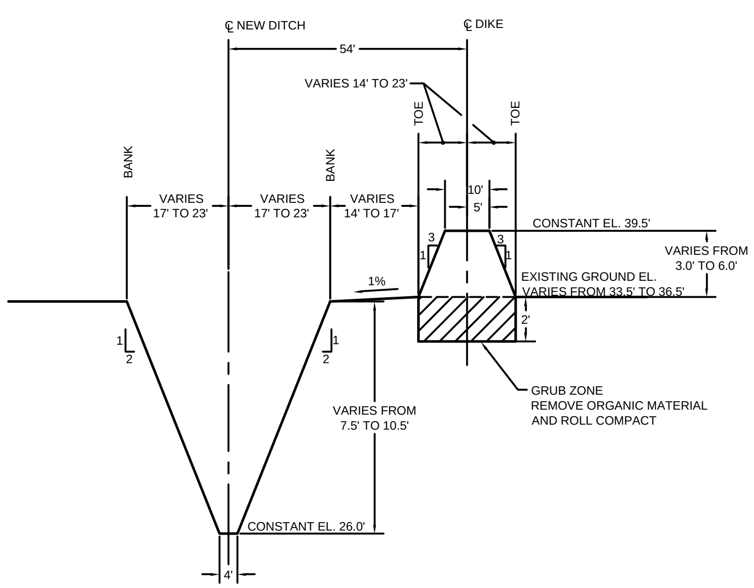
1. INCREASE / DECREASE DIKE WIDTH EQUALLY ON BOTH SIDES OF BASE TO ACCOMMODATE ELEVATION CHANGES.
2. SEED DIKE, ROAD SIDES, AND DITCH BANKS WITH FDOT MIX.
3. DITCH BOTTOM ELEVATION = 25.0', MINIMUM BOTTOM WIDTH = 4', AND MAXIMUM TOP WIDTH = 46'. SIDE SLOPES MAINTAINED AT 2H:1V. DEPTH OF DITCH CHANGES TO ACCOMODATE ELEVATION CHANGES.



DIKE SECTION B (B/4)

NOTES

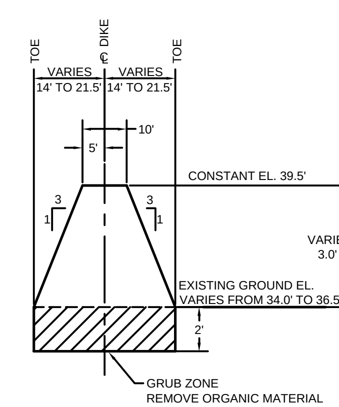
1. INCREASE / DECREASE DIKE WIDTH EQUALLY ON BOTH SIDES OF BASE TO ACCOMMODATE ELEVATION CHANGES.
2. SEED DIKE, ROAD SIDES, DITCH BANKS AND DISTRIBUTION WEIR WITH FDOT MIX.
3. DITCH BOTTOM ELEVATION = 25.0', MINIMUM BOTTOM WIDTH = 4', AND MAXIMUM TOP WIDTH = 48'. SIDE SLOPES MAINTAINED AT 2H:1V. DEPTH OF DITCH CHANGES TO ACCOMODATE ELEVATION CHANGES.
4. DISTRIBUTION DITCH BOTTOM EL. = 30.0', MINIMUM BOTTOM WIDTH = 16.0', AND MAXIMUM TOP WIDTH = 41.0'. SIDE SLOPES MANTAINED AT 2H:1V. DEPTH OF DITCH CHANGES TO ACCOMODATE ELEVATION CHANGES.



DIKE SECTION C (C/4)

NOTES

1. INCREASE / DECREASE DIKE WIDTH EQUALLY ON BOTH SIDES OF BASE TO ACCOMMODATE ELEVATION CHANGES.
2. SEED DIKE, ROAD SIDES, AND DITCH BANKS WITH FDOT MIX.
3. DITCH BOTTOM ELEVATION = 25.0', MINIMUM BOTTOM WIDTH = 4', AND MAXIMUM TOP WIDTH = 46'. SIDE SLOPES MAINTAINED AT 2H:1V. DEPTH OF DITCH CHANGES TO ACCOMODATE ELEVATION CHANGES.



DIKE SECTION D (D/4)

NOTES

1. INCREASE / DECREASE DIKE WIDTH EQUALLY ON BOTH SIDES OF BASE TO ACCOMMODATE ELEVATION CHANGES.
2. SEED DIKE, ROAD SIDES, AND DITCH BANKS WITH FDOT MIX.

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VERSION DATE: 01-07-03
PRINT DATE: 01-07-03
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NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: SECTIONS
Designed By: B.R.M.
Drawn By: D.D.T.
Checked By:
Verify Scale: 0 — 1 (1 Inch)

Date:

DRY LAKE DAIRY

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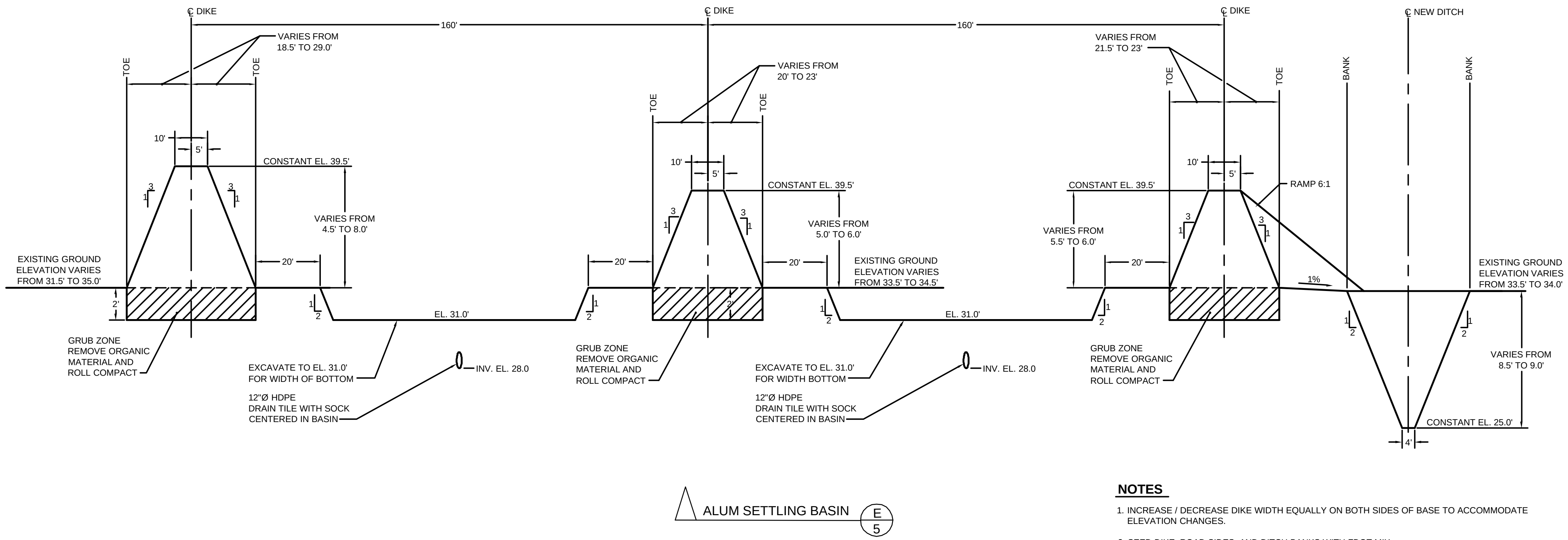
EDGE OF FARM TREATMENT

STORMWATER TREATMENT
SECTION DETAILS

H. Scale: 1'=20'
V. Scale: N/A
Date: MAY-23-02

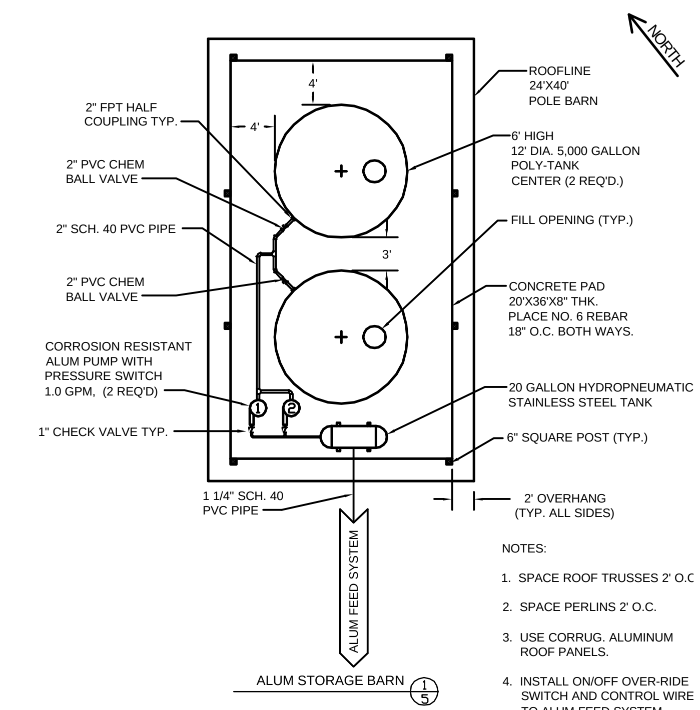
Sheet
4



ALUM SETTLING BASIN E/5

NOTES

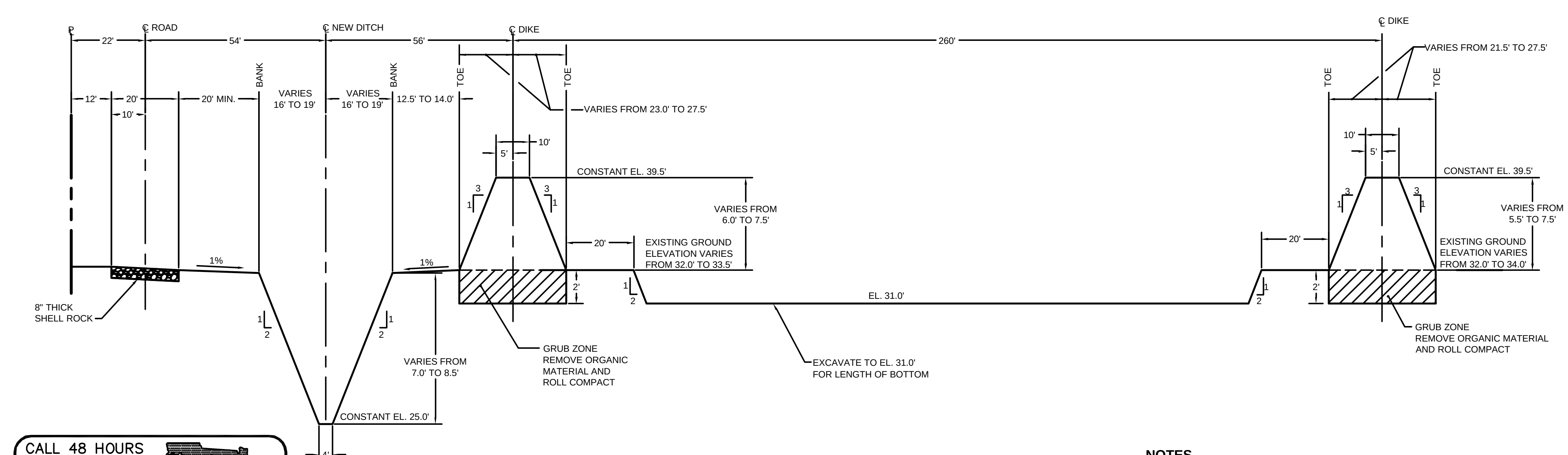
1. INCREASE / DECREASE DIKE WIDTH EQUALLY ON BOTH SIDES OF BASE TO ACCOMMODATE ELEVATION CHANGES.
2. SEED DIKE, ROAD SIDES, AND DITCH BANKS WITH FDOT MIX.
3. DITCH BOTTOM ELEVATION = 25.0', MINIMUM BOTTOM WIDTH = 4', AND MAXIMUM TOP WIDTH = 40'. SIDE SLOPES MAINTAINED AT 2H:1V. DEPTH OF DITCH CHANGES TO ACCOMODATE ELEVATION CHANGES.



ALUM STORAGE BARN 1/5

NOTES:

1. SPACE ROOF TRUSSES 2' O.C
2. SPACE PERLINS 2' O.C.
3. USE CORRUG. ALUMINUM ROOF PANELS.
4. INSTALL ON/OFF OVER-RIDE SWITCH AND CONTROL WIRE TO ALUM FEED SYSTEM.
5. PROVIDE PRESSURE SWITCH ON EACH PUMP TO START @ 10 PSI AND STOP @ 15 PSI.



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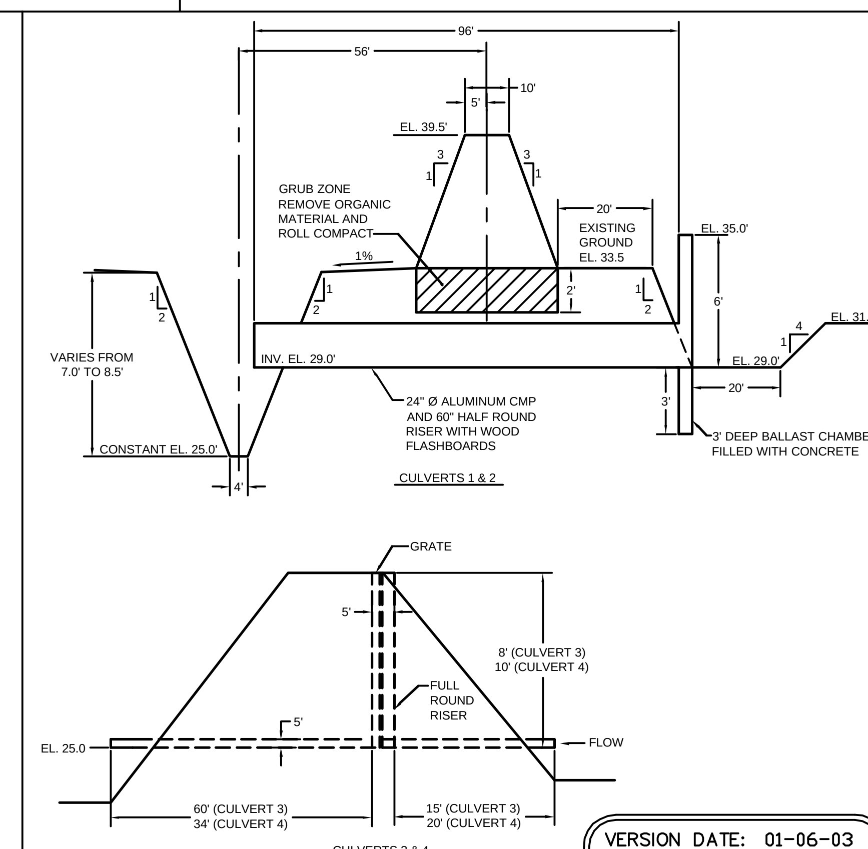
ALUM SETTLING BASIN F/5

NOTES

1. INCREASE / DECREASE DIKE WIDTH EQUALLY ON BOTH SIDES OF BASE TO ACCOMMODATE ELEVATION CHANGES.
2. SEED DIKE, ROAD SIDES, AND DITCH BANKS WITH FDOT MIX.
3. DITCH BOTTOM ELEVATION = 25.0', MINIMUM BOTTOM WIDTH = 4', AND MAXIMUM TOP WIDTH = 38'. SIDE SLOPES MAINTAINED AT 2H:1V. WIDTH OF DITCH CHANGES TO ACCOMODATE ELEVATION CHANGES.



CULVERT DETAIL 2/5

VERSION DATE: 01-06-03
PRINT DATE: 01-06-03
DRAWN BY: DDT

NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: SECTIONS
Designed By: B.R.M.
Drawn By: D.D.T.
Checked By:
Verify Scale: 0 1 Inch 1

Date:

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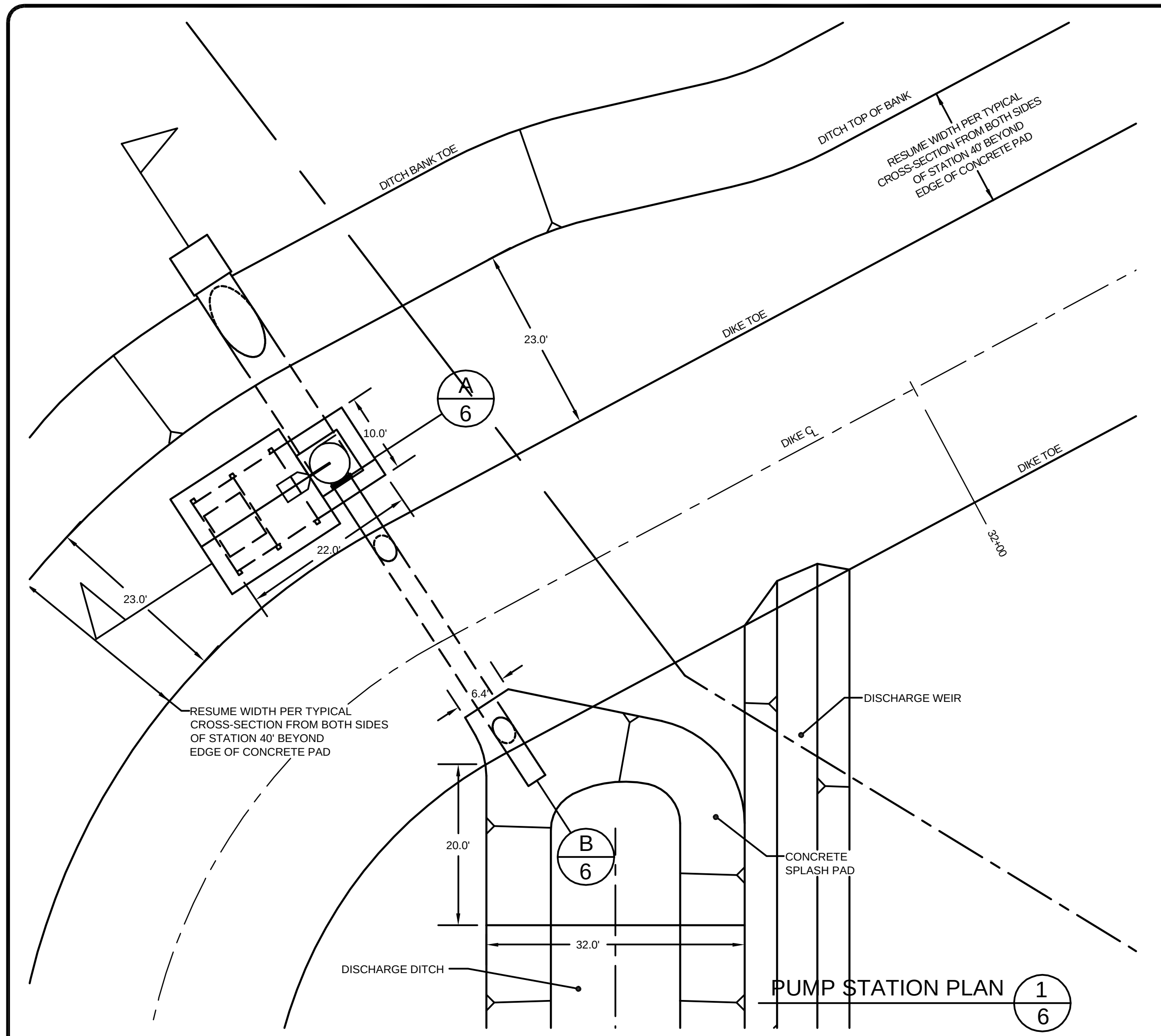
EDGE OF FARM TREATMENT

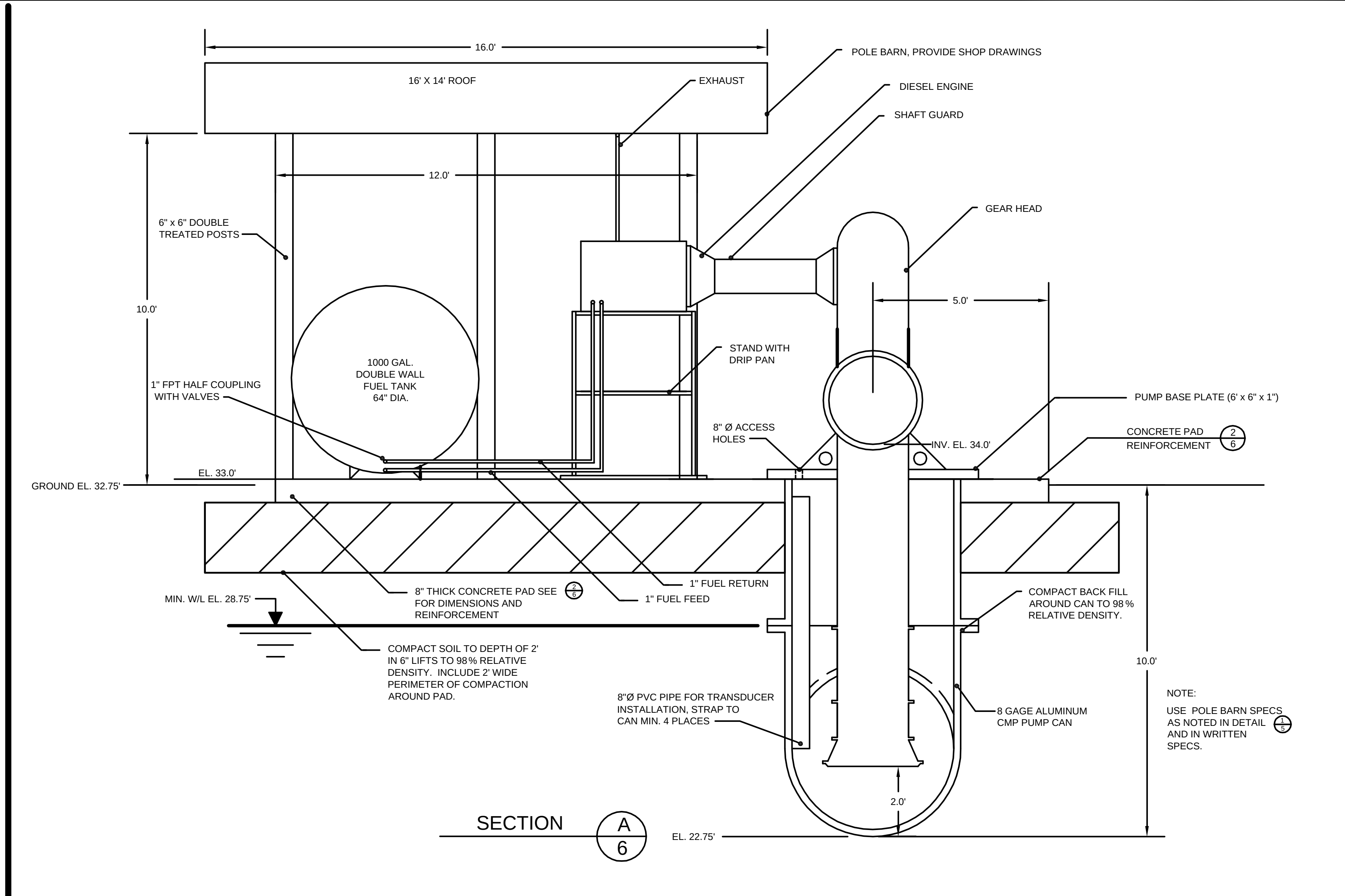
STORMWATER TREATMENT SECTION DETAILS

H. Scale: AS NOTED
V. Scale: AS NOTED
Date: MAY-23-02

Sheet 5



PUMP STATION PLAN 1/6



SECTION A/6

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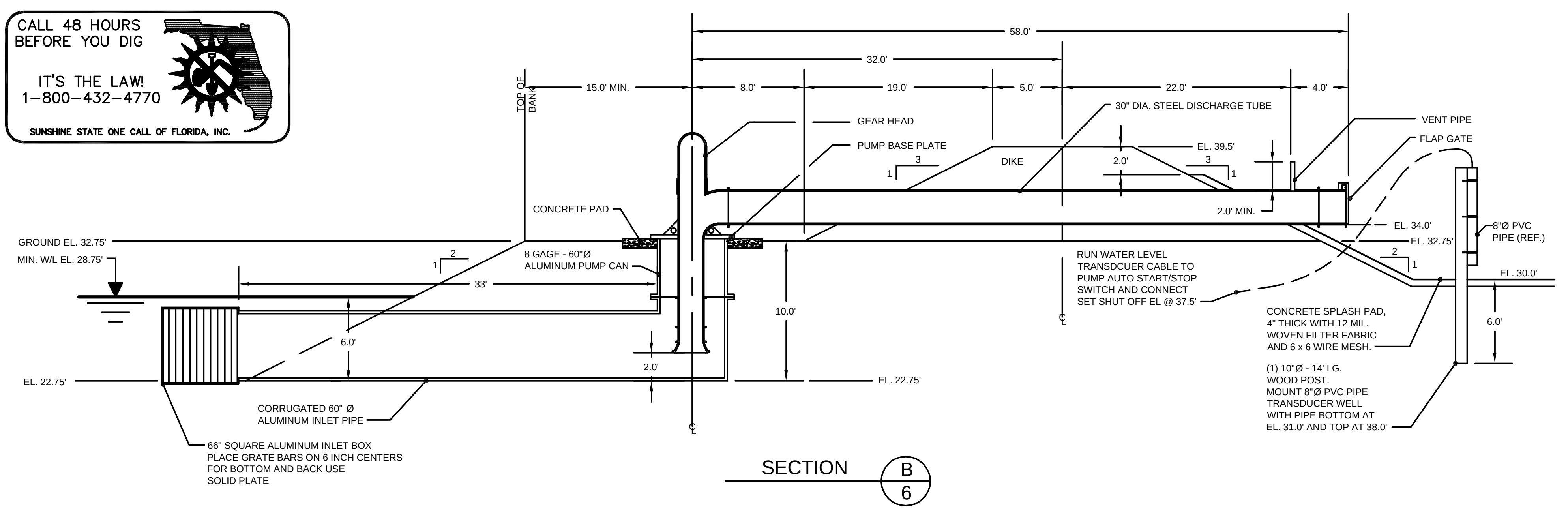
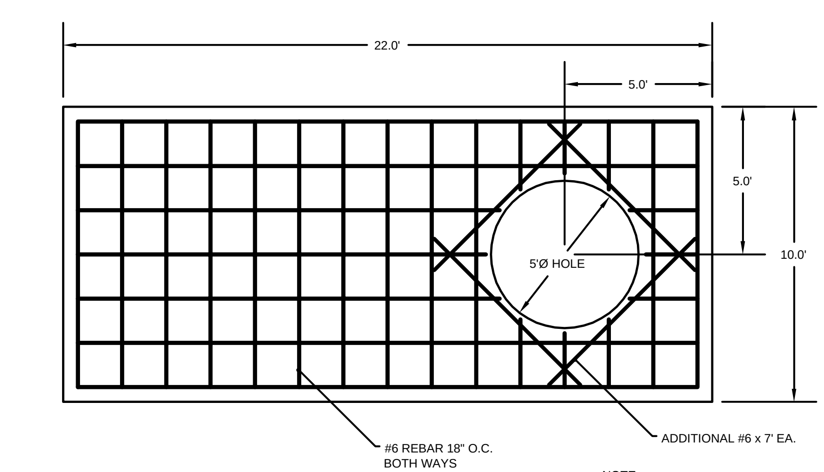


SECTION B/6



NOTE:
1. CUT EXPANSION JOINTS EVERY 5 FEET.
2. CENTER REBAR IN LOWER HALF OF PAD.

CONCRETE PAD REINFORCEMENT 2/6

VERSION DATE: 01-06-03
PRINT DATE: 01-06-03
DRAWN BY: DDT

NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: LIFT PUMP
Designed By: BRM
Drawn By: DDT
Checked By: BRM, RAM
Verify Scale: 0 — 1 Inch

Date:

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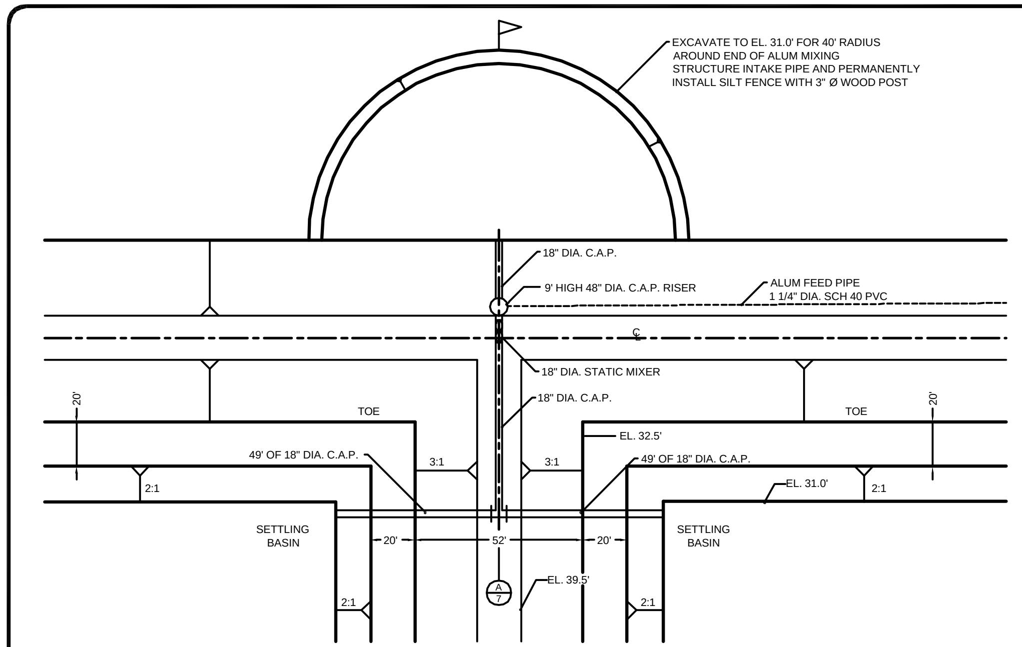
EDGE OF FARM TREATMENT

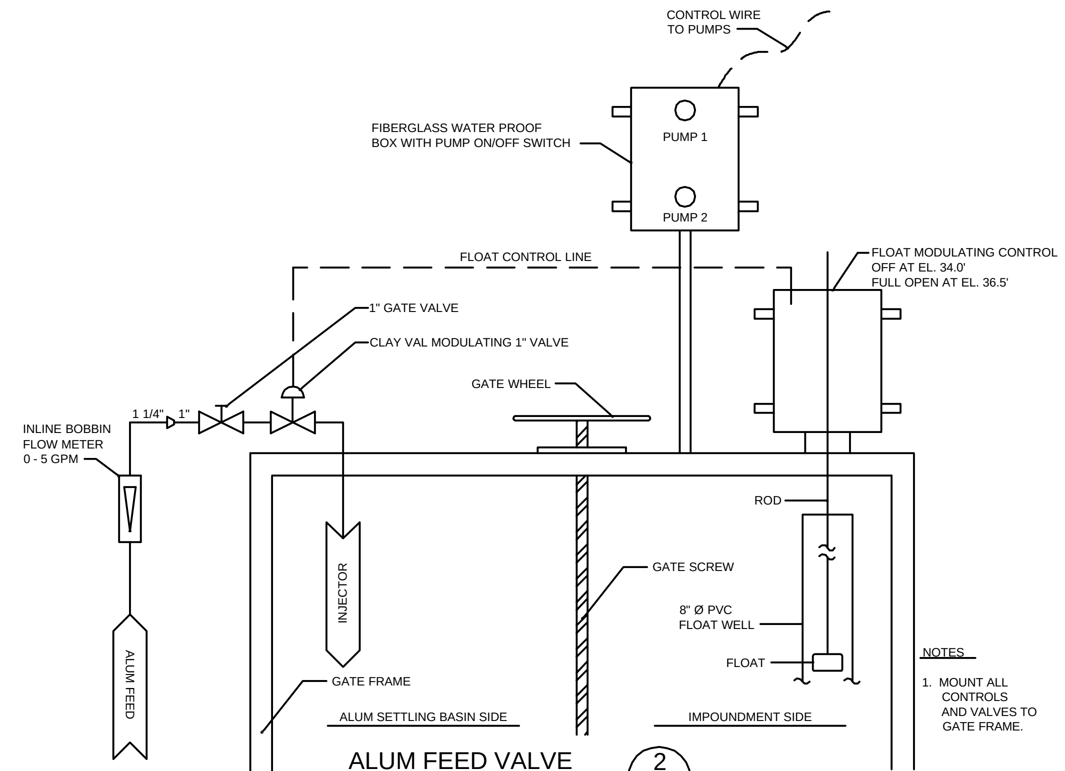
LIFT PUMP STATION

H. Scale: N/A
V. Scale: N/A
Date: 08-05-02

Sheet 6



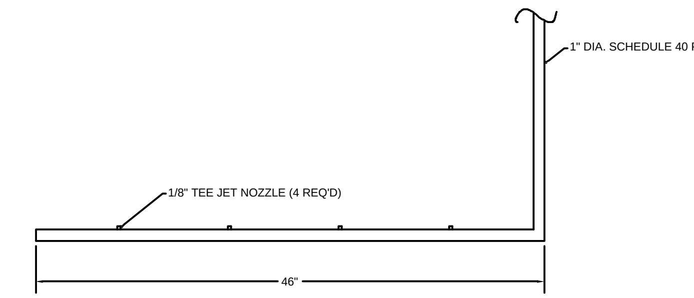
ALUM STRUCTURE 1/7



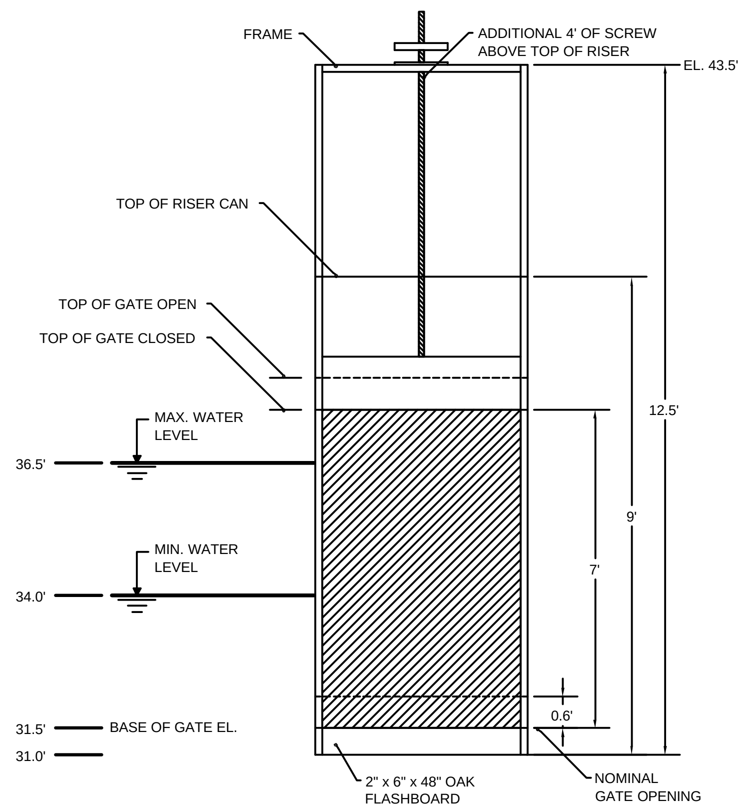
NOTES

1. MOUNT ALL CONTROLS AND VALVES TO GATE FRAME.

ALUM FEED VALVE 2/7



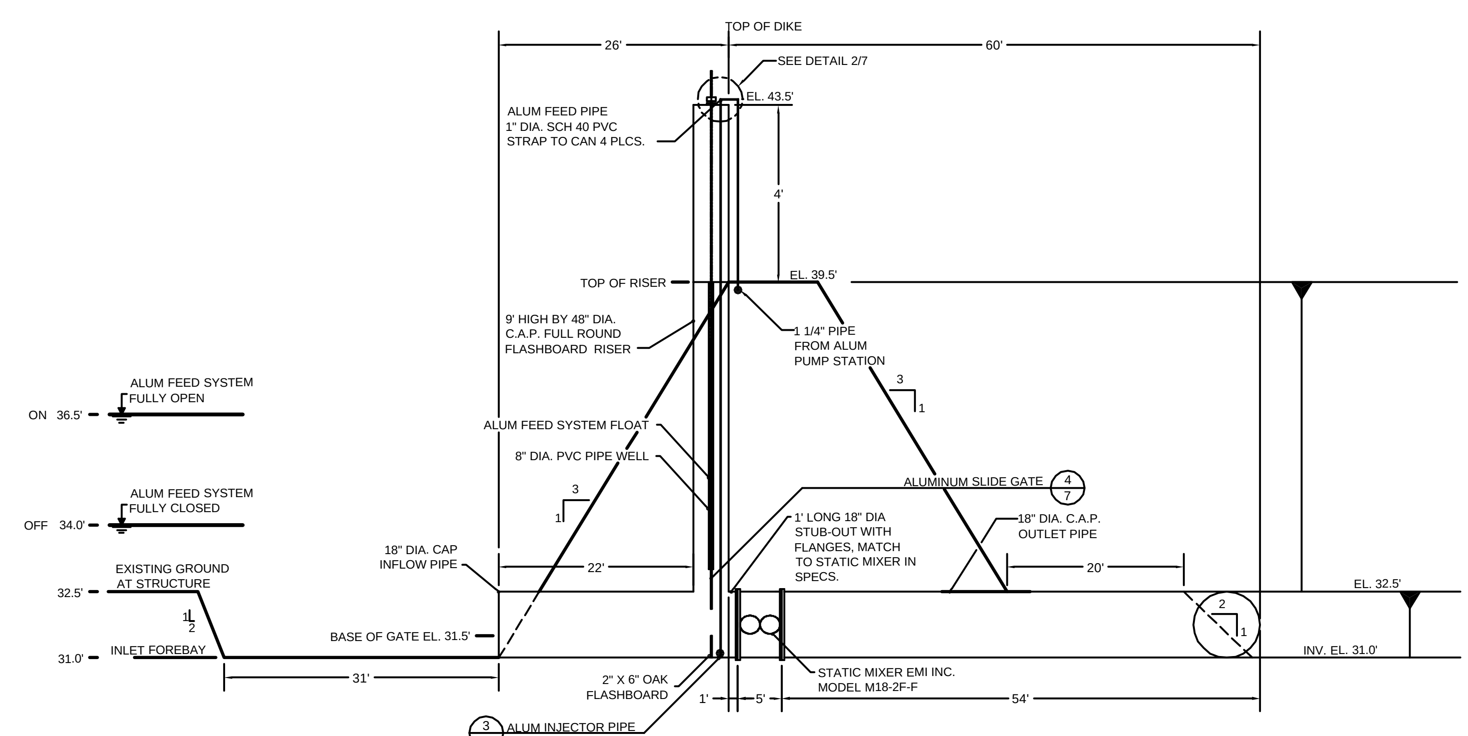
ALUM INJECTOR PIPE 3/7



NOTES

SLIDE GATE IS MODEL AR-5fy DESIGNED BY WATERMAN INDUSTRIES. REFER TO CATALOG DATA IN SPECS.

ALUMINUM SLIDE GATE 4/7



NOTES

1. PROVIDE OVERSIZE GASKETS AT FLANGESTO PREVENT GALVINIZATION.
2. PROVIDE STANDARD ASA PATTERN FLANGES TO MATE WITH STATIC MIXER.

SECTION A/7

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VERSION DATE: 01-06-03
PRINT DATE: 01-06-03
DRAWN BY: DDT

NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: STATIC MIX
Designed By: BRM
Drawn By: DDT
Checked By: BRM, RAM
Verify Scale: 0 1 — 1 Inch

Date:

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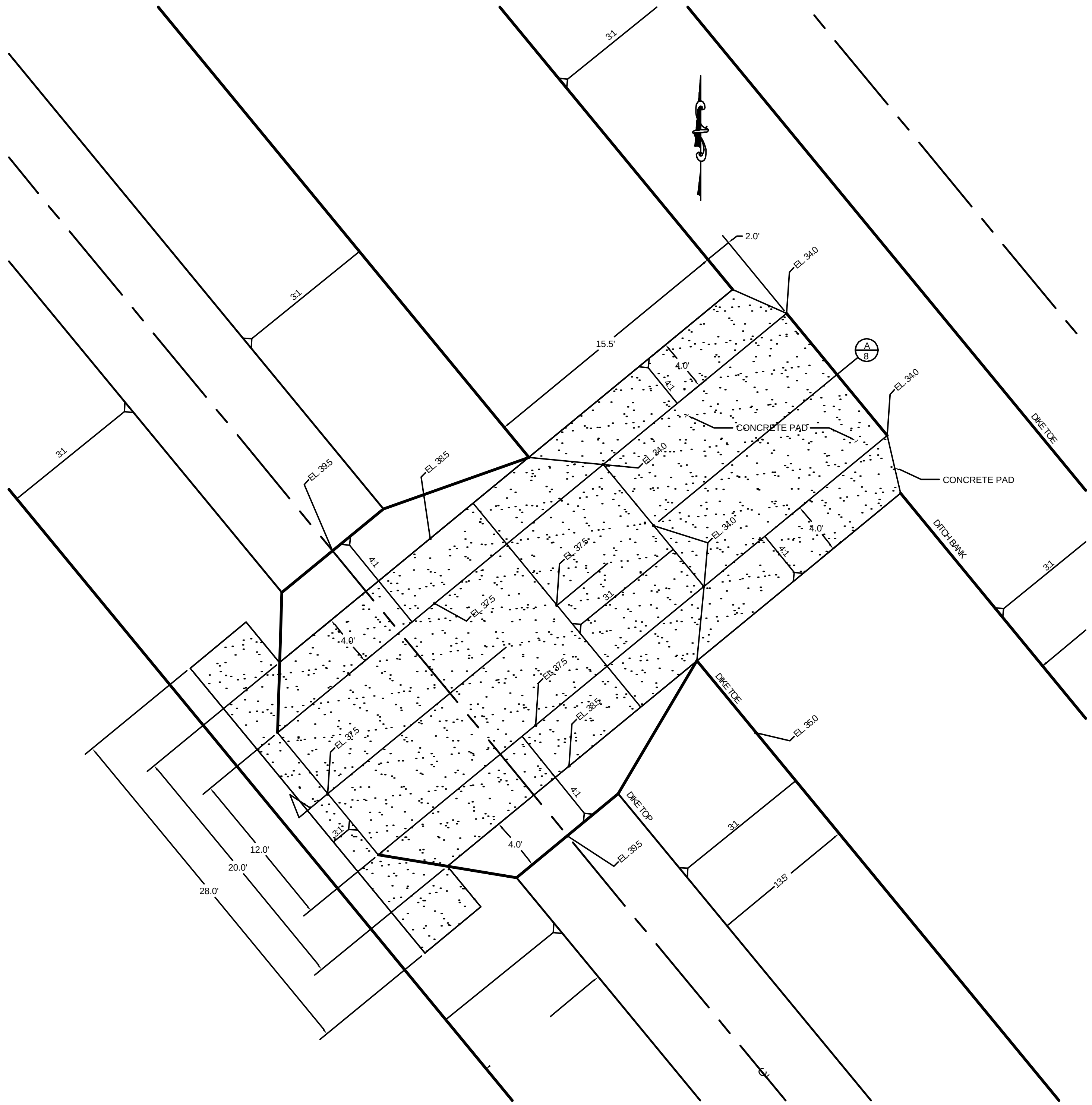
EDGE OF FARM TREATMENT

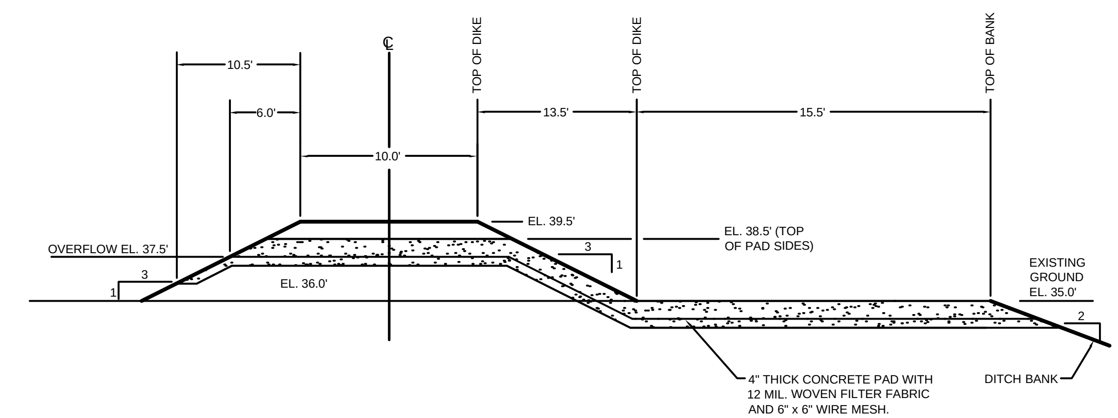
ALUM MIXING STRUCTURE

H. Scale: N/A
V. Scale: N/A
Date: 08-13-02

Sheet 7



EMERGENCY OVERFLOW 1/8



SECTION A/8

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VERSION DATE: 01-06-03
PRINT DATE: 01-06-03
DRAWN BY: DDT

NO.	Date	By	Revision

Project Folder: DAIRY BAT
Drawing Name: EMERGENCY OVERFLOW
Designed By: BRM
Drawn By: DDT
Checked By: BRM, RAM
Verify Scale: 0 1 — 1 Inch

Date:

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EDGE OF FARM TREATMENT

EMERGENCY OVERFLOW

H. Scale: N/A
V. Scale: N/A
Date: 08-09-02

Sheet
8

SFWMD DAIRY BAT PROJECT
DRY LAKE DAIRY
TECHNICAL SPECIFICATIONS
June 8, 2002

1) Coordination and Shop Drawings

   a) Coordinate the specifications herein with those listed on the drawings and provided elsewhere.
   b) Provide shop drawings for all fabrications and equipment prior to ordering.

2) Culverts and Risers

   a) Provide corrugated aluminum culverts and risers with wall thicknesses per FDOT specifications.
   b) Provide double pressure-treated, oak riser boards, cut to fit riser.
   c) Use only aluminum flanges with rubber gaskets and stainless steel hardware to join culvert sections and risers.
   d) Brace half-round risers per Southern Culvert Dwng. Nos. 950623-1 attached.
   e) Brace full-round risers sufficiently to minimize deformation.
   f) Provide aluminum grates with hinges on top of all full-round risers.
   g) Refer to Sheet 3A and Sheet 5 for unit dimensions.
   h) On Alum mix structure, provide flanges to match the static mixer and board channels to match the Waterman slide gate. Catalog sheets for these two items are attached.

3) Pole Barns

   a) Provide pole barns with dimensions shown in the drawings with painted structural steel members and galvanized steel corrugated roof panels.
   b) Size structural members and roof to withstand sustained wind speed of 100 miles per hour.
   c) Fasten poles to concrete pad with galvanized steel anchor bolts and plates..
   d) Fasten engine exhaust pipe to roof truss with galvanized steel hangers approved for exhaust pipe service.
   e) Provide overhead lights and switches for good nighttime illumination. Use 24 volt, DC system on lift station and connect to engine power system.

4) Alum Equipment

   a) Provide two HDPE, heavy gage storage tanks with dimensions as indicated in the drawings as manufactured by Chemical Containers or equal. Equip tanks with fill inlets and threaded bungs for pipe connections.
   b) Provide two alum injection pumps on steel stands with capacity of 0.5 gallons per minute, minimum 20 psi, manufactured specifically for alum service. Do not use constant displacement pumps, as flow rate will be varied with a valve.

c) Provide all motor controls with external on/off switch, main breaker and fiberglass enclosures. Select motors to match available power supply.
d) Use PVC plastic pipe, fittings and ball valves rated specifically for alum service.
e) Provide flow meters for alum service at each pump and at the mixing feed point.
f) Attach pipe to floor of barn with approved fasteners.

5) Lift Pump Station

a) Provide an 13,200 gallon per minute axial flow pump as indicated in the attached specifications Section 11212 – "Axial Flow Pumps" and the drawings. Design pump to produce a total dynamic head to provide for all head losses and 7 feet static lift.

b) Provide a double-wall painted steel fuel tank with 1000-gallon capacity and all vents, overfill protection and fittings to meet all FDEP requirements for diesel fuel service.

c) Connect fuel tank to engine with 1-inch diameter galvanized steel pipe, fittings and shutoff valves. Provide supplemental fuel filter on feed line.

d) Provide complete diesel engine with stand, oil drip pan, battery holder, two – 24 volt batteries, engine controls and clutch. Size engine to produce 1.2 times the maximum pump horsepower required at the PTO shaft at maximum 2000 rpm including gear head and drive shaft losses. Provide the engine brand specified by the dairy owner.

e) Select gear head to match pump rpm to engine with engine design operating speed.

f) Provide complete automatic engine start/stop system with a level transducer located in the pump sump and one located inside the impoundment. House transducers in PVC pipe stilling wells. Configure to run off of engine power system. Include pre-start alarm. Provide unit as manufactured by Tradewinds Power Corp.

SECTION 11212 AXIAL FLOW PUMPS

PART 1 – GENERAL

A. Description

1. This section includes materials, testing, shipping, warranty and installation of axial flow pumps, discharge tubes, discharge tubes, flap gates and right-angle drive gear drives for drainage service.

B. Related Work Specified Elsewhere

1. Owner has provided drawings indicating the configuration, capacity and dimensions of each pump station. Confirm in writing that Owner's pump station design and configuration will accommodate the pump design and hydraulic requirements. Report any inconsistencies to Owner prior to commencement of fabrication.

C. Submittals

1. Submit pump catalog data, including intended pump speed, to Owner with the Bid Proposal.

2. Submit to Owner shop drawings, as set forth in the following paragraphs, for each pump assembly and gear drive two weeks prior to commencement of fabrication.

3. Submit dimensional drawings showing materials of construction by ASTM reference and grade.

4. Submit manufacturer's sample form for reporting performance test results to Owner for approval. Include on the test form the following: date of test, pump model no., Owner's pump designation, project name, test location, personnel conducting test, duration of test, flow rates, static head, total head, input horsepower, output water horsepower, required submergence, power efficiency, shaft run-out above the packing box and test conditions.

5. Submit a schematic of the testing facility indicating where and how measurements are obtained.

6. Submit a written copy of the warranty specified in this section.

7. Submit a complete schedule for manufacture, testing and delivery of the equipment that complies with Owner's delivery requirements.

8. Submit two copies of manufacturer's test results on the Owner-approved form two weeks prior to shipping the equipment to the project site.

9. Submit three copies of operation and maintenance manuals, covering all pumps provided, to Owner prior to requesting payment.

D. Measurement for Payment

1. Equipment will be paid for on a lump sum basis for each pump assembly that is fully manufactured, tested and delivered to Owner's project site. Owner will identify specific delivery points within the project site as work progresses. Written warranty and all shop drawing data must be received and approved by Owner prior to payment.

E. Warranty

1. Provide a written warranty for removal, transportation, complete replacement and/or repair of any defects and re-installation of the equipment into Owner's pump station. Warranty period shall be not less than one year from the date each pump is put into service.

F. Services of Manufacturer During Construction

1. Owner will hire an independent contractor to construct each pump station and install the equipment. Provide up to two days of manufacturer's personnel, as directed by Owner, to coordinate with Owner's contractor and assist in the installation and start up of each pump station at Owner's project site.

G. Definitions

1. All test data, methodologies and definitions must conform to those used in publications of the Hydraulic Institute Standards. If closed-loop testing is proposed, the velocity head of water piped to the pump inlet must be accounted for in calculating total head and pump efficiency and available submergence must be verified.

PART 2 – MATERIALS

A. Right-Angle Drive Gear Drive

1. Equip each pump with an oil-lubricated right angle gear drive sized to transmit the duty point horsepower requirement of the pump plus at least 15% excess horsepower. Provide a units with a 90-degree bevel gear, hollow shaft, heavy duty speed reducer capable of handling all thrust loads imposed by the pump and drive unit. Provide thrust bearings and gears with an AFBMA B-10 life of at least 20,000 hours and service factor of 1.5 by AGMA standards, based on the maximum load at design point. Acceptable manufacturers include De'Ran, Johnson and Amarillo.

B. Steel Thickness

1. Fabricate the pump intake bell, pump bowl, vanes, discharge column, elbow, tower, flap gate and discharge tube using the following minimum steel thickness:

    a) Pumps up to 10,000 gallons per minute (gpm) capacity: 1/4 inch thick,
    b) Pumps above 10,000-gpm capacity: 3/8 inch thick.

2. Fabricate all flanges in conformance with dimensions specified for ANSI B16.1 Class 25 flanges.

C. Pump Bowl

1. Manufacture the pump bowl and intake bell from ASTM A242 "Corten" steel with a replaceable AISI Series 300 stainless steel liner. Locate bearings above and below the impeller with an AFBMA B-10 life of at least 20,000 hours. Bolt the intake bell to the pump bowl, and the bowl to the discharge column, with ASTM A242 "Corten" steel flanges conforming to dimensional requirements of ANSI B16.1 Class 25 flanges, accurately machine faced and drilled. Provide straightening vanes on both the pump bowl and intake bell. The intake bell diameter shall be 1 1/2 times the impeller diameter. Construct it to minimize vortex formation by maintaining equal pressure and velocity across the intake bell entrance.

D. Impellers

1. Manufacture the impeller hub and blades from ASTM A242 "Corten" steel. Taper bore the hub and employ a key for positive locking to the pump shaft and easy removal. Round the leading edges of impeller blades and taper the trailing edges to provide a smooth blade contour and enhance hydraulic efficiency. Chamfer blades on both sides at the root for full-penetration welding to the hub. Machine the blade periphery for a close running fit with the impeller casing. Statically and dynamically balance the completed impeller assembly.

E. Bearings

1. Provide bearings at the top of the pump, above and below the impeller and within the shaft enclosing tube. Bearings shall be constructed from Bronze, ASTM B 584, Alloy C 93700 and have a minimum AFBMA B-10 life of 20,000 hours.

2. Support the pump lineshaft with bearings at intervals so that the first natural frequency is at least 20% above the operating speed. At bearing locations, support the shaft enclosing tube with "spider" supports fastened to the pump discharge column. Lubricate bearings with oil from the top of the enclosure tube by means of a one-gallon oil reservoir.

3. Design the thrust bearing to carry the entire weight of the rotating element of the pump and hydraulic thrust imposed by the impeller. Locate the thrust bearing in the bearing housing at

the top of the pump hood. Provide bearings with an AFBMA B-10 life of at least 20,000 hours and design it to be readily removable in the field.

F. Pump Column Assembly

1. Manufacture the pump discharge column and elbow from ASTM A242 "Corten" steel. Pump column, elbow and discharge tube shall be the same diameter as specified in the Contract Documents. Flanges shall be fabricated from ASTM A242 "Corten" steel conforming to dimensional requirements of ANSI B16.1 Class 25 flanges. The elbow shall have a centerline radius of not less than one times the nominal pipe diameter. Pipe outside diameters shall conform to the dimensions specified in ANSI B36.10 – Welded and Seamless Wrought Steel Pipe for each specified nominal diameter.

G. Pump Lineshaft and Enclosure

1. Select the pump lineshaft diameter to transmit the full load torque at the pump's highest power requirement and to limit vibration in accordance with ASME code for transmission shafting. Manufacture the shaft from cold rolled AISI 1045 steel with hardened nickel chrome inlays at each contact point with seals and bearings. Maximum allowable total shaft run-out above the packing box shall not exceed 0.003 inch.

2. Provide a shaft enclosing tube between the pump bowl and upper thrust bearing fabricated from ASTM A53, Schedule 80 steel pipe. Seal both ends of the enclosing tube with lip seals to prevent leakage of shaft lubricant and entrance of water or foreign materials.

3. Seal shall be accessible through windows placed at 90 degrees from the discharge pipe centerline. Fit the windows with hinged, galvanized, expanded metal guards to protect personnel from the exposed shaft and coupling

H. Pump Mounting Plate

1. Manufacture the pump mounting plate from ASTM A36 steel with mounting holes. The minimum mounting plate thickness shall be 3/4 inch for pump capacities below 10,000 gallons per minute. All other pumps shall have a 1-inch thick plate.

I. Discharge Tube, Air Vent and Flap Gate

1. Manufacture the discharge tube and flap gate from ASTM A242 "Corten" steel. Connect the discharge pipe to the pump with an ASTM A242 "Corten steel flange conforming to dimensions of ANSI B16.1, Class 25 flanges and full face neoprene gaskets. Select the discharge tube diameter to limit pipe velocity to 7 feet per second at the design duty point.

2. Flange and bolt the flap gate to the pipe to allow easy removal. Machine finish the flap gate surfaces to minimize leakage back through the gate.

3. Provide a square anti-seepage plate made from 3/16 inch thick, ASTM A242 "Corten Steel that is field-mountable to the pipe. Size the plate such that the width is equal to the pipe outside diameter plus four (4) feet.

4. Provide a 2-inch diameter, ASTM A53, Schedule 40 steel pipe air vent located upstream of the flap gate with a length of six feet.

J. <u>Hardware</u>

1. Provide hexhead bolts and washers fabricated from Type 316 stainless steel conforming to ASTM A 193, Grade B8M. Provide nuts that are Type 316 stainless steel conforming to ASTM A 194, Grade 8M.

K. <u>Data Plates</u>

1. Attach a permanent stainless steel data plate to the pump where it can be easily read at ground surface. Include the manufacturer's name, pump size and type, serial number, speed, capacity, impeller diameter, head rating, efficiency, horsepower requirement and date of manufacture.

PART 3 – EXECUTION

A. <u>Welding</u>

1. Weld all pump and pipe components with a continuous full penetration weld inside and out. Remove all welding slag and limit undercutting to less than 15% of the material thickness. Submit to Owner written evidence of the welders' training and certifications to perform these operations.

B. <u>Painting and Coating</u>

1. After all welding is completed, prepare all surfaces for painting with a white metal blast cleaning per SSPC surface preparation no. SP-5. Give Owner 48 hours notice before surface preparation is to commence.

2. Factory coat the interior and exterior of the pump, discharge piping and all other components with black 100% solids epoxy paint. Apply two coats of Keysite 740, Scotchkote 302 or equal to a minimum total dry film thickness of 14 mils. Provide to Owner results of the dry film thickness tests.

3. Touch up all damaged paint in the field with the same type of paint.

C. Factory Pumping Tests

1. Factory test each pumping unit, complete with the job right-angle gear drive. Perform tests in accordance with the standards of the Hydraulic Institute. To pass the test, each pumping unit must meet all specified performance requirements.

2. Conduct "full scale" performance tests with the complete pump, discharge column, intake bell and elbow. Conduct tests at the same minimum submergence that will be expected in actual operation. If closed-loop testing is proposed, calculations of efficiency must clearly account for the inlet velocity provided by the suction feed pipe and submergence conditions must be verified and reported.

D. Minimum Performance Criteria

1. Capacity and dimensional data for each pump are indicated on the accompanying drawings.

2. All pumps shall possess the following hydraulic performance characteristics at the specified duty point:

a) Flow rate at duty point:	13,200 gpm
b) Minimum pump power efficiency:	75 percent
c) Maximum pump speed, up to 20,000 gpm:	800 rpm
d) Drive unit speed:	1800 rpm
e) Flow rate variation allowed:	+5 percent
f) Static water lift:	7 feet
g) Maximum allowable total head loss:	4 feet

Additional hydraulic performance criteria and dimensional data for each specific pump are shown in the drawings. Manufacturer shall design the pumps to produce a total head sufficient to accomplish the specified criteria and report that total head to Owner.

3. Pumps shall operate without inordinate vibration as set forth in this section and be free of oil leaks.

E. Field Testing

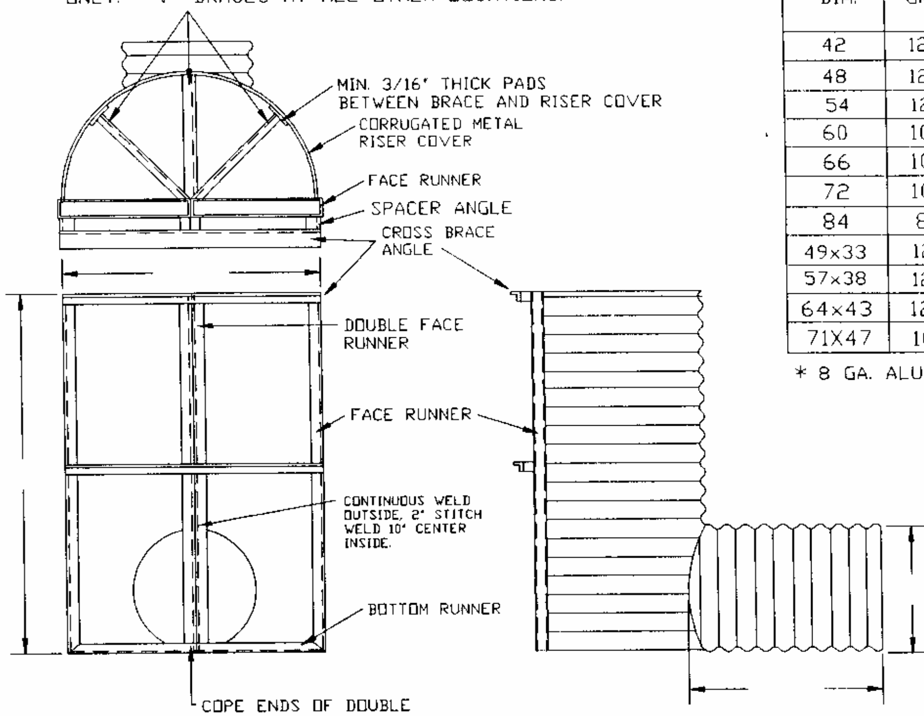
1. Conduct flow rate and pressure tests in the field after pumps are installed and operational. Operate the pump under design conditions for one hour to assess compliance with the pump curve and that there is no binding, sticking, squealing or overload of the drive unit. Assure that the pump is operating with no visible leaks and confirm that vibration does not exceed the standards of the Hydraulics Institute.

F. Delivery Schedule

1. Provide the discharge pipe within 15 days of order. Provide pump within 60 days of order. Manufacturer shall provide to Owner a schedule indicating when fabrication of each pump will commence. Owner reserves the right to change a delivery date provided it notifies manufacturer of the change at least two weeks prior to the date when fabrication will commence.

END OF SECTION

INTERIOR BRACE ANGLES "CROW'S FEET" LOCATED BEHIND CROSS-BRACE AT TOP OF RISER ONLY. "V" BRACES AT ALL OTHER LOCATIONS.



STUB DIA.	STUB GA.	RISER COVER			FRAME WIDTH
		FACE WTH.	GA.	SHEET LNGTH	
42	12	60	12	98	62
48	12	72	12	117	74
54	12	84	12	137	86
60	10	84	10	137	86
66	10	96	10	156	98
72	10 *	96	10	156	98
84	8	96	8	156	98
49x33	12	60	12	98	62
57x38	12	72	12	117	74
64x43	12	72	12	117	74
71X47	10	84	10	137	86

* 8 GA. ALUMINUM

CHANNEL

STEEL

2 1/2"x3 1/2"x2 1/2"x3/16"

ALUMINUM

2 1/4"x3x2 1/4"x1/4"

ANGLE (ALL)

3"X3"X1/4"

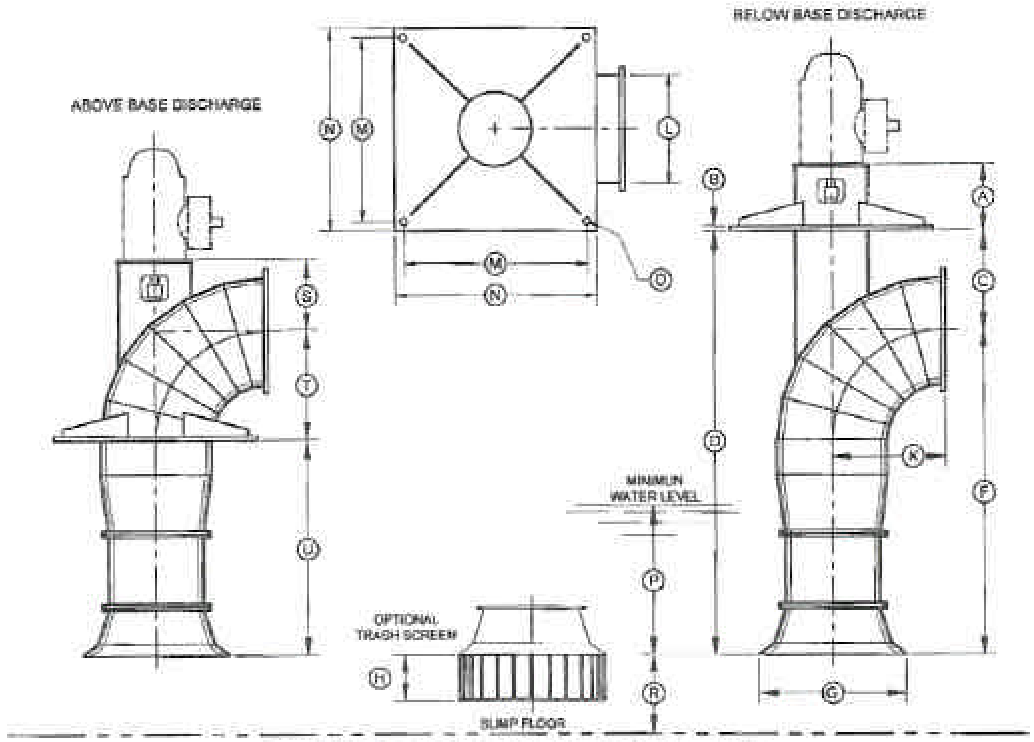
NOTES

1) ALL RISERS 6' TO 10' HIGH GET 1 CROSS BRACE ANGLE AT TOP, AND 1 CROSS BRACE ANGLE AT TOP OF STUB. UNDER 6' HIGH TOP ONLY. RISERS OVER 10' HIGH GET 3 CROSS BRACES AT EVENLY SPACED INCREMENTS. NOT TO BLOCK FLOW UNLESS SPECIFIED.

SOUTHERN CULVERT PINELLAS PARK, FL	
DRAWN BY E. LEMIRE	COMPANY STANDARD
APPROVED	STD. DOUBLE FACE RISER
DATE 6-23-95	SCALE N.T.S. / DWNG # 950623-1

Manufacturing Co. Pumps Since 1937

TWO STAGE VERTICAL TYPE "AF" AXIAL FLOW PUMP GEAR DRIVE

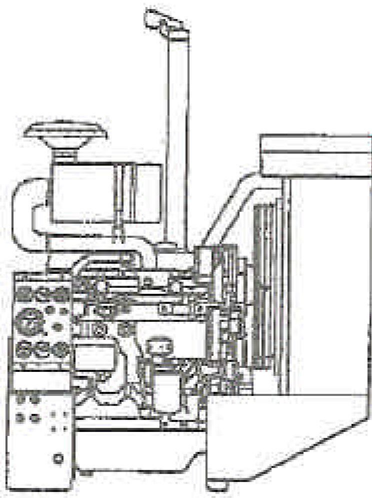


STANDARD DIMENSIONS IN INCHES

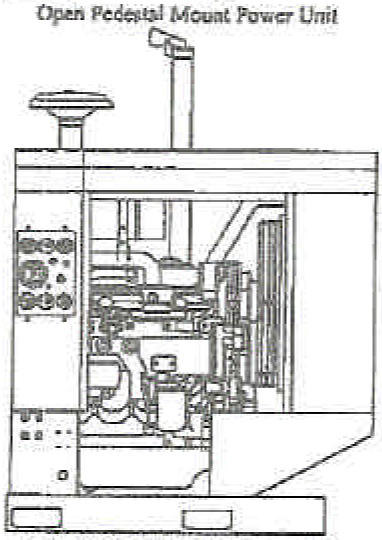
PUMP SIZE	A MIN.	B	C MIN.	D MIN.	F MIN.	G	H	K	L	M	N	O	P	R	S MIN.	T MIN.	U MIN.	PUMP SIZE
8	12	3/8	6	34	28	12	6	12	8-5/8	18	20	9/16	24	8	6	12	16	8
10	12	3/8	7	38	32	15	6	12	10-3/4	20	22	9/16	24	8	6	12	20	10
12	12	3/8	8	50	42	16	8	14	12-3/4	22	24	9/16	24	8	8	14	28	12
14	12	3/8	9	56	47	18	8	15	14	26	28	9/16	27	9	8	15	32	14
16	15	1/2	10	71	56	21	8	18	16	30	32	9/16	32	10	8	18	38	16
18	15	1/2	11	72	61	24	10	21	18	32	34	9/16	36	12	9	21	40	18
20	15	1/2	12	80	65	27	10	25	20	34	36	9/16	41	13	10	25	40	20
24	15	1/2	14	99	70	32	14	30	24	44	48	9/16	48	16	12	30	40	24
30	15	3/4	17	120	94	39	16	40	30	50	54	9/16	59	19	15	40	54	30
36	18	3/4	21	146	118	45	20	48	36	56	60	11/16	68	22	18	48	70	36
42	18	3/4	24	149	125	54	24	53	42	62	66	11/16	81	27	21	53	72	42
48	18	3/4	27	152	125	63	28	53	48	68	72	13/16	95	31	24	53	72	48
54	18	3/4	30	172	138	72	32	60	54	77	81	13/16	108	36	27	60	78	54
60	24	3/4	33	175	142	81	36	60	60	86	90	13/16	120	40	30	60	82	60
66	24	3/4	36	196	160	90	36	66	66	95	99	13/16	135	45	33	66	94	66
72	24	3/4	39	207	166	99	36	72	72	104	108	13/16	148	49	36	72	96	72

NOTES:
DIMENSIONS A,B,C,D,F,S,T & U ARE MINIMUM FOR STANDARD CONSTRUCTION.
CONSULT FACTORY FOR CUSTOM CONFIGURATIONS TO SUIT YOUR APPLICATION.

MODEL: CK45DP4-80



Open Pedestal Mount Power Unit



Enclosed Skid Mounted Power Unit

JOHN DEERE *Power* TECH emission certified diesel engine provides reliability, durability and fuel economy.

Two years/2000 hours standard engine warranty, 2 year and 5 year extended warranties available.

Proto-type desigard and tested to meet engine manufacturers' guidelines to ensure product performance, reliability and customer satisfaction.

Standard power units are designed to satisfy the power requirements of a large range of applications with a large selection of optional equipment.

Standard power units can be reconfigured to fit the requirements of special applications with a large selection of engine options and power transmission equipment available.

Heavy-duty 2-stage air cleaner, suction fan, exhaust stack with rain protection, and Murphy instrument panel with safely shutdown standard equipment.

Enclosures are constructed of corrosion resistant *Galvanese* treated heavy-duty 16 gauge steel and finished with high quality enamel paint.

Available as open or enclosed units and pedestal mounted or skid mounted.

Designed and built in the U.S.A.

ENGINE PERFORMANCE DATA

ENGINE SPEED (RPM)	2500	2400	2200	2000	1800	1600	1400	1200	1000
CONTINOUS LIMIT (HP)	72	71	68	66	62	56	51	44	—
INTERMITTENT POWER (HP)	80	79	76	72	68	63	56	50	40
INTERMITTENT TORQUE (HP)	168	173	183	192	199	205	211	215	214
BSFC (LB/HP-HR)	.389	.382	.372	.364	.359	.358	.369	.362	.369

1180 RESEARCH BLVD. CREVE COEUR, MO 63136 PHONE: 314-868-8620
180 S.W. 52ND AVENUE, OCALA, FL 34474 PHONE: 352-237-7660

MODEL AR ALUMINUM SLIDE GATES

Waterman Model AR aluminum slide gates are designed for low seating heads where light weight and resistance to certain types of corrosiveness is desired. Applications include use in open channels and wall openings for waste and water purification plants.

The Model AR gate is available for seating heads of 5 to 25 feet and is furnished with a rising or non-rising stem. Gate may be conventional or downward opening, self-contained or non self-contained or with flush-bottom seals.

For unseating head conditions, fabricated slide gates with specially designed seals and pressure bars are available.

Guide rails are extruded aluminum shapes of dual slot design weighing over four pounds per foot to produce a very rigid rail.

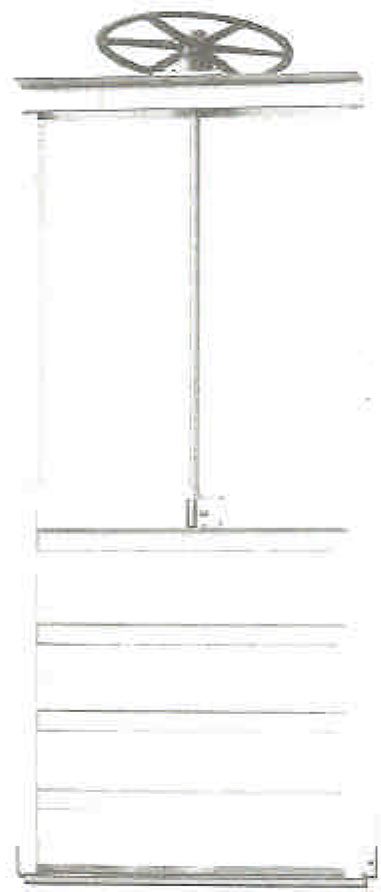
The dual slot design allows the plate slide, with its integrally welded strong ribs, to extend over the seating area surface. This provides additional strength to the area of the slide subjected to the greatest shear stress.

Headrails or yokes on self-contained gates are comprised of two parallel angles welded to both sides of the guide rail making a slot that allows for easy removal of the gate slide. Total welding of all connecting frame members increases rigidity of the entire unit.

Special options include J-bulb seals for extra tight sealing and dual interconnected stems for wider gates. Downward opening and special shaped weir gates are also available.

Gate lifts designated for various sized gates are based on lifting load and operational requirements. Included are bench type lifts, pedestal lifts, tandem operators, side chain wheel drives and electric motor driven lifts.

See Lifts, Stems and Accessories section of this catalog for further information.



Model QAR-5sj-RSY
5 Foot Head
Spigotback with "J"-Bulb Seals,
Self-Contained, Flushbottom Seal

MODEL R SLIDE GATE MODEL IDENTIFICATION

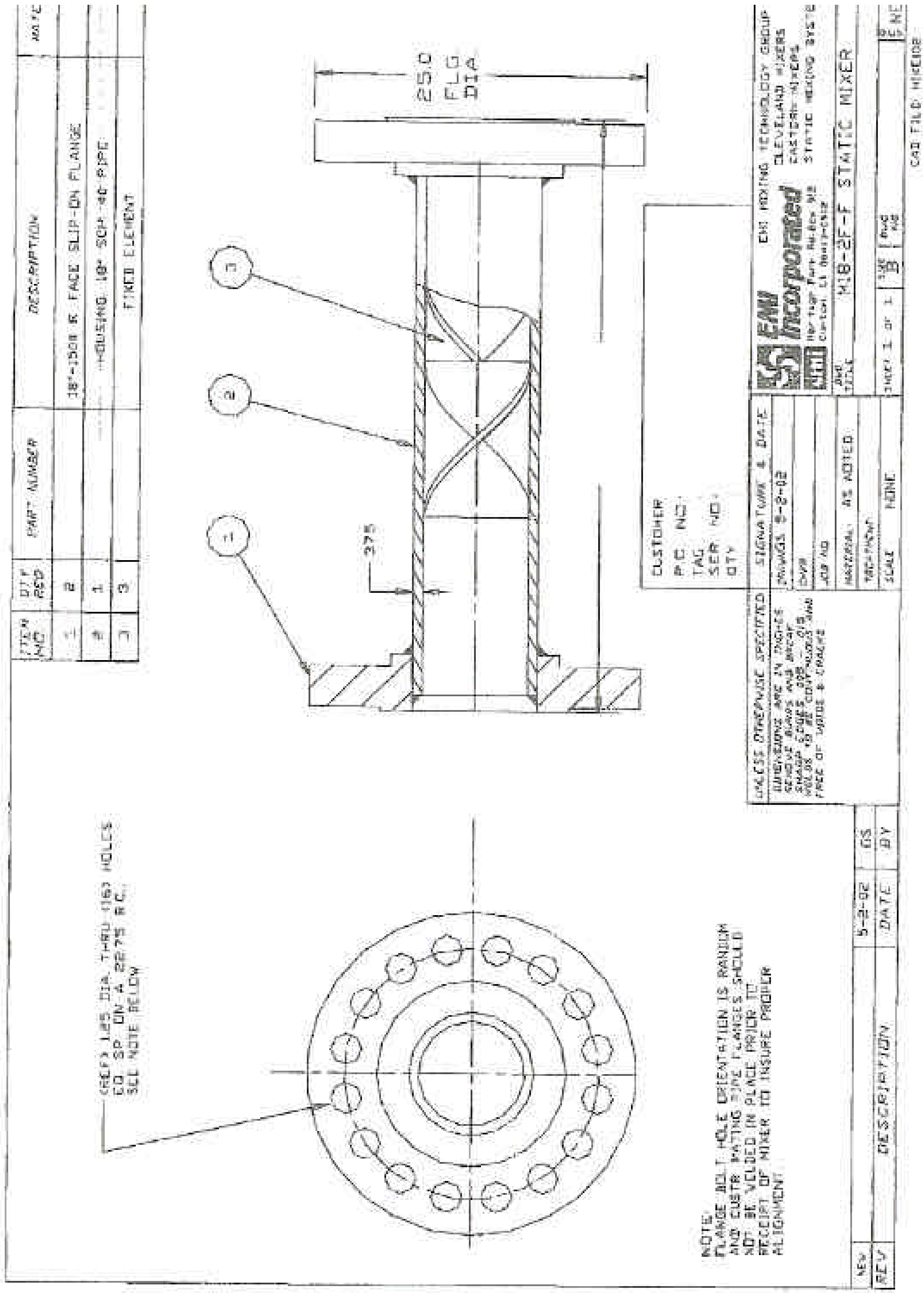
EXAMPLE

QAP R-5 sj - Y

Prefix	Basic Number	Suffix
Q = Flushbottom Seal	5 = 5 ft. Head	f = Flatback
S = Mild Steel	10 = 10 ft. Head	ff = Flangeback
A = Aluminum	15 = 15 ft. Head	fj = Flangeback with J-Bulb Seal
SS = Stainless Steel	25 = 25 ft. Head	sb = Spigotback
F = Fiberglass		e = Embedded
P = UHMW (Ultra-high Molecular Weight Polyethylene)		sj = Spigotback with J-Bulb Seals
		y = Self-Contained
		ej = Embedded Gate with J-Bulb Seals
		I = Inverted (Downward Opening)
		NRS = Non-Rising Stem
		X = Special Modification or Lift Mechanism

Note:
* R is constant for all Fabricated Slide Gates.
1. Add "Q" to prefix where Flushbottom Seal is required.
2. All Fabricated Slide Gates have Rising Stems unless otherwise indicated.

Waterman INDUSTRIES, INC.



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APPENDIX D – FDEP's and NRCS' Letters Addressing Permit, Alum Disposal, and Wetland Jurisdiction Issues

Department of
Environmental Protection

Jeb Bush
Governor

Southeast District
P.O. Box 15425
West Palm Beach, Florida 33416

David B. Struhs
Secretary

November 15, 2002 ELECTRONIC CORRESPONDENCE

Dr. Del B. Bottcher, Dairy BAT Project Manager
Soil and Water Engineering Technology, Inc.
3448 NW 12th Ave.
Gainesville, FL 32605
Email: dbottcher@swet.com

RE: Regulatory Issues Associated with Alum Treatment

Dear Del:

This letter is in response to your request for clarification of potential regulatory issues associated with using alum for the edge-of-farm treatment systems to be installed on three Okeechobee dairies. There will be two regulations that potentially come into play with the use of alum for treating stormwater. The first is the surface water criteria for "free froms" in the system's discharge water which prohibit the discharge of potentially toxic substances, and secondly, rules associated with land application of the alum residuals that are formed during the treatment process.

Alum is used in approximately 35 regional stormwater treatment systems around the state to remove suspended solids and other contaminants. While there is not a water quality standard for aluminum in freshwater systems, there is still a concern about the potential for aluminum toxicity to aquatic organisms. Experience has shown that the free aluminum ion, which can be toxic, can be eliminated through proper design and operation procedures. Specifically, jar tests need to be done to determine the proper dosage of alum to achieve the desired level of treatment and to determine the alkalinity and buffering capacity of the effluent and the receiving waters. Most of the alum injection for urban stormwater treatment systems use a dosing rate of 10 mg/l. Additionally, it is crucial that the pH remain between 6 and 7, and that there be at least a 60 second mixing time from the point of alum injection to the discharge into freshwaters. The only way for free aluminum to persist in water would be if exceedingly high dosing rates were used in waters with very low alkalinity levels. We would not anticipate either of the cases to be true for the dairy systems. However, the use of alum has the potential to reduce pH, which means the Class III surface water standard for pH could come into play if the systems are not properly managed. If the pH cannot be maintained between 6 and 7, then the standard practice of base buffering can be used to raise the pH to acceptable levels.

Finally, the resulting floc must be disposed of properly. Alum sludge can be land spread on the farm at agronomic application rates, as determined by the amount of available P in the floc. If sludge is to be temporarily stockpiled, the runoff should be directed back into the treatment basin or otherwise contained on-site. The dewatered sludge can also be taken to a permitted landfill for disposal. If sludge is to be taken off the dairy for landspreading, we will need to review and approve of the sight prior to such use. A specific sludge handling plan should be submitted to the Department for approval. We would also like to see records kept of alum use and sludge handling (disposal).

In summary, alum is commonly used throughout the State without any problems, and therefore I do not see any regulatory issues that will limit the use of alum for the proposed dairy projects. Hopefully, this will help alleviate the dairy farmers' concerns about the use of alum on their dairies.

Sincerely,
Tim Powell

Tim Powell, P.E., Supervisor
Wastewater Permitting Section

ec: Eric Livingston, Bureau of Watershed Management/DEP/TLH
(eric.livingston@dep.state.fl.us)
Vince Seibold, Industrial Waste/DEP/TLH (vince.seibold@dep.state.fl.us)
James Laing, SFWMD (jlaing@sfwmd.gov)
Greg Kennedy, DEP/Okeechobee (greg.a.kennedy@dep.state.fl.us)

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
452 Hwy 98 North
Okeechobee, Fl. 34972-4168

May 9, 2003

Mr. Del Botcher
Soil & Water Engineering Technology, Inc.
3448 NW 12th Ave
Gainesville, FL 32605

Mr. Botcher

We have just completed wetland determinations for Dry Lake Dairy and Davie Dairy. The proposed activities as part of their participation in the South Florida Water Management District's Dairy Bat program have been taken into account.

Both participants have already received certified wetland determinations (form NRCS-CPA-026E and an aerial photo). These determinations supersede any previous USDA wetland determinations. Both properties in the BAT project have received Converted Wetland Non Agricultural (CWNA) use exemptions for the wetlands being impacted by the project. The planned land use for the CWNA area is a water quality detention area. Dikes and treatment facilities will be constructed to convey water from the drainage ways to detention areas where water treatment will take place and then the treated water will be returned to drainage system before it leaves the property. A CWNA exemption allows the conversion of wetlands while retaining the producer's eligibility in USDA programs as long as no food or fiber crops are planted on these areas should the project be abandoned.

We have not identified "other waters of the United States" as defined by the Corps of Engineers. These areas may be present in areas where you propose manipulation that will potentially impact them. In this case, these areas are marked as "NI" or "non-inventoried by NRCS." Both projects have received permits from the Army Corps of Engineers so any proposed activities as part of the project have already been taken into account and permitted.

Sincerely,

J. Scott Kuipers
District Conservationist