FINAL REPORT
DEP CONTRACT NO. SW123

STUDY OF THE SUITABILITY OF GROUND RUBBER TIRE AS A PARKING LOT SURFACE

AT
FLORIDA COMMUNITY COLLEGE AT JACKSONVILLE
BETTY P. COOK NASSAU COUNTY CENTER
YULEE, FLORIDA

Prepared for:

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Date

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APPENDICES

I.

PROJECT OVERVIEW

This document will summarize a study conducted by the State of Florida Department of Environmental Protection (DEP)-Bureau of Solid and Hazardous Waste in contract with Florida Community College at Jacksonville (FCCJ). The study, conducted over a three-year period, investigated the environmental impact and practicality of using ground rubber vehicle tires as a parking lot surface at the FCCJ Nassau Outdoor Education Center in Yulee, Florida.

Site and Location

The FCCJ Betty P. Cook Nassau County Center consists of 43 acres of property. It can be reached by traveling north from Jacksonville, Florida on Interstate 95 to Exit 129. Exit 129 is located eight miles north of the Jacksonville International Airport. William Burgess Boulevard, the entrance road to the college, is located on the south side of A1A east of I95, one-half mile from Exit 129. The FCCJ Nassau Center is located 1.2 miles on the right as you travel south on William Burgess Boulevard. The Outdoor Education Center is the second entrance on the right hand side of the road.

Approximately 16 acres of the FCCJ property is designated as the Outdoor Education Center. The buildings at the Outdoor Center are renovated portable classrooms and cargo shipping containers. The renovations and adaptations to the buildings include cedar siding, raised wooden walkways between buildings, and exterior porches. The Outdoor Center offers outdoor-related recreational courses, a low-ropes course, and workshops and classes on team-building, problem-solving, communication, and creativity. The facilities are also utilized by community groups for meetings and retreats. A layout of the buildings can be found in Appendix A – General Site Plan.

The wooded cover of the site nestles the small cedar buildings to create a peaceful and relaxing ambiance. Unfortunately, the site was disturbed during hot, dry, days by traffic entering the dirt parking areas and internal roadways creating dust and sometimes disturbing the outside activities and learning experiences that were taking place.

Florida Community College at Jacksonville eagerly pursued the opportunity to contract with the State of Florida DEP to conduct an experiment to test the environmental impact and practicality of using ground rubber tire to cover the dirt parking areas and internal roadways. FCCJ wanted to resolve the dust issue but did not intend to pave the areas in question because of the environmental restrictions and because of the negative impact on the ambiance. The opportunity to use the Outdoor Center parking/roadways as a test site for the use of ground tires appealed to the college as it helped maintain the aesthetics and reduce the dust problem. The need of FCCJ and the desire of the DEP to find uses for recycled tire material led to Contract SW123 that is summarized in this report.

Contract SW123

Contract SW123, which outlines the steps that were to be taken in the study, was executed in June 1995. The contract was completed in August 1998. Although the contract was designed to conclude in a shorter time period, State budget restrictions mandated that the project be put on hold for a time and then restarted. This chronology is documented in Section II of this report.

Project Intent

The project was designed to test the practicality and use of ground tires as a material to surface parking areas. It included assessing the environmental impact that the recycled tire surface would have on the soil, groundwater, and storm water. Baseline data was established and regular monitoring and testing of the site was conducted over a period of time. The timing of the monitoring varied at times due to the lack of rainfall. Rainfall was necessary in order to collect samples.

Project Steps

Guidelines for the project required several steps including a Planning Phase and a Field Test Phase.

PLANNING PHASE

1. Prepare a topographical site plan.
2. Determine the flow of surface water.
3. Determine sampling points for rainwater prior to ground contact, storm water in various contact stages, and groundwater in various contact stages.
4. Describe all potable wells within 0.5 miles of the test site.
5. Design storm water sampling points.
6. Submit an approved Quality Assurance/Quality Control (QA/QC) project plan.

FIELD TEST PHASE

1. Install rain gauge sampling point.
2. Construct three storm water-sampling points.
3. Construct and develop four groundwater-sampling points.
4. Sample as directed after rain event.
5. Analyze all samples in a timely manner for specified elements.
6. Install ground rubber tire on 39,000 square feet of parking and driveway to a thickness of 3-4 inches.
7. Repeat sample collection and analysis on a periodic basis.
8. Submit appropriate formative and summative reports.

Please refer to Appendix B - Scope of Services, for complete detailed steps for Planning and Field Phases of the study.

Results

The project, although delayed as previously noted, was successfully concluded in August of 1998. The results, including the practicality of use and the environmental impact, were primarily positive with very little impact on the soils and water that was tested. A complete summary of the environmental impact can be found in Appendix C – Final Report Groundwater, Rainwater, Surface Runoff, and Soil Quality Investigation. Practicality issues are addressed in Section IV.

II.

Chronology of Major Project Activities

The following chronology summarizes the major activities that occurred in fulfilling the conditions of DEP Contract No. SW123. Although self-explanatory, there were a few obstacles encountered.

State funding for the project was withdrawn in December of 1995 due to State fiscal concerns. This resulted in suspending the project until the fiscal concerns were remedied. At that time, the physical requirements to monitor the project were in place (rain gauge, groundwater-monitoring wells, and stormwater monitoring devices) and a baseline sample and report had been submitted. The railroad tie "curbs", to contain the PermaPark material, and the PermaPark had also been installed.

The fiscal issues resulted in no activity on the project for approximately 18 months. A new vendor, Aerostar Environmental, Inc., was selected by Florida Community College at Jacksonville to complete the project as RSDI Environmental, Inc. was unwilling to continue the project within the allowed budget. The number of sampling events was adjusted to meet the budget and necessary time frame for completion. These changes are noted in the contract amendments.

March 1995	Draft proposal for an "Environmental Impact Study of Waste Tire Shreds as a Parking Lot Surface" developed. See Appendix D.
March 1995	PermaPark rubber surfacing selected as surface for proposed project. See Appendix E.
May 1995	Florida Community College at Jacksonville Board of Trustees approves Project.

June 1995	Department of Environmental Protection Contract No. SW123 entered into by DEP and FCCJ.
July 1995	FCCJ enters contract with RSDI Environmental, Inc., to install monitoring equipment and to conduct sampling and testing in accordance with DEP approved Quality Assurance Project Plan (QAPP).
August 1995	RSDI, Environmental, Inc. QAPP plan approved by DEP.
August 1995	Site work completed and tested for monitoring and sampling purposes.
November 1995	Baseline sampling conducted.
Nov./Dec. 1995	Parking area and internal roadway covered with PermaPark surface material.
December 1995	Baseline study submitted by RSDI Environmental, Inc.
December 1995	DEP temporarily terminates project due to State funding restraints.
June 1996	DEP Contract No. SW123 amended (#1).
March 1997	FCCJ approves Aerostar Environmental Services, Inc. as the new vendor for DEP Contract SW123. RSDI, Environmental, Inc. was invited to continue project but was unwilling to continue without a substantial increase to the fees they charged, thus the change to Aerostar Environmental Services, Inc.
April 1997	DEP Contract No. SW123 amended (#2).
June 1997	Project restarted with cleaning and recalibration of monitoring stations.
June 3, 1997	Sampling conducted.
July 8, 1997	First Progress Report issued.
September 1997	Aerostar Environmental Services Quality Assurance Project Plan approved by DEP.
December 1997	Sampling conducted.
January 1998	Second Progress Report issued.
June 1998	DEP Contract No. SW123 amended (#3).
June 1998	Sampling conducted.

July 1998 Third Progress Report issued.

September 1998 Final Summary Report submitted by Aerostar Environmental Services, Inc.

III.

Quantitative and Qualitative Summaries

Quantitative Summary - Materials & Test Results

A total of 131 tons of PermaPark treated waste tire product was placed on 39,000 square feet of internal roadways and parking lot spaces at the FCCJ Nassau Outdoor Education Center (See Appendix A- General Site Plan). The exterior edges of the roadway and parking areas, with the exception of ingresses and egresses, were lined with donated CSX railroad ties to create a barrier to keep the material from spreading. The ingresses and egresses were not lined with the railroad ties because of the need for vehicles to travel in and out of the area. The ground surface coverage ranged from 2 1/2 to 3 1/2 inches deep, with the lowest concentration being used in the less traveled parking areas and the deepest application in the roadways. The materials were applied over a natural dirt road. The application of the PermaPark was done with a farm tractor equipped with a front-end bucket. An approximately 4' x 8' wire fence rake, with a wooden weighted cross piece at the back, was constructed to drag behind the tractor to groom the material to the desired application depth. This tool is used periodically to groom the material after it shifts due to use and/or heavy rains.

The materials used to collect the samples and the quantitative study data (in chart form) and implications are best summarized in Appendix C, the Final Report issued by Aerostar Environmental Services, Inc. The report summarizes the collection methods, dates, and laboratory analysis of the samples.

The four sampling events showed sodium, chromium, iron, total xylenes, and antimony concentrations above laboratory detection limits in the groundwater samples collected during the study (Table 1 in Appendix C). The groundwater iron concentrations exceeded the FDEP groundwater guidance concentration of 0.3 mg/L, with high readings from .33 to 1.46. Nassau County background levels in the shallow aquifer typically range from 0.2 ppm to 0.6 ppm.

The four sampling events showed barium, iron, sodium, zinc, chromium, lead, and antimony concentrations above laboratory detection limits in the surface water runoff samples (Table 2 in Appendix C). The concentrations detected were below surface quality standards.

The four sampling events showed toluene, antimony, chromium, copper, iron, lead, zinc, barium, nickel, sodium, arsenic, selenium, and TRPH concentrations above laboratory detection limits in the soil samples collected for the investigation (Table 3 in Appendix C). The detected concentrations are below the soil cleanup target levels.

Only the iron concentrations detected in the groundwater samples exceeded State guidance concentrations. The sampling data on this element fluctuated widely (Table 1 in Appendix C) by sampling site and collection date, with no obvious pattern. It is inconclusive that this fluctuation was caused by the water runoff from the PermaPark material and/or normal background concentrations, or a combination of both.

Qualitative Summary

The sampling and analysis of the groundwater, storm water, and soil show evidence of minimal, if somewhat insignificant, contamination due to the installation of the PermaPark rubber tire material. It cannot be assumed that similar results would occur in other applications of recycled tire material.

The PermaPark recycled tire product is a high quality product that is almost metal free. Similar material produced from other manufacturers may have slightly different specifications. Different specifications could drastically increase the contaminants introduced into the environment. Care should be taken, when using recycled tire product, to carefully examine the product specifications to insure that the product is of the highest quality possible. Soil quality is another factor and it is not known, from the results of this study, if different soil composition would react differently to the introduction of tire material.

The cost of the PermaPark material, at the time of installation, was $185 a ton. One ton covers 300 square feet of surface to a depth of 3". The present cost for the material is $265 a ton, an increase of 43.6% over a three-year period. These figures do not include installation costs such as containment barriers (we used railroad ties) and the labor and equipment needed to spread and maintain the material. These financial considerations, as well as the environmental and aesthetic factors, need to be taken into consideration when making a determination on whether to use this type of substance for ground cover. The relative return on investment is an important consideration.

The monitoring and testing process that occurred in this project required that the subcontractors have access to the site for sample collections and maintenance of groundwater and storm water collection points. The initial start-up, suspension, then re-start of the project resulted in changing vendors. The first vendor installed the necessary equipment and produced the baseline study and initial QAPP. The project was then suspended due to funding issues. The second vendor re-started the project, resubmitted a QAPP and conducted three sampling events.

Sampling could only be conducted after significant rainfall during the time frames specified in the QAPP. This required FCCJ to issue access keys to the vendors to enable them to enter the property on weekends and holidays when the college is normally closed and gated. There were no problems associated with this action.

Determining the location of the monitoring stations, during the re-start by the new vendor, proved to be an unanticipated difficulty. During the approximately 18 months that the project was suspended, the natural vegetation at the project site grew and literally covered up many of the monitoring stations. The new vendor, even with monitoring well map in hand, had some difficulty locating the stations. The locations were eventually found after clearing brush and using some of the FCCJ staff to assist in the search. Location flags, or some other above ground locator should be considered for future projects in natural vegetation areas.

The "loss" of material was a phenomena that occurred due to the topography (See Appendix F) of the site. The site is naturally sloped to drain to a nearby marsh area. Significant and prolonged rain resulted in the movement of material within the project area and also resulted in some of the material being washed out of the project area through the open ingresses and egresses. I estimate that 10-20% of the material was lost to this phenomena over the duration of the project. This will result in a replacement cost and an adjustment to the entrances/exits to create a barrier to minimize the losses due to "material erosion". The impact of the material that drifted into non-project areas was not monitored in this project, other than through the monitoring stations.

Environmentally, the project data showed that the PermaPark material was a suitable and permeable ground cover for parking areas and internal roadways that vehicles travel to reach parking areas. A complete discussion and conclusion on the suitability of using the material in parking and driveway areas follows in Section IV.

IV.

Discussion/Conclusions and Suitability for Future Installations

Practicality of Use

The use of the ground rubber tire accomplished the objective of the FCCJ Nassau Outdoor Education Center. The covering of ground tire over the dirt parking and driveway kept the dust at a minimum and retained, and may have even enhanced, the ambiance of the setting. The road covering was more often a topic of conversation than it was not when a new group or person arrived at the Center. The Outdoor Center was developed with many recycled materials (buildings, cargo containers, used furniture, etc.). The utilization of yet another recycled material strengthened this theme and prompted many discussions regarding the effective use of waste or discarded products.

This experiment was designed to field test the material in an application over a dirt surface in a fairly pristine environment. In addition to the measurable scientific analysis of the impact of the material on the water and soil it contacted, there were evaluations made in relation to the practicality and maintenance of the material. In this specific application, there were important advantages and some disadvantages.

The advantages of using the PermaPark, in this specific application were:

- It is aesthetically pleasing, especially in the outdoor education setting
- It kept the dust to a minimum
- It created a quiet driving surface
- It is very permeable and, except for deluges, drains quickly thus keeping mud to a minimum
  The permeability of the material make it environmentally friendly in terms of rainwater and storm water dissipation
- Because of the permeable quality of the material, users are not under the restrictions they would face if installing non-permeable material
- It created a cushioned surface for outdoor activities
- It didn't noticeably seem to wear in texture nor fade in color
- It is light in weight and easy to handle as opposed to gravel

The disadvantages of using the PermaPark material in this application were:

- It requires raking and grooming especially following rain storms or after a prolonged period of heavy vehicle traffic
  Rainwater runoff on the gently sloped terrain resulted in the shifting of the material, some of which was "lost" in the land adjoining the parking area
- Prolonged torrential rain, over a period of days, resulted in an incident or two when the material was washed over the top of the railroad ties used to contain it
- The material is not ADA compliant as wheelchair bound individuals cannot traverse it without assistance
- It radiates heat on hot summer days
- Leaves and other windblown material tends to collect on this material and can only be removed by picking it up by hand
- During periods of ground saturation, the material slightly floats and exhibits a squishy quality
- The material gave off a petroleum odor for about two months after the initial application
- On sloped terrain, the material needs to be contained by some type of barrier
- The railroad tie barriers used in this project gave off a creosote odor for the first couple of months
- The railroad tie barrier was several inches higher than the PermaPark which created a safety hazard for all (creating a step-over area) and created an accessibility issue for wheelchair bound individuals
- Vehicles that travel over 5 mph tend to "pick-up" PermaPark material in their vehicle frame or undercarriage thus causing unnatural erosion of the product
  The product sometimes is carried away on the bottom of shoes

Conclusions

The application of the PermaPark material to the natural parking and road surface at the FCCJ Outdoor Education Center has been a positive experience that would be repeated if the choice was given again. The treated area, which primarily consists of parking areas, has been well served by the substance. The material, unless it is applied on a flat surface, requires edge barriers to prevent it from drifting due to heavy rainfall and/or heavy or fast moving traffic.

Use of the material without accommodations for wheelchair crossings, etc., possibly violates the guidelines established by the ADA regulations. It is almost impossible for an individual in a wheelchair to traverse the road independently.

The use of railroad ties as the containment barrier for the material has proven to be effective but will eventually create maintenance problems as they deteriorate and need to be replaced. A less intrusive (height), but more permanent containment barrier, should be explored. Although not done so in this project, containment barriers should be installed around the entire project area. This would substantially reduce the loss of product.

Adjustments to this site, now that the scientific data has been collected, include erecting some kind of containment barrier at the entrances and exits of the parking area to reduce erosion, and the development of "wheelchair crossings" than can be used independently by individuals who utilize wheelchairs for transport.

Suitability for Future Installations

The ground rubber tire, specifically PermaPark, is a viable alternative for a parking area as opposed to the application of a permanent material such as asphalt or concrete. Potential consumers need to carefully analyze their needs and issues. Some questions they may want to address include:

1. Is the topography of the land flat or sloped?
2. Will the traffic speed generally be less or more than 5 mph?
3. Will the physical appearance of the material enhance or hinder the site ambiance?
4. Can the cost of the product be justified when compared with other "surfacing" options?
5. Will there be the resources available (staff & equipment) to maintain and groom the product at the application site if it drifts?
6. Will there be adequate distance between the parking area and an entrance to a building in order for material that is carried on the bottom of shoes to fall off before it is tracked inside the building?

The use of PermaPark or similar material in parking areas is feasible if the user is capable and willing to maintain it. Short term uses for a temporary parking area, or longer-term uses, such as the project summarized here create excellent opportunities to responsibly recycle waste tires. Maintenance issues, desired site ambience, and relative cost are the three factors that anyone considering the material should explore first. Containment of the material is the most critical maintenance issue that needs to be addressed before deciding to utilize this type of product. The inability to effectively contain the material will result in increased maintenance and, eventually, refurbishment expenses.

In conclusion, this experimental project has been very successful for the host sponsor. The environmental impact has been minimal. The objective for using the material has been accomplished. The issues that have surfaced through formative and summative evaluation are all resolvable. The PermaPark, or a similar product, should be considered as an alternative to permanent paving of parking areas when the nature and use of the parking deem it feasible. Conditions that would be favorable to the use of the material include a flat topographical surface, the ability to erect containment barriers, a speed limit of no more than 5 mph, and an appropriate distance between the parking and buildings to prevent tracking the material into buildings.

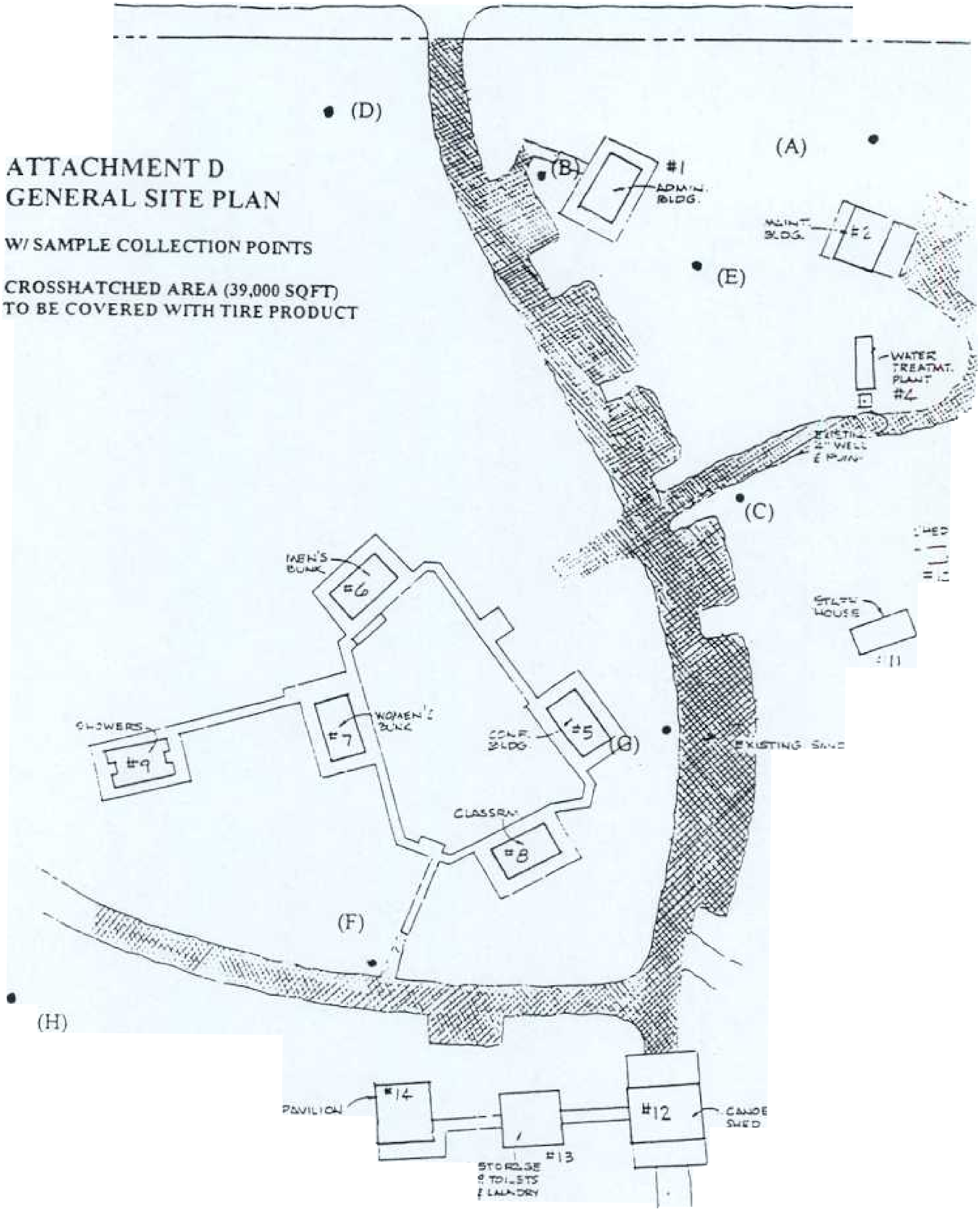
Appendix A

General Site Plan

ATTACHMENT D
GENERAL SITE PLAN

W/ SAMPLE COLLECTION POINTS

CROSSHATCHED AREA (39,000 SQFT)
TO BE COVERED WITH TIRE PRODUCT



SITE PLAN - EXISTING BLDGS AT OUTDOOR
ADVENTURE PROGRAM, NASSAU CENTER, FCCJ

Appendix B

Scope of Services

SCOPE OF SERVICES
STUDY OF THE SUITABILITY OF GROUND TIRE RUBBER AS A PARKING LOT SURFACE

Section 403.709 (2)(b), Florida Statutes, (F.S.), authorizes the FDEP to expend funds from the waste tire account of the Solid Waste Management Trust Fund for research projects relating to solving solid waste problems resulting from waste tires.

This contract with Florida Community College at Jacksonville is to determine the efficacy and safety of using a granulated waste tire material for surfacing of a parking lot. Under the proposal, the College is responsible for the following activities:

I. Planning Phase
   A. Prepare a topographical site plan of the FCCJ Outdoor Adventure Center in Yulee, Florida which shows:
      1. The directional flow of surface water.
      2. The proposed location of the waste tire material surface.
      3. The proposed location of sampling points to sample:
         a. Rainwater prior to ground contact.
         b. Stormwater that has passed through granulated tire rubber but not subjected to fluid leakage from vehicles.
         c. Stormwater that has passed through granulated tire rubber and subjected to possible fluid leakage from vehicles.
         d. Stormwater that has had ground contact but which has not passed through granulated tire rubber
         e. Groundwater that has not had contact with granulated tire rubber.
         f. Groundwater that has passed through both soil and granulated tire rubber but has not been subjected to fluid leakage from vehicles.
         g. Groundwater that has passed through both soil and granulated tire rubber and has been subjected to possible fluid leakage from vehicles.
         h. Groundwater that is down gradient from the site.
      4. Potable drinking water wells within 0.5 miles of the test site. Occupants of each dwelling within this area will be contacted and asked to provide the size, depth, and age of their wells.
   B. Design stormwater sampling points.
   C. Submit an approved QA/QC plan for the project.

II. Field Test Phase
   A. Install eight sampling points.
      1. Rainwater sampling point is a recording rain gauge.
      2. Construct three stormwater sampling points.
      3. Construct and develop four groundwater sampling points. Each of these sampling points consists of a 2" diameter monitor well with a maximum depth of 15'. Wells will be constructed of schedule 40 PVC

flush thread pipe (assembled without adhesive) with 5' of .010 slotted screen. Wells will be filter packed with clean, dry silica sand from bottom of screen to 2' above top of screen, then grouted from that point to land surface. After grout has set for a minimum of 12 hours, wells will be developed. Development will be accomplished by pumping with a centrifugal pump until water is free of sediment or for a period of time determined by FDEP representative. Finished wells will be protected by a locking cover and set in 2'x2'x4" concrete pads.

B During or immediately after a rain event, collect one set of samples from each of the sampling points, one replicate set from a monitoring well, and two soil samples in the area to be covered by tire material. Prepare one set of field blanks. All samples will be collected and preserved in accord with the QA/QC plan.

C. Analyze all samples in a timely manner for:
   1. Total petroleum hydrocarbons(TPH) Method 3500/418.1
   2. Semi-volatile organics Method 8270
   3. Volatile organics Method 8020
   4. Metals EPA primary pollutant metals plus iron, excluding TCLP procedures

D. Install granulated tire rubber on 39,000 square feet of parking and driveway area and compact the material to a thickness of three to four inches.

E. Restart the project when funds are available.

F. Repeat sample collection (B) and analysis (C) at the time of restarting. Submit a report comparing the before and after results.

G. Repeat sample collection (B) and analysis (C) six months after the samples collected in AF@. Submit a report comparing the before and one, three, and nine month results.

H. Repeat sample collection (B) and analysis (C) eighteen months after the installation of granulated tire rubber.

C. Submit a draft final report within 45 days of the project's completion which will contain:
   1. A chronological description of major project activities, including any unexpected obstacles or observations.
   2. Quantitative and qualitative summaries of the analytical data, including discussion of the environmental impact of the project.
   3. Discussion and conclusions regarding the physical suitability of granulated tire rubber material in parking lot and driveway applications and any recommendations to improve future installations.

D. Submit a final report. At least one copy of the final report will be bound and one copy will be one sided and un-bound with no holes or staples.

Appendix C

Final Report – Groundwater, Rain Water, Surface Runoff, and Soil Quality Investigation

FINAL REPORT
GROUNDWATER, RAIN WATER, SURFACE RUNOFF,
AND SOIL QUALITY INVESTIGATION
FCCJ-NASSAU CENTER
YULEE, FLORIDA

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Date

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FCCJ-NASSAU CENTER
YULEE, FLORIDA

1.0 EXECUTIVE SUMMARY

Aerostar Environmental Services, Inc. (**AEROSTAR**) has completed the bi-annual sampling and laboratory analyses events as part of the feasibility study of the suitability of granulated tire rubber as a parking lot surface material for the Florida Community College at Jacksonville (FCCJ)-Betty P. Cook Nassau County Center located in Yulee, Florida, hereinafter referred to as the site.

Groundwater, surface water runoff, rain water, and soil sampling was conducted on June 3, 1997, December 3, 1997, and June 24, 1998 by **AEROSTAR** personnel. The sampling was conducted in accordance with the Comprehensive Quality Assurance Project Plan (CompQAPP) number 940023G, approved by the Florida Department of Environmental Protection (FDEP) and the requirements specified by FCCJ in the Scope of Services-Study of Suitability of Ground Tire Rubber As A Parking Lot Surface Material. Four groundwater samples (including an equipment blank and a duplicate blank), three surface water runoff samples, one rain water sample, and soil samples (collected directly beneath the rubber tire material) were submitted for laboratory analyses. The samples were analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) by the FL-PRO Method, and the parameters listed in EPA Method 8270 for Semi-Volatile Organics, EPA Method 8020 for Volatile Organics, EPA 13 Priority Pollutant Metals, barium, sodium, and iron. Samples were also collected in November 1995 by a previous consultant as part of the feasibility study. The results of the sampling events are summarized in this report.

Except for the iron concentrations detected in groundwater samples collected from MW-1, MW-3, and MW-4, all remaining soil, groundwater, rain water, and surface water runoff concentrations were below State guidance concentrations.

2.0 INTRODUCTION

Aerostar Environmental Services, Inc. (**AEROSTAR**) was retained by FCCJ to continue the feasibility study of the suitability of ground tire rubber as a parking lot surface material at the site. The site is located approximately two miles southeast of the intersection of Interstate I-95 and State Road A1A. A Site Location Map is included as Figure 1. **AEROSTAR** completed the first, second, and third sampling and analyses after installation of the sampling points and the baseline sampling event were conducted by a previous consultant.

3.0 SAMPLE COLLECTION AND LABORATORY ANALYSES

Sampling Procedures

Groundwater, surface water runoff, rain water, and soil sampling was conducted by **AEROSTAR** personnel in accordance with **AEROSTAR**'s CompQAPP Number 940023G, approved by the FDEP; and the requirements specified by FCCJ in the Scope of Services-Study of Suitability of Ground Tire Rubber as a Parking Lot Surface Material. The samples were collected approximately 48 hours after a rain event in the area of the site. Four groundwater samples (MW-1 through MW-4, including an equipment and a duplicate blank), three surface water runoff samples (SC-1 through SC-3), one rain water sample (RC), and soil samples were collected directly beneath the granulated rubber tire material, were submitted for laboratory analyses.

Groundwater Sampling Procedures

Groundwater sampling procedures consisted of measuring the total depth and diameter of the well and the depth to the water table surface at each well location. Each well was determined to be approximately 15 feet deep and two inches in diameter. The depth to water at the site was estimated to be between four feet and five feet below land surface. Prior to sample collection, each well was developed using a bailer to assure the well was in hydraulic communication with the aquifer by removing approximately five well volumes of groundwater. All sampling equipment was properly decontaminated between samples following the requirements listed in **AEROSTAR**'s approved CompQAPP. Groundwater samples were collected after well development and placed in appropriate sample containers supplied by the subcontracted laboratory. The containers were placed in ice and delivered to the laboratory for analyses.

Rain Water and Surface Water Runoff Sampling Procedures

Rain water and surface water runoff sampling procedures consisted of collecting the water sample directly from the collecting devices. The collecting devices consisted of a two-gallon stainless steel bucket for the rain water collection point (RC) and three-gallon stainless steel buckets for the surface water/runoff sampling points (SC-1 through SC-3). Each sample collection device was properly decontaminated approximately two weeks prior to sample collection in accordance with **AEROSTAR**'s approved CompQAPP. Samples were collected directly from the water collecting device using the sample containers provided by laboratory. The containers were placed in ice and delivered to the laboratory for analyses.

Soil Sample Collection

Soil sample collection was conducted by removing the overlying granulated rubber tire material, collecting a soil sample directly beneath the tire material, and placing the sample in appropriate sample containers supplied by laboratory. The containers were placed in ice and delivered to laboratory for analyses.

Sample Analyses

The samples were submitted to a State approved laboratory for analyses of the parameters listed in EPA Method 8270 for Semi-Volatile Organics, EPA Method 8020 for Volatile Organics, EPA 13 priority pollutant metals, sodium, barium, iron, and TRPH by the FL-PRO Method.

4.0 RESULTS OF LABORATORY ANALYSES

The following presents the results of the laboratory analyses:

Groundwater Analyses

Baseline groundwater, runoff surface water, rain water, and soil samples were obtained in November 1995 by a previous consultant. The first, second, and third bi-annual sampling and analyses events were performed by **AEROSTAR** in June 1997, December 1997, and June 1998. The results of sampling and analyses events are summarized in Table 1, Table 2, and Table 3. The laboratory data sheets were included with Progress Reports.

Results of the November 1995, June 1997, December 1997, and June 1998 sampling events showed sodium, chromium, iron, and antimony concentrations above laboratory detection limits in the rain water collection point.

Results of the November 1995, June 1997, December 1997, and June 1998 sampling events showed sodium, chromium, iron, total xylenes, and antimony concentrations above laboratory detection limits in the groundwater samples collected for this investigation. The iron concentrations detected exceeded the FDEP groundwater guidance concentration of 0.3 mg/L. According to groundwater quality investigations conducted in Nassau County, iron concentrations range from 0.2 parts per million (ppm) to 0.6 ppm (Leve, 1966) for background levels in the shallow aquifer throughout the county. The remaining concentrations were below State target levels.

Results of the November 1995, June 1997, December 1997, and June 1998 sampling events showed barium, iron, sodium, zinc, chromium, lead, and antimony concentrations above laboratory detection limits in the surface water runoff samples. The concentrations detected are below Surface Quality Standards.

Results of the November 1995, June 1997, December 1997, and June 1998 sampling events showed toluene, antimony, chromium, copper, iron, lead, zinc, barium, nickel, sodium, arsenic, selenium, and TRPH concentrations above laboratory detection limits in the soil samples collected for this investigation. The concentrations detected are below Soil Cleanup Target Levels.

Results of the laboratory analyses are summarized in Tables 1, 2, and 3.

5.0 CONCLUSIONS

Results of the soil analyses showed all concentrations well below soil cleanup target levels; except, in a background sample collected in November 1995, which exceeded the State target levels for Arsenic.

Results of the groundwater analyses showed Iron concentrations above State target levels in the groundwater samples collected from the MW-1, MW-3, and MW-4.

TABLES

TABLE 1
SUMMARY OF RAIN COLLECTION AND GROUNDWATER ANALYSES

FCCJ Nassau Center
Yulee, Florida

PARAMETER	DATE	RC/ FA[2]	MW-1/ FE[2]	MW-2/ FF[2]	MW-3/ FG[2]	MW-4/ FH[2]	GROUNDWATER GUIDANCE CONCENTRATION[1,3]
TOTAL XYLENES[1]	11-13-95	BDL	BDL	BDL	BDL	BDL	0.02
	6-3-97	BDL	BDL	BDL	BDL	BDL	
	12-3-97	BDL	BDL	BDL	BDL	BDL	
	6-24-98	BDL	BDL	0.0014	BDL	BDL	
IRON[1]	11-13-95	BDL[4]	BDL	BDL	BDL	BDL	0.3
	6-3-97	BDL	0.33	0.15	0.44	0.62	
	12-3-97	0.11	BDL	0.22	0.26	0.49	
	6-24-98	BDL	0.332	0.180	0.534	1.46	
CHROMIUM[1]	11-13-95	BDL[4]	BDL	BDL	BDL	BDL	0.1
	6-3-97	BDL	BDL	BDL	BDL	BDL	
	12-3-97	BDL	BDL	BDL	BDL	BDL	
	6-24-98	0.003	BDL	BDL	0.004	0.002	
SODIUM[1]	11-13-95	1.8	8.9	6.5	8.7	9.7	160
	6-3-97	NA[5]	NA	NA	NA	NA	
	12-3-97	2.56	4.25	5.77	9.26	6.92	
	6-24-98	1.4	18.5	6.27	13.8	17.9	
ANTIMONY[1]	11-13-95	0.14	BDL	BDL	BDL	BDL	0.006
	6-3-97	BDL	BDL	BDL	BDL	BDL	
	12-3-97	BDL	BDL	BDL	BDL	BDL	
	6-24-98	BDL	0.005	BDL	BDL	0.003	

Notes:
1) Concentration values in milligrams per liter (mg/L)
2) Sampling points as labelled in December 20, 1995 Baseline Study
3) Groundwater Cleanup Target Level - Chapter 62-777, FAC
4) BDL-below method detection limits
5) NA-analyses not performed

TABLE 2
SUMMARY OF SURFACE WATER COLLECTION ANALYSES

FCCJ Nassau Center
Yulee, Florida

PARAMETER	DATE	SC-1/FD[2]	SC-2/FB[2]	SC-3/FC[2]	SURFACE WATER QUALITY STANDARD[1,3]
BARIUM[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL[4] BDL 1.23 BDL	BDL BDL BDL BDL	0.1 BDL BDL BDL	110 % of Background
IRON[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL BDL 0.21 0.102	BDL BDL 0.16 0.129	BDL BDL BDL BDL	1.0
SODIUM[1]	11-13-95 6-3-97 12-3-97 6-24-98	3.1 BDL 36.7 15.1	5.0 BDL 1.51 2.92	5.5 BDL 1.45 2.97	150 % of Background
ZINC[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL BDL BDL 0.068	BDL BDL 0.01 0.063	BDL BDL 0.07 0.103	28.0 to 305.0*
CHROMIUM[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL BDL BDL 0.002	BDL BDL BDL 0.002	BDL BDL BDL BDL	0.011
LEAD[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL BDL BDL 0.006	BDL BDL BDL 0.004	BDL BDL BDL BDL	0.54 to 18.58**
ANTIMONY[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL BDL BDL 0.006	0.12 BDL BDL BDL	0.17 BDL BDL 0.002	4.3

Notes:
1) Concentration values in milligrams per liter (mg/L)
2) Sampling points as labelled in December 20, 1995 Baseline Study
3) Class III Surface Water Quality Standards (Chapter 62-302, FAC) - Chapter 62-777, FAC
4) BDL-below method detection limits

* Zinc water quality standard is ≤ $e^{(0.8473[\ln H]+0.7614)}$, where H is the natural logarithm of total hardness expressed as mg/L of $CaCO_3$. Based on Total Hardness range of 25 mg/L to 400 mg/L as indicated in Chapter 62-302, FAC. Samples not analyzed for Hardness for this investigation.

Lead water quality standard is ≤ $e^{(1.273[\ln H]-4.705)}$, where H is the natural logarithm of total hardness expressed as mg/L of $CaCO_3$. Based on Total Hardness range of 25 mg/L to 400 mg/L as indicated in Chapter 62-302, FAC. Samples not analyzed for Hardness for this investigation.

TABLE 3
SUMMARY OF SOIL LABORATORY ANALYSES

FCCJ Nassau Center
Yulee, Florida

PARAMETER	DATE	S-1/ FI[2]	S-2/ FJ[2]	SS-1	SS-2	SS-3	SOIL CLEANUP GOALS[1,3]
TOLUENE[1]	11-13-95	BDL	BDL	-	-	-	380
	6-3-97	BDL	BDL	-	-	-	
	12-3-97	-	-	BDL	BDL	BDL	
	6-24-98	-	-	0.0625	0.0625	-	
ANTIMONY[1]	11-13-95	BDL	BDL	-	-	-	26
	6-3-97	BDL	BDL	-	-	-	
	12-3-97	-	-	BDL	BDL	BDL	
	6-24-98	-	-	0.458	0.489	-	
CHROMIUM[1]	11-13-95	2.7	2.1	-	-	-	210
	6-3-97	1.7	1.4	-	-	-	
	12-3-97	-	-	2.3	BDL	1.38	
	6-24-98	-	-	1.19	1.07	-	
COPPER[1]	11-13-95	BDL	BDL	-	-	-	110
	6-3-97	BDL	BDL	-	-	-	
	12-3-97	-	-	2.3	BDL	BDL	
	6-24-98	-	-	BDL	BDL	-	
IRON[1]	11-13-95	8.0	4.4	-	-	-	23000
	6-3-97	960.0	510.0	-	-	-	
	12-3-97	-	-	386.0	476.0	397.0	
	6-24-98	-	-	456.0	671.0	-	
LEAD[1]	11-13-95	6.6	3.0	-	-	-	400
	6-3-97	4.4	3.6	-	-	-	
	12-3-97	-	-	3.8	3.64	13.3	
	6-24-98	-	-	2.56	2.65	-	
ZINC[1]	11-13-95	BDL	BDL	-	-	-	23,000
	6-3-97	5.7	26.0	-	-	--	
	12-3-97	-	-	45.0	4.7	2.13	
	6-24-98	-	-	2.7	0.9	-	
BARIUM[1]	11-13-95	3.8	3.8	-	-	-	110
	6-3-97	BDL	BDL	-	-	-	
	12-3-97	-	-	10.3	1.9	1.23	
	6-24-98	-	-	BDL	BDL	-	

Notes: 1) Concentration values in milligrams per kilogram (mg/Kg)
2) Sampling points as labelled in December 20, 1995 Baseline Study
3) FDEP Soil Cleanup Target Levels - Chapter 62-777, FAC
- indicates sample not obtained from location

TABLE 3
SUMMARY OF SOIL LABORATORY ANALYSES

FCCJ Nassau Center
Yulee, Florida

PARAMETER	DATE	S-1/ FI[2]	S-2/ FJ[2]	SS-1	SS-2	SS-3	SOIL CLEANUP GOALS[1,3]
NICKEL[1]	11-13-95 6-3-97 12-3-97 6-24-98	1.2 BDL - -	BDL BDL - -	- - BDL BDL	- - BDL BDL	- - BDL -	110
SODIUM[1]	11-13-95 6-3-97 12-3-97 6-24-98	170.0 BDL - -	160.0 BDL - -	- - 39.0 1,337	- - 38.7 1,212	- - 36.7 -	NA
ARSENIC[1]	11-13-95 6-3-97 12-3-97 6-24-98	1.3 BDL - -	BDL BDL - -	- - BDL BDL	- - BDL BDL	- - BDL -	0.8
SELENIUM[1]	11-13-95 6-3-97 12-3-97 6-24-98	BDL BDL - -	BDL BDL - -	- - BDL 0.227	- - BDL 0.253	- - BDL -	390
TRPH[1]	11-13-95 6-3-97 12-3-97 6-24-98	34.0 58.0 - -	5.5 BDL - -	- - 24.0 BDL	- - 21.0 BDL	- - 4.3 -	340

Notes: 1) Concentration values in milligrams per kilogram (mg/Kg)
2) Sampling points as labelled in December 20, 1995 Baseline Study
3) FDEP Soil Cleanup Target Levels - Chapter 62-777, FAC
\- indicates sample not obtained from location

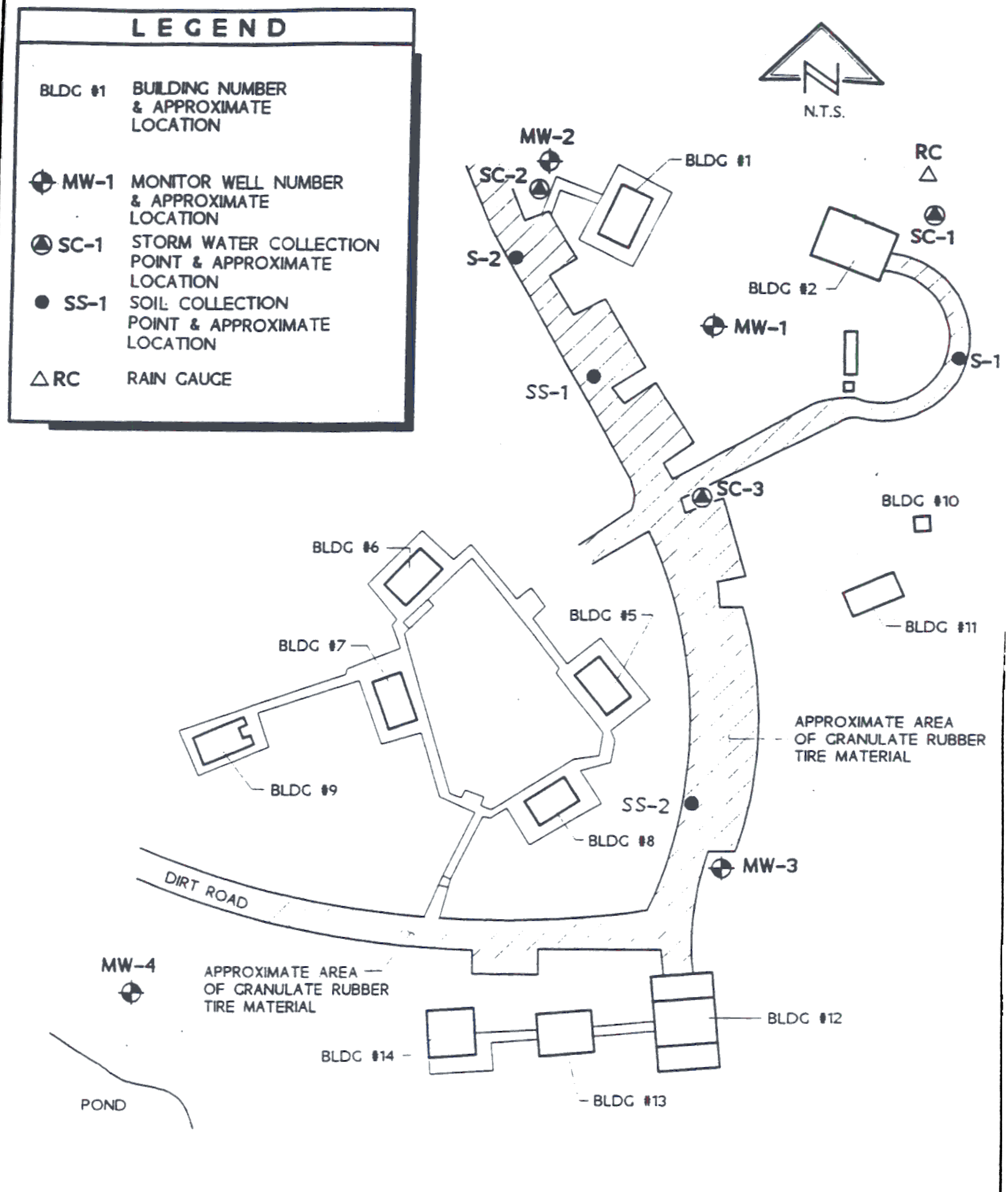


FIGURE 2
SITE PLAN

Aerostar Environmental Services, Inc.	FCCJ-NASSAU CENTER YULEE, FLORIDA	Drawn by: G.C.R. Date

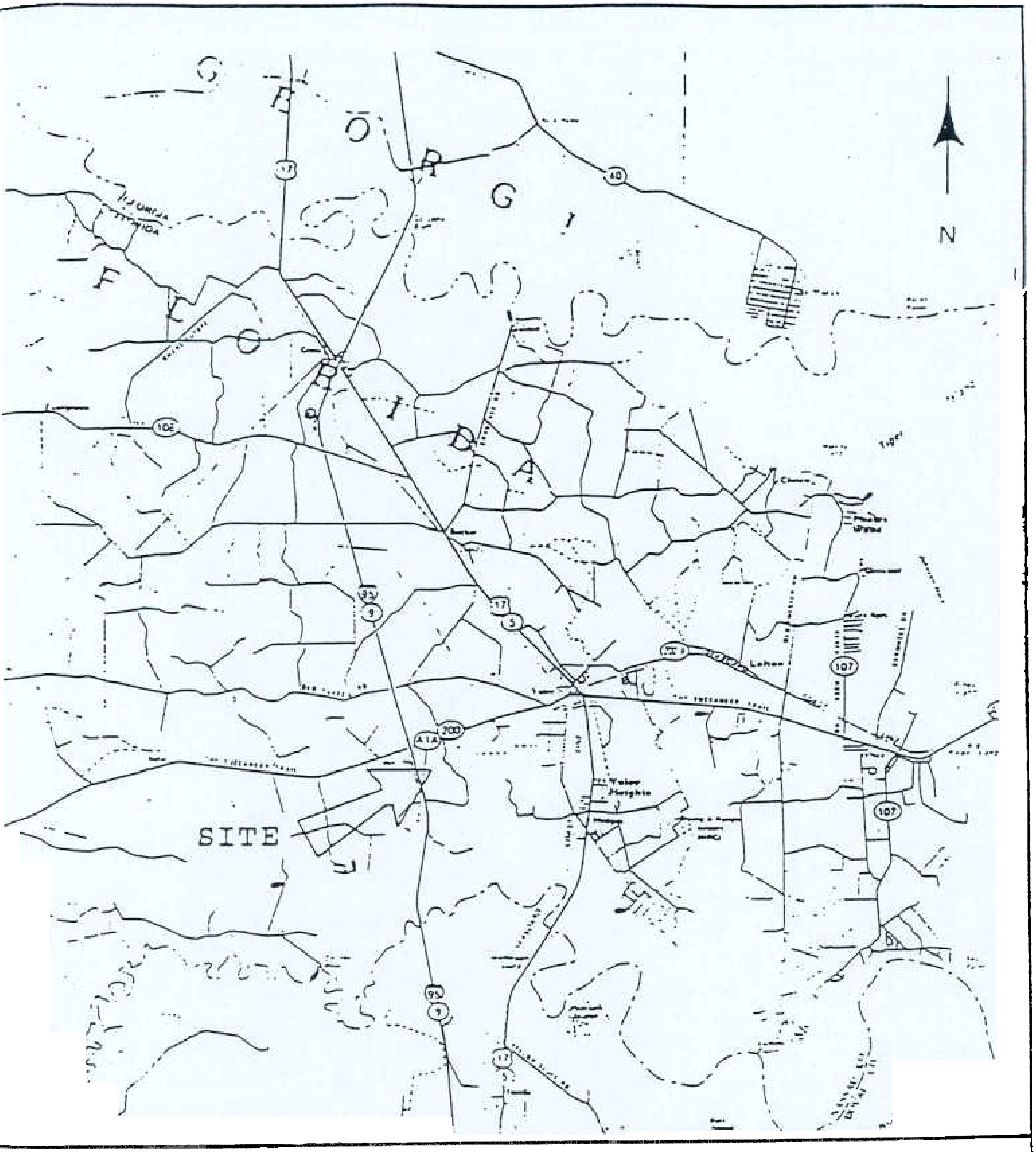


FIGURE 1 - SITE LOCATION MAP

Erostar Environmental Services, Inc.

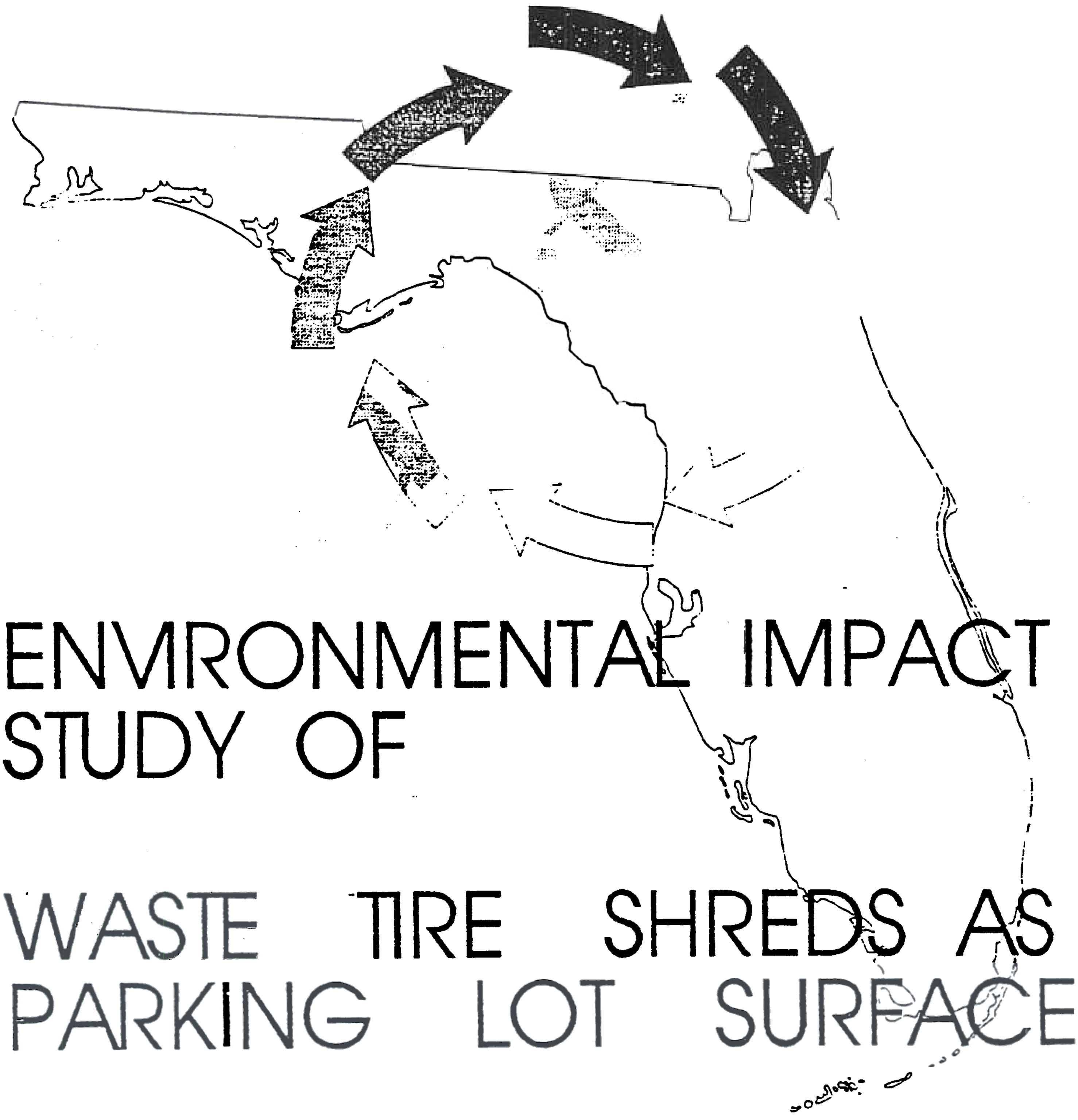
FCCJ-NASSAU CENTER
YULEE, FLORIDA

DRAWN BY: TCS

Appendix D

Environmental Impact Study of Waste Tire Shreds
as Parking Lot Surface

A PROPOSED SCOPE
OF SERVICES FOR AN



ENVIRONMENTAL IMPACT STUDY OF

WASTE TIRE SHREDS AS PARKING LOT SURFACE

AT THE FLORIDA COMMUNITY COLLEGE AT
JACKSONVILLE, NASSAU COUNTY CENTER

SCOPE OF SERVICES

ENVIRONMENTAL IMPACT STUDY OF

WASTE TIRE SHREDS AS A PARKING LOT SURFACE

Background

Section 403.709(2)(b), Florida Statutes, (FS), authorizes the Florida Department of Environmental Protection (FDEP) to expend monies from the waste tire account of the Solid Waste Management Trust Fund for research projects relating to solving solid waste problems resulting from waste tires. Identification and demonstration of constructive applications for products derived from waste tires is a critical factor in developing recycling alternatives for this potentially valuable waste resource.

The project set forth in this proposal was developed and submitted by the Florida Community College at Jacksonville (FCCJ) and is intended to define the practical viability and environmental impact associated with using shredded waste tire granules as a parking lot and walkway surfacing material. The objectives of the project are to implement and analyze the use of the product PermaPark as specified in Attachment A at FCCJ's Outdoor Adventure Center in Yulee, Florida so as to allow technical and environmental evaluation of this product application. The location of this facility is shown on the area map included as Attachment B.

Planning Phase

The objective of the Planning Phase was to design a detailed experimental plan providing for the complete assessment of the environmental impact associated with the use of tire granules as a parking lot surface, including the detailed definition of, and comparison to, initial an ongoing baseline conditions.

Under this phase:

(A) A topographical site plan showing the general drainage pattern for the site and a general site plan defining all areas to be surfaced with tire granules were prepared and are included in this proposal as Attachments C and D. The total area to be covered constitutes some 39,000 square feet of roadway, parking area and pedestrian walkways.

(B) FCCJ , working with private vendors certified under FDEP Quality Assurance Guidelines for water sampling and analysis, identified on the topographical site plan:

(1) the general directional flow of surface water by means of arrows, and

on the general site plan:

(2) proposed sample collection points, labeled as points (A) through (H), for the processing of:

(A) rainwater prior to ground contact,

(B) storm water that passed through tire granules but not subjected to fluid leakage from vehicles,

(C) storm water that passed through tire granules but subjected to possible fluid leakage from vehicles,

(D) storm water from surface not impacted by tire granules,

(E) groundwater not impacted by tire granules,

(F) groundwater that has passed through tire granules and soil but not subjected to fluid leakage from vehicles,

(G) groundwater that has passed through granules but subjected to possible fluid leakage from vehicles, and

(H) groundwater down site from covered area but fed by natural directional flow of surface water from site.

(C) Under the plan, monitoring wells (MW) will be installed with a five (5) foot offset from the proposed PermaPark installation as appropriate and will be placed up gradient, intermediate gradient, and down gradient in regards to the subsurface directional flow of groundwater for sample collection as follows:

MW (A)	Up Gradient/Background Sampling Point
MW (B)	Intermediate Gradient
MW (C)	Intermediate Gradient
MW(D)	Intermediate Gradient
MW(E)	Intermediate Gradient
MW (F)	Intermediate Gradient

MW(G)	Intermediate Gradient
MW(H)	Down Gradient

The monitoring wells, under this plan, will be installed in accordance with the following procedure:

1. Elevation of the natural ground will first be established before the ground is disrupted.

2. Wells will be drilled to a total depth of 15 feet (ft) below land surface

3. Wells will be drilled implementing a mud rotary auger or split spoon auger if vehicle access is prohibited.

4. Well casings will be constructed of PVC with a #20 mesh slotting to allow water intrusion.

5. Wells will be sand packed.

6. Following installation wells will be capped, provided a cement collar and locking metal cap for protection.

7. Installed wells will sit for a twenty four (24) hour period before any activity.

8. Following the 24 hour period, wells will be developed by implementing a 1 inch centrifical pump for purging,

9. Wells will be purged three (3) times before sample collection.

When sampling from the wells installed as above, the following equipment will be utilized for each sampling interval.

1. Disposable nitrile gloves will be donned between each sample collection at each monitoring well.

2. Precleaned/prepreserved sample containers will be supplied by a state certified laboratory.

3. Samples collected for semi-volatile (8270) and volatile organic analysis will be preserved with hydrochloric acid (HCL) to enure pH is below 2. Sample collection containers will be 40 milliliter (ml) amber glass containers prepared by a state certified laboratory.

4. Samples collected for TPH (3550) and TCLP Metals will be collected in one (1) liter wide mouth amber glass containers. The TPH sample will be

preserved with HCL and the TCLP sample will be preserved with nitric acid to ensure pH levels below 2.

5. A dedicated Teflon bailer will be assigned to each monitoring well.

6. Each dedicated bailed will be engraved with the well number for identification.

7. Each dedicated bailer will be decontaminated between sample intervals with warm water and an Alconox solution. Bailers will then be wrapped with aluminum foil for preservation during storage until the next sampling period.

8. All grab samples will be labeled, placed in a plastic bag and preserved on ice.

9. All grab samples will be transported within 24 hours following collection.

10. All grab samples will be transported under a chain of custody to a state certified laboratory for analysis.

11. A trip blank to assure quality control will be prepared using analyte free water and submitted for analysis.

(D) The sampling plan to provide the baseline and periodic data for analysis shall include tests of ground and storm water prior to the start of product installation. These tests shall be conducted prior to rainfall at seven locations marked as B through H on Attachment D and shall be supplemented by a rainfall sample taken at the location marked A on this same attachment.

The plan includes the analysis of ground and storm water during rain events at approximately 1, 3, 9, and 18 months after the installation of the surface material. This frequency may be altered based on the data collected during the sampling periods of the first and third months.

The sampling plan and analysis will include:

1. A wellhead engineering survey of the eight monitoring wells

2. Aquifer characterization tests (slug tests).

3. A data base search of permitted potable wells within 0.5 miles of the facility.

4. Analysis of samples collected from the eight shallow monitoring wells in accordance with the following EPA methods unless otherwise agreed to

prior to any deviation from the FDEP.

a. Total Petroleum Hydrocarbons (TPH) - Method 3500/418.1

b. Semi-volatile Organics - Method 8270

c. Volatile Organics - Method 8020

d. Metals - EPA Primary Pollutant Metals plus iron, excluding TCLP procedure unless significant increases warrant complete impact assessment.

5. Reports on the results of the testing outlined above shall be submitted in accordance with the schedule set forth in the description of the Project Implementation Phase to follow.

(E) The specifications for the purchased product are presented in attachment A and the costs for the product are reflected in a budget for the project included as Attachment E. From the approval of this plan by FDEP, the entire project will run for 24 months, six months prior to product installation and 18 months after installation.

(F) All of the field work and monitoring will be performed in accordance with FDEP guidelines. A Quality Assurance/Quality Control (QA/QC) Plan for all major tasks will be submitted to and approved by, FDEP prior to baseline testing or product installation.

Implementation Phase

It is anticipated that water testing and analysis, and the installation of surface material will commence approximately six months after plan/grant approval by the FDEP. During this period the College will solicit competitive bids for both sampling/testing services and the provision of the bed material (131 tons). This period will also be used to submit and gain approval for the QA\QC plan prepared by the vendor selected to perform the testing and analysis.

(A) Once the QA\QC plan is approved the surface material can be ordered and baseline sampling can be conducted as outlined in the plan proposal. This baseline would be established up to one month prior to product installation.

(B) Once the baseline has been established the tire granules will be installed per plan specifications. Completion of the installation will establish month 0 for further testing and analysis of rain, ground and storm waters.

(C) Sampling and analytical testing will be performed at months 1, 3, 9, and 18 per plan specifications unless otherwise modified with FDEP approval.

Reporting to the FDEP under this implementation plan shall include:

(A) Monthly project progress reports during the first 12 months and bi-monthly project progress reports during the second 12 months. These reports will outline progress, current status versus planned schedules, expenditures versus budget, and any unexpected difficulties/solutions.

(B) Sampling analysis results will be submitted within 45 days of each sampling date and the report of these results shall include a narrative description of any difficulties encountered with the installation or sampling, interim conclusions, any any recommendations for plan modifications.

(C) A final report submitted within 45 days of the project's completion which will contain:

1. A chronological description of major project activities, including any unexpected obstacles/solutions.

2. Quantitative and qualitative summaries of the analytical data, including comparison and discussion of environmental impact.

3. Discussions and conclusions regarding the physical suitability of tire granules for this application and any recommendations to improve future installations.

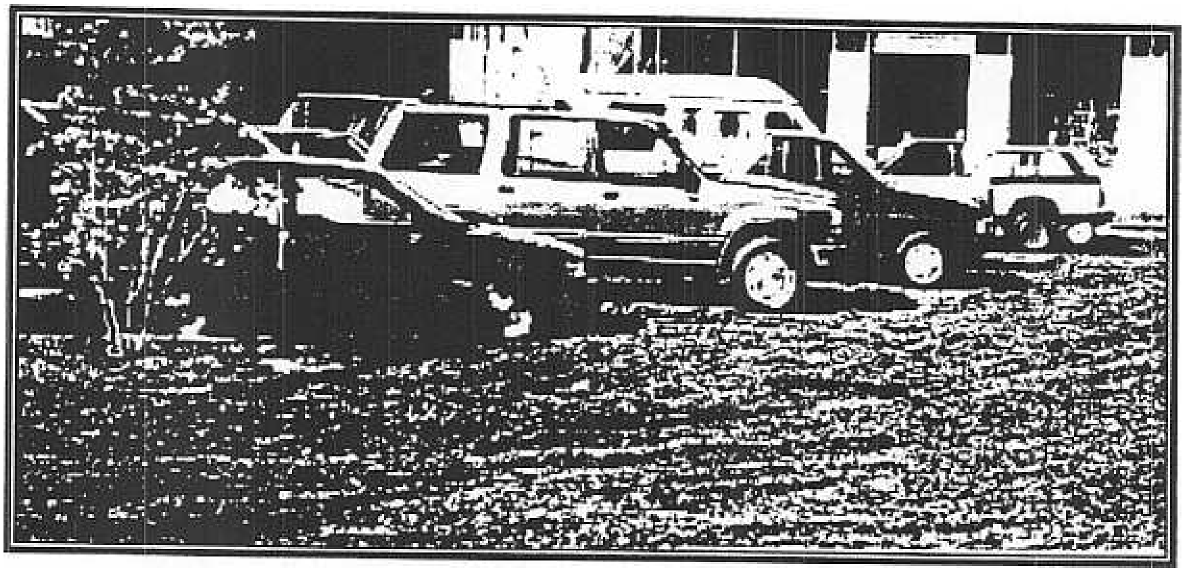
Appendix E

PermaPark

A*R*T

American Rubber Technologies, Inc.

PermaPark™



PermaPark™ rubber surfacing is the solution to elevate muddy parking lots and the constant hassle of replacing mulch or sand. It is a porous durable surface made of fiber-reinforced rubber granules. When used at a 3" depth, PermaPark™ creates a resilient surfacing which provides constant traction with superb drainage. In dry conditions, it greatly reduces dust. In wet conditions, it virtually eliminates puddles and mud problems by allowing water to percolate through the rubber... **no need for retention ponds!**

It is easy to install - just dump and spread with a small tractor or common yard rake. Because it is heavier than water it will not float or blow away. It is a wise investment considering replacement costs of other surface materials. PermaPark™ is a durable, economical, long lasting ground covering.

2 " Depth	**Multiply sq. ft. x 4 = lbs. needed**
Depth for private driveways/walks - low usage areas	*1 Ton Covers 475 sq. ft. 2" Deep
3" Depth	**Multiply sq. ft. x 6 = lbs. needed**
Depth for commercial parking lots/driveways	*1 Ton Covers 325 sq. ft. 3" Deep

CALL 800-741-5201

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Appendix F

Topographic Site Plan

ATTACHMENT C
TOPOGRAPHIC SITE PLAN