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ANALYSIS OF STABILIZATION AND ABATEMENT ALTERNATIVES FOR THE FLORIDA TIRE RECYCLING, INC WASTE TIRE SITE

St. Lucie Co.

Prepared for

The Florida Department of Environmental Regulation

by

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PURPOSE

The Florida Tire Recycling, Inc. Waste Tire Site has been estimated to contain approximately 4,000,000 passenger tire equivalents (PTE) as of June 30, 1992. The site represents a potentially serious public health hazard. Massive quantities of dense smoke potentially generated during a fire at the site could negatively impact regional air quality and represent a health hazard to area residents. In addition, concurrent generation of pyrolytic oils containing hazardous organic and inorganic chemicals could readily contaminate local surface/ground waters and possibly even potable water aquifers. As a result of potentially serious environmental and public health consequences associated with a fire at this site, the Florida Department of Environmental Regulation has requested this study to define the following site-specific objectives:

(1) Intermediate stabilization procedures designed to minimize the potential of, and environmental damage from, a possible fire at the site.

(2) Available utilization/disposal alternatives for tires removed from the site during stabilization and abatement activities.

The results of this analysis are discussed in the following sections.

SITE CHARACTERISTICS

The Florida Tire Recycling, Inc. Waste Tire Site is located at 10151 Range Line Road in St. Lucie County, approximately 0.4 miles south of State Highway 709 and 8 miles southwest of Interstate Highway 95, as illustrated in Figure 1. The site is less than 10 miles west of Port St. Lucie and within 20 miles of Fort Pierce and Lake Okeechobee.

Figure 1

A waste tire processing facility conducting business under the name of Florida Tire Recycling, Inc. (Florida Tire or FTRI) is currently operating on the site. The total facility occupies approximately 9 acres in a rural area containing scattered commercial, industrial, and agricultural properties. The site is irregularly shaped, resembling a rectangle with a triangular attachment at its northwestern corner. A schematic plot plan depicting site conditions as of our visit on June 29-30, 1992 is provided in Appendix A and discussed below.

The Florida Tire Site is bordered by Range Line Road on the eastern perimeter, open land on the southern and western perimeter, power lines above open land along the northwestern diagonal, and Miami Tank's facility along the remainder of the northern perimeter. A stabilized access roadway roughly bisects the eastern portion of the property. The southeastern section of the site is undeveloped land with an area along the access roadway serving as a staging and storage area for trailers.

The southwestern section contains a series of organized whole tire storage piles that have generally been segregated according to tire size. The owner indicated that the organized piles were 100 feet by 100 feet, but actual dimensions ranged from 95 to 125 feet with all seven of the organized piles (designated T-2 through T-8 in Appendix A) occupying more than 10,000 square feet of surface area. Truck tires were being moved from other random pile locations and stacked in pile T-10 during our visit. Most of the southern portion of the property was submerged in standing water up to two feet deep during our visit.

The northeastern section contains a processing area, including two independent shredders and piles of tires and shreds associated with processing operations. The northwestern section (including the triangular property extension) contains a large pile of coarsely shredded tires occupying approximately 110,000 square feet of surface area as well as miscellaneous smaller piles of whole and shredded tires.

The large shred pile extended within approximately 50 feet (at ground level) of high voltage electrical transmission lines along the diagonal portion of the northwestern property line. The shred pile also comes within about 30 feet of a railroad spur at the western perimeter of the Miami Tank facility. Railroad tank cars containing hazard warnings associated with chlorinated chemicals were sitting on this spur at the time of our visit. Chemical storage tanks were also located on the Miami Tank property within approximately 100 feet of the shred pile.

Two fiberglass water storage tanks with a total capacity of about 25,000 gallons were installed in the central section of the site at the request of the local fire department. However, this quantity of water would not have any material impact upon extinguishing, or even controlling, a fire in the tire piles or shred piles at the site.

At the time of our visit on June 29-30, 1992, the site contained piles of whole and shredded tires with distinct characteristics as briefly described below. Organized piles containing passenger tires (designated T-2, T-4, T-5, and T-6) were tightly laced to a height of approximately 7 feet. Similar piles containing truck tires (designated T-3, T-7, T-8, and T-10A) were uniformly stacked 9 tires high to a height of about 7 feet. Other piles (designated T-1, T-9, T-11, T-12, T-13, T-15, and T-16) contained mostly large, randomly-deposited truck and off-road tires with pile heights ranging from 4 to 10 feet. Pile T-14 contained a mixture of shreds, off-road, and stacked truck tires with an estimated average height of 7 feet.

Based on surface observation, the average tire size percentages appear to be about 35% truck, 30% off-road, and the remainder are passenger and light truck tires. This site contains the highest percentage of off-road tires of any site examined to date. Several of the smaller piles contained a high percentage of truck and off-road tires that were still mounted on rims, representing an additional obstacle to proper disposal of these tires during stabilization and abatement activities.

The whole tire piles were estimated to contain approximately 596,000 passenger tire equivalents (PTE) as of June 30, 1992. The methodology and summary calculations associated with this estimate are also provided in Appendix A. Since a passenger tire equivalent is generally considered to be 20 pounds, this estimated quantity represents 5,960 tons (at 100 PTE/ton).

The shred piles consist primarily of coarsely shredded tires typical of single-pass shredding operations. Pieces significantly larger than one eighth of a tire (including some pieces approaching half of a tire) were observed on pile surfaces and photographically documented. Such large pieces generally result from the use of inadequately maintained shredding equipment or wide knife spacing that increases productivity but does not allow adequate cutting frequency. The shredded tire piles were estimated to contain approximately 3,311,300 passenger tire equivalents (or 33,113 tons) based on methodology and calculations included in Appendix A.

Under existing regulations of The Florida Department of Environmental Regulation, passenger and truck tires must be shredded into pieces smaller than one eighth of a tire prior to storage or landfill disposal. Shredded tires must meet even more stringent size specifications to be suitable for use as landfill daily cover. Non-uniform coarse shreds like those present at this site have historically not proven to be a useful product because the large particles tend to intertwine to form large clumps, thereby creating severe handling problems when reintroduced into metering systems or other subsequent processing machinery.

Some finer shreds were visible in pile segments, but surface observation indicated only a limited quantity. Based on short-term observation of shredding operations during our visit, the operator appeared to be attempting to make a smaller shred size. However, pieces larger than one eighth of a tire were still observed in product streams exiting both shredders. Shredder #2 had a large hole in the classifying trammel that allowed large particles to exit with the product without recycling for further size reduction. Ongoing processing operations did not allow safe examination of shredder # 1's internal condition to define reasons for its poor performance.

During our visit, shreds were being transported up a ramped portion of the main pile and dumped on top of the existing pile. This material was then pushed and leveled by other heavy equipment to create a higher plateau on top of the existing shred pile. The ramp and upper surface had been significantly compacted by repeated movement of heavy equipment across the tire shreds as indicated by pile stability and absence of resiliency. The combination of large shred size, depth and density will promote formation of pyrolysis oils if this pile is ignited. These factors will also make it extremely difficult, if not impossible, to rapidly break the shred pile into smaller segregated segments if a fire occurs.

The total quantity of waste tires and shreds on the site as of June 30, 1992 was estimated to be 3,907,300 passenger tire equivalents representing 39,073 tons. The waste tires and shreds have been, and are continuing to be, accumulated by Florida Tire Recycling, Inc. as part of their ongoing operations. Since this is an operating site, it is likely that site conditions will change as a result of continuing receipt, shredding and storage operations.

Based upon DER records, the waste tires and shreds at this site have been accumulated since the facility began operating as a waste tire processing facility in late August, 1989. In addition to the estimated 3,907,300 passenger tire equivalents accumulated on-site during this period, County Landfill records indicate that 21,819.04 tons of shreds (representing 2,181,904 passenger tire equivalents) were taken to the nearby St. Lucie County Landfill under a favorable contractual agreement that expired in April, 1992. Therefore, an estimated 6,089,204 passenger tire equivalents were collected in a period of 35 months, resulting in average collection rate of 173,977 passenger tire equivalents/month. Current accumulation rates may be even greater if business growth has continued to accelerate during this period. On-site accumulation of whole and shredded tires will continue to increase by the quantity difference between waste tires entering the site and tires/shreds removed for shipment to permitted markets or disposal sites.

The site is relatively flat but slopes gradually to the south and east within the property boundary. The entire site is located within a designated flood prone area. Most of the southern half of the property, including the area containing piles of whole tires, was submerged in water up to 2 feet deep during our visit. An additional large area of standing water, possibly a water control pond, is located about 50 feet from the western property line. A topographical map of the site area is provided in Appendix B.

The predominant soil is Pineda sand. It is a poorly drained soil that typically has a water table depth of less than 10 inches for 1 to 6 months and 10-40 inches for most of the rest of the year. In a few areas, the soil is covered with shallow standing water for 1 week to 6 months per year. The water table is below a depth of 40 inches only for short periods in dry seasons.

The surface layer is typically 6 inches thick with very dark grayish brown sand in the upper 3 inches and dark brown sand in the lower 3 inches. It requires stabilization even for light applications such as playground use. The upper part of the subsoil extends to a depth of 34 inches and contains yellowish brown sand in the upper 6 inches, strong brown sand in the next 9 inches, and pale brown sand in the lower 13 inches. A layer of light gray sand 4 inches thick separates the upper and lower parts of the subsoil. The lower subsoil is olive gray sandy loam that extends to a depth of 52 inches. The upper 4 inches has intrusions of white sand. The substratum is gray loamy sand to a depth of 80 inches or more. Permeability is classified as rapid in the surface and subsurface layers, slow to very slow in the subsoil, and moderately rapid to rapid in the substratum. A map and description of predominant soil types in the site area are provided in Appendix C.

The Miami Tank Manufacturing facility directly adjacent to the site contains chemical storage tanks and rail cars that could reasonably be affected by heat generated from a fire at in nearby whole or shredded tire piles. Depending on the flammability and chemical characteristics of materials contained in these vessels, they could significantly impact the personnel safety and environmental impact of a fire at the site. In addition, United States Geological Survey maps identify a flowing water well about 1/2 mile west of the site.

Tires and coarse shreds containing stagnant water are generally recognized as excellent breeding grounds for the aedes albopictus (often referred to as the Asian Tiger) mosquito and other species capable of serving as carriers of diseases that are potentially fatal to humans. As a result, such breeding grounds become a threat to human life if sources of diseases carried by these mosquitos are present in the area.

There was no indication of the Asian Tiger Mosquito during the site visit. However, the Asian Tiger Mosquito is spreading southward and may become established within the pile by natural migration. This mosquito represents a potential nuisance and health hazard for local residents. The Asian Tiger Mosquito is an aggressive daytime biter capable of serving as a carrier of potentially serious diseases such as Dengue Fever and Encephalitis, among others. If sources of diseases carried by the mosquito are identified, then the site should be considered in any mosquito control programs initiated within the area.

In addition, any accumulation of this size represents a potentially significant source of air and water pollution in the event of a fire. Combustion of the large tire and shred piles would be virtually impossible to extinguish and would be expected to generate large quantities of dense black smoke and pyrolytic oils (containing partially combusted hydrocarbons and heavy metals) for an extended period of time. Under proper conditions, the smoke plume could potentially affect ambient air quality as far away as Fort Pierce or Lake Okeechobee and could result in fallout of fine zinc particulate matter within this area. If pyrolytic oils and heavy metals penetrate the surface soil, the resulting water table contamination could create a hazardous waste site requiring substantial remediation costs. The site should be stabilized, and preferably abated, as rapidly as possible to control the magnitude of consequences associated with a potential fire.

SECURITY MEASURES

Waste tire site security measures are generally structured to meet three primary objectives:

1. Prevention of pile growth;

2. Prevention of public access resulting in accidental or intentional fire initiation; and

3. Rapid activation of pre-planned response procedures in the event of a fire.

Relevant background information and alternatives associated with each objective are presented below.

Pile Growth Prevention

Tire piles historically continue to grow until access is controlled. The main entrance gate off of Range Line Road provides the only apparent entrance to the site for heavy vehicles. A sliding chain link fence can be extended across this entrance to control access. A chain link fence has been installed along portions of the northern boundary by Miami Tank Manufacturing Company. Heavy vehicle access from Range Line Road and other perimeter areas is limited by ditches or unstable soil conditions. There was no indication of vehicular traffic through any point other than the main entrance gate. The site will remain vulnerable to additional growth until all vehicle access points are controlled. Therefore, the main entrance gate should be improved and secured with a 4-digit combination lock. The combination should be incorporated into all local emergency response plans to avoid access delay if a fire occurs. The site should be periodically examined for evidence of recent additions and photographically documented. Since the State may pursue available legal avenues to recover costs associated with implementing site control and abatement measures from site owners, it is in the owners' financial interest to prevent pile additions.

Prevention of Public Access

The Florida Tire Recycling Waste Tire Site is accessible by pedestrians from all perimeter directions except the northern areas bordered by Miami Tank. Due to limited foliage, the site is readily visible from Range Line Road and all perimeter directions. Since most tire pile fires are initiated by man, not nature, controlling vehicle and pedestrian access to the pile is normally an important component of fire prevention. The following measures have historically been considered as impediments to public access at waste tire sites:

(1) Security Patrol. On-site security personnel are considered a major deterrent to unauthorized intruders and a critical link in early fire detection, especially if the pile perimeter is actively patrolled. DER should initiate security guard protection as rapidly as possible once it has gained access and assumed responsibility for site abatement. It may be possible to use a single guard per shift, at least during daylight hours, if radio contact can be used to maintain a communications link. Two guards per shift may be required during night hours as a personnel safety measure. All security personnel must be familiar with established emergency response procedures and have rapid access to outside police and fire contacts.

(2) Perimeter Clearing. The tires around the site perimeter offer hidden shelter for an intruder. A perimeter buffer zone should be cleared to a minimum width of 50 feet as required by Florida Waste Tire Site Regulations. A wide clearing increases patrol effectiveness, decreases possible pile ignition by thrown objects, and reduces the possibility of fire transmission between the pile and adjacent property.

(3) Access and Perimeter Roadways. Installation of stabilized access and perimeter roadways is desirable to enhance movement of heavy equipment at the site during tire removal or fire-fighting operations. A perimeter roadway around the pile also improves effectiveness of security patrols. Access and perimeter roadways, as depicted schematically in Appendix D, should be installed as rapidly as possible. Two stabilized work areas are also included to improve on-site efficiency if two contractors operate concurrently to decrease site stabilization and abatement time requirements. Additional stabilized work areas may be required if more than two contractors are concurrently deployed on-site.

(4) Perimeter Fencing. A chain-link fence 6 feet high with razor wire top sections is desirable to minimize access by pedestrian intruders at large exposed sites like Florida Tire Recycling. The fence decreases probability of a fire by providing an obstacle to mischievous people who have been

responsible for some tire fires. However, a perimeter fence does not provide complete protection from intruders. It has not historically been successful in preventing access by a determined arsonist or ignition by thrown objects. Use of a perimeter fence in conjunction with security guard(s) who actively patrol the site increase the probability of preventing and/or controlling a fire at the site. Rapid pile stabilization and abatement remains the only proven method of decreasing the potential for arson.

(5) Perimeter Lighting. Perimeter lighting enhances effectiveness of security patrols by increasing visibility. However, at rural sites such as Florida Tire, this advantage may be more than offset by the attention attracted by the lighting. As a result, perimeter lighting is not recommended for this site unless the security contractor feels that it is necessary for personnel safety.

(6) Other Measures. Other security measures have been considered for waste tire sites. For example, motion sensors and infrared detection devices are theoretically useful, but can be falsely activated by wildlife normally present at rural sites like Florida Tire. Trained guard dogs contained within a fenced area can be an effective deterrent, but potential liability issues have generally prevented their use. These methods have not been widely applied and are dependent upon local conditions. Advice of a qualified security firm and attorney is suggested prior to implementation.

The estimated capital costs associated with implementing outlined roadway stabilization and perimeter fencing are provided in Appendix D. Estimated monthly costs associated with maintaining an on-site security guard around the clock have also been calculated in Appendix D. Total security costs associated with each subsequently discussed tire removal alternative have been provided based on the projected elapsed time required to complete each one.

Actual security costs will increase beyond these projections at the rate of $1,712/week if security guards are maintained during periods not included within planned contractor activity. Examples might include initiation of security measures prior to full contractor productivity or any extended operating period required by the contractor beyond projections. Similar weekly savings may be achieved by reducing total elapsed time associated with site abatement through concurrent use of multiple contractors.

Actual security costs may also be increased by use of two guards/shift if deemed necessary by the security contractor and FDER. Costs will increase by $1,512/week if a second guard is deployed around the clock, and by $1,008/week if a second guard is used only on two shifts/day involving nighttime.

Activation of Pre-Planned Emergency Response Procedures

Pre-planned emergency response procedures and reliable activation methods are critical components of effective security plans. Access to police assistance may be required if intruders are sighted. Analysis and coordination of fire fighting capabilities must be pre-planned to minimize on-site delays which could unnecessarily allow a fire to spread or increase in intensity. The procedures may be activated by security personnel: (1) calling all necessary response teams; or (2) making a single phone call to 911 emergency response, who in turn follow a pre-determined notification procedure. The latter procedure is preferable for the following reasons: (1) 911 has direct access to resource requirements and awareness of other conflicting events requiring resources; (2) on-site security personnel may be preoccupied with the emergency; and (3) 911 personnel training is more extensive and probably experiences lower turnover rates than security forces.

Established written procedures should be carefully developed by all participants and reviewed periodically to reflect changing site conditions. The appropriate local emergency response coordinators and the fire coordinator for Orange County should develop a written plan for a emergency response pertaining to the Florida Tire Site. The plan should make available D-6 class (or larger) dozers and a 1,000 gpm pumper within thirty minutes of a reported fire. The plan should also identify a water supply potentially using area surface waters or nearby hydrants to control the spread of a fire.

Fire officials should be aware that a tire fire is considered a chemical fire in nature, so respondents should be equipped and trained for that type of fire response. The plan should identify fire fighting techniques in the event of a "chemical" type fire, manpower allocation, equipment allocation, crowd and traffic control, and support for the fire fighters and security officers. Furthermore, an on-site coordinator must be identified to eliminate confusion in the event of an emergency response. The on-site coordinator typically has authority over allocation and use of manpower, ultimate decision-making at the fire scene, and methods used to fight the fire.

FIRE CONTROL ALTERNATIVES

The best practical security measures only represent deterrents, and cannot be expected to prevent pile ignition by natural causes (lightning) or a determined arsonist. However, additional steps may be taken to limit the magnitude of a possible fire and its environmental consequences. The following sections discuss:

(1) the historical characteristics of tire fires;

(2) environmental considerations;

(3) methods of fire fighting;

Characteristics of a Tire Fire

A tire is an integral mixture of oil-based elastomers, inorganic compounds, and reinforcing wire and/or fabric. Although its ignition temperature is relatively high (about 585°F), tires contain almost 65% volatile organic compounds (2-3 times higher than coal) which are readily combustible. The heat content of scrap tires is 13,000-15,000 Btu/pound, compared to coal with 10,000-12,500 Btu/pound. A tire requires high oxygen availability for complete combustion, and can generate over two gallons of oil (containing hazardous components) per tire if it is thermally decomposed in the absence of oxygen. Dense black smoke containing partially combusted hydrocarbons can also be emitted until the fire is ultimately extinguished.

When a pile of whole or coarsely shredded tires is ignited, flames generally spread progressively over the entire pile surface, often rapidly if aided by wind. When the surface is ignited, heat is conducted throughout the pile depth by the reinforcing steel belts and generated oils. When water is applied to the surface, it decreases oxygen availability and initiates a water-shift reaction, both of which increase production of pyrolytic oils. Greater pile depth and/or density associated with compacted coarse shreds also increase oil generation due to oxygen starvation within the pile. Even if the surface is cooled by water, the water is typically vaporized before it can reach and cool the entire pile depth. As a result, internal sections of the pile continue to generate heat and combustible gases which cause re-ignition of the surface when water application is stopped. Some tire piles have burned for thirty days, and smoldered for up to nine months.

Environmental Considerations

A tire fire can negatively impact both air and aquatic environments. Massive quantities of dense black smoke containing partially combusted hydrocarbons and particulate (organics and heavy metals) are typically generated from a fire. Plume dissipation normally occurs within 1 to 5 miles of the site, but some tire fire plumes have reportedly reached 40,000 feet with particulate fallout occurring up to 50 miles away. The quantity of smoke and its impact on local or regional ambient air quality is dependent upon the number of tires combusted and site-specific conditions at the time of the fire. The Florida Tire Site is located in a rural area, but airborne emissions associated with such a large quantity of tires and shreds may still impact high population density areas under normal atmospheric conditions. The probability of this occurrence should be further decreased by taking intermediate steps to isolate and control a potential fire within segments of the pile, especially the large shred pile containing the equivalent of over 3,000,000 passenger tires.

The partially combusted pyrolytic oils and metallic residue (primarily zinc and iron plus traces of other heavy metals) can potentially contaminate soil and groundwater supplies. Up to 200,000 gallons of oil have reportedly been removed from some fire sites. Analysis of oil generated at the Ontario Site showed the presence of 2,300 parts per quadrillion of 2,3,7,8 TCDD (a carcinogenic dioxin) among other components.

Methods of Fire Fighting

From the previous description, it should be apparent that extinguishing a tire pile fire is extremely difficult. During recent fires in New Hampshire, Minnesota, Ontario and Quebec, a variety of techniques were used, including traditional high volume water sprays, water bombers, fire control foams, light water, and burial. None were effective in completely extinguishing pile combustion within 10 days. In cases using water or foams, increased oil generation was noted after application, but impact on fire control was limited.

Water does seem to have a positive effect on decreasing total combustion time once available volatile component concentrations have been depleted, presumably due to lower volumetric heat generation. Burial with dirt or sand can effectively control air emissions once the initial intensity of the fire has decreased. However, sub-surface pyrolysis can continue for over a month with its associated generation of oils.

In general, the most effective fire control method has been use of available water supplies and heavy equipment to isolate the burning pile segments, if possible, and prevent propagation to nearby segments. As the initial intensity decreases, water or burial can be used to shorten total elapsed combustion time. However, tires can continue to thermally decompose into oil and gas in the complete absence of oxygen. Therefore, the environmental clean-up consequences of increased oil generation and higher disposal volumes during site remediation should be considered prior to initiation of these procedures.

Fire fighting procedures must also include appropriate personnel protection. High levels of energy released from tire fires can lead to rapid heat exhaustion and liquids depletion for fire fighters working in close proximity to the fire. A water spray has been used to shield men and equipment from direct radiant heat impact when close contact is absolutely necessary. Dense smoke can impair vision and represent a potential health hazard due to the presence of partially combusted hydrocarbons. As a result, appropriate self-contained breathing apparatus should be worn by personnel directly exposed to smoke at the fire site.

Applying the preceding discussions specifically to the Florida Tire Site, fire fighting procedures must be established to prevent a fire from penetrating below the surface of the large shred pile. The shred pile containing an estimated 3,000,000 passenger tire equivalents represents a much greater hazard than any of the individual whole tire piles containing less than 60,000 PTE each. Massive quantities (potentially up to 6 million gallons) of pyrolytic oils could be generated if heat is allowed to penetrate the entire shred pile. The best, and perhaps only, possibility of preventing massive oil generation is development of a rapid emergency response plan that will allow at least 2,000 gallons of water to be applied to burning areas of the shred pile surface within 10-15 minutes of ignition if possible. Construction of dedicated on-site water sources, piping, pumps, and possibly even distribution systems should be considered if locally available equipment and resources can't reasonably achieve this required objective. If a fire is allowed time to penetrate the shred pile surface, burial may offer the only other alternative but large quantities of oil will still be generated for weeks even after complete burial. If this alternative is implemented, trenches should be dug down to, but not through, low permeability soil levels to contain, collect and remove generated oils as quickly as possible.

If a fire at the site is initiated in one of the piles of whole tire, it is recommended that available resources be devoted to preventing ignition of other piles, especially the shred pile. Therefore, it is recommended that no water be directly applied to burning whole tire pile unless: (1) the fire is isolated in a shallow perimeter pile segment where water can penetrate and extinguish the entire pile depth; (2) the fire has been caught very rapidly before its intense heat has penetrated the pile surface; or (3) the plume and prevailing wind direction are negatively impacting densely populated areas or business centers.

As previously stated, adding water to whole tire pile segments that are over 4-5 feet deep will increase the probability of oil generation and will provide a hydraulic carrier for aquifer penetration through sandy surface soils. However, it may be necessary or desirable under the above conditions. Otherwise, available water should be devoted to cooling of adjacent pile segments to prevent their ignition and for protection of any men and equipment engaged in creating fire breaks in unaffected pile areas. The on-site commander must evaluate the consequences of this action against the hazard or damage caused by airborne emissions, and apply suffocating sand or water to the pile if he believes it will have a necessary and positive impact.

INTERIM SITE STABILIZATION PLAN

Based upon the preceding discussion, initiation of interim measures to control the potential magnitude of air and groundwater contamination resulting from a fire at the Florida Tire Site deserve serious consideration. Interim measures to be considered include the following:

(1) removal of tires and shreds from the central section of the site to create an efficient work area, a wide buffer zone between the whole tire piles and the main shred pile, and allow construction of stabilized access roadways.

(2) removal of tires and shreds to create fire lanes within the main shred pile;

(3) removal of tires and shreds from the perimeter areas to create a perimeter buffer and allow construction of the perimeter roadway;

(4) widening of existing fire lanes between whole tire piles to at least 50 feet.

Creation of fire control lanes within the site increases the probability of containing a possible fire to a limited segment of the total site. Fire lane widths of at least 50 feet are required under current Florida regulations and are generally recognized as the minimum width necessary for movement of fire fighters and equipment. However, a fire can traverse this width, especially between deep piles containing densely packed shreds. Therefore, the three initial fire lanes cut through the main shred pile should be at least 100 feet wide. Subsequent fire lanes within the shred segments and whole tire pile areas can be 50 feet wide once heights have been reduced below 15 feet. The choice of frequency and location of fire lanes is a balance of pile size control, required preparation time, and economics.

Removal of tires to create a perimeter break serves two main functions. The first is to provide access to all sides of the site in the event of a fire. The second is to decrease the possibility of fire communication between the tires and surrounding property, especially in the area bordering the adjacent railroad cars and chemical storage tanks on Miami Tank's property.

The suggested sequence for construction of fire lanes and a perimeter fire break is as follows:

(1) clear the central portion of the property by removal of piles T-10B/A, S-1, T-13, S-11, T-9, T-12, T-14, S-10, and S-9 to allow construction of central access roadways and work areas as identified in Appendix E.

(2) clear fire lanes 1, 2 (including removal of T-14), and 3 as identified in Appendix E to divide the shred pile into smaller segments.

(3) remove portions of S-6 and S-4 located within 50 feet of the site perimeter, T-16, and T-15 to allow completion of the perimeter roadway.

(4) clear fire lane 4 to enhance separation between whole tire piles.

(5) lower the height of each remaining shred pile segment to 15 feet or less, then clear an additional fire lane through the center of each segment.

This recommended plan includes removal of an estimated 1,670 tons of off-road tires, 25 tons of passenger/truck tires, and 25,000 tons of shredded tires from perimeter and fire lane areas as depicted in Appendix E. The objective of this site stabilization phase is to decrease the potential magnitude and environmental consequences of a possible fire. However, total tire removal is the only proven method of eliminating these hazards.

ABATEMENT PLAN REMOVAL SEQUENCE

The Florida Tire Site contains an estimated total of 5,960 tons of whole tires and 33,110 tons of shredded tires as of June 30, 1992. Once tires have been removed from the perimeter and fire lanes during initial site stabilization, the remaining segregated piles should be removed in alternating order to further enhance separation between piles, beginning with shred piles. This sequence is desirable but may be modified if it impedes efficiency of the contractor(s).

TIRE REMOVAL ALTERNATIVES

As tires are removed from the Florida Tire Site, they must be placed, processed or disposed of in a manner consistent with State objectives, procedures and regulations. This section describes currently identified alternatives. If additional acceptable alternatives or variations become available prior to initiation of site abatement activities, they may be evaluated in context with these existing alternatives.

Cost and time required for implementation of these alternatives have been estimated using bases derived from previous abatement activities. It is likely that specific contractor estimates will differ from these projections, so review of the project scope and/or budget may be appropriate once specific contractor capabilities and costs have been fully documented for this specific site.

Since the Asian Tiger Mosquito currently does not appear to be present at the Florida Tire Site, transfer of whole tires should be acceptable to public agencies at the receiving site. However, since this mosquito has been observed in all northern and central Florida counties and it appears to be spreading naturally, the presence of the mosquito and its impact should be reassessed prior to whole tire transfer outside of this area.

The following discussion outlines the method, cost and implementation time associated with each of the identified alternatives. Some apparently available alternatives have not been evaluated because they were considered incompatible with current objectives and/or practices. For example, leaving whole or shredded tires on-site is unacceptable within the State's objective of complete site abatement. A description of five alternatives considered for stabilization and abatement of the Florida Tire Site is presented in the following sections.

The quantity of material involved in Florida Tire Site abatement is large. DER recognizes that it could potentially impact existing markets and disposal practices currently being used for ongoing generation of waste tires. Since market disruption would be counter-productive within the State's overall waste tire management program, DER will attempt to establish shred removal rates that are compatible with market absorption capabilities, including quantities generated by other site abatement activities. Since it may not be feasible for any single market alternative to use all shreds within a reasonable time, DER may realize economic and project management efficiency by awarding contracts to more than one contractor for ultimate abatement of this large site. Although economics of each alternative have been calculated based on removal of an estimated 2,070 tons of off-road tires, 3,890 tons of passenger/truck tires and 33,110 tons of shredded waste tires present at the site, actual project economics may realistically reflect utilization of a combination of alternatives.

Since there are limited options for disposing of off-road tires, all alternatives include cutting these tires into pieces to enhance space utilization prior to disposal in the St. Lucie County Landfill. At an estimated processing rate of 30 tons/day and a 20% contingency allowance for operating difficulties and holidays, processing of 2,070 tons of off-road tires is projected to require 17 weeks. Using a shear capable of processing an estimated 30 tons/8-hour day at a cost of $150/hour (including operator) results in a shearing cost of $40/ton or $82,800. Transport costs are estimated to be $7.50/ton, or $15,525, based on a truck/driver cost of $75.00/hour, 1 hour/trip, and 10 tons/load. Disposal fees are estimated to be $81.00/ton, or $167,670, based on current fee schedules. Total cost of shearing and disposal of 2,070 tons of off-road tires are estimated to be $265,995 or $129/ton. This method and cost of off-road tire disposal has been included in each subsequent analysis of alternatives applied to remaining whole and shredded tires.

Alternative #1

Produce 4 Sq. In. Nominal Shreds On-Site and Transport to South Florida Landfills for Use as Alternative Leachate Layer

Shredded tires may be reprocessed on-site into a product suitable for use as an alternative leachate collection layer in new landfill cell construction. The Florida Department of Environmental Regulation requires that shreds utilized for this application meet defined particle size specifications. As a result, the current shreds must be screened and/or reprocessed through the shredder until the effective particle size is reduced to meet applicable specifications. Disposal of debris generated by Hurricane Andrew is forcing rapid construction of additional landfill cells in South Florida. One operator indicated a potential ability to use up to 2,000 tons/month for the next 12-18 months. However, if abatement is delayed, demand will decrease dramatically as the new cells are constructed with other materials. This alternative offers a reasonably high probability of successful implementation if abatement is initiated promptly. As a result, this option represents a viable comparative baseline for other alternatives.

Production rates are projected to be 2,000 tons/month (market limited) under a conservative assumption that all tires and shreds will be reprocessed through an on-site operation to meet product uniformity requirements using two shredders. On this basis, an estimated 7.6 months would be required to reprocess all shreds contained on the site. This time may be further accelerated (or only one shredder may be required) if shreds can be efficiently pre-screened to minimize quantities requiring re-shredding. Required elapsed site abatement time will be dependent on cell construction demand at the time of implementation. If abatement is initiated promptly, demand could consume available shreds within 75 weeks. If it is delayed, usage of all shreds could take up to 3 years to avoid a negative market impact. An average usage rate of 1,000 tons/month appears to be a reasonable minimum usage projection if abatement is initiated by mid-1993.

The on-site cost of whole tire processing and shred reprocessing are estimated to be $75.00/ton and $70.00/ton, respectively, resulting in $291,750 for whole tires and $2,317,700 for shredded tires. As previously stated, this projection conservatively assumes re-shredding of all material, but efficient pre-screening may significantly reduce processing costs. Transportation costs will be totally dependent upon the location of landfills capable of using the material, but they have been conservatively estimated based upon a 300 mile round trip distance, 22 tons/load, and $1.25/mile trucking charge. On this basis, transportation costs are estimated to be $17.05/ton or $66,325 for whole tire quantities and $564,526 for shreds. This cost could be decreased by up to 40% if backhauls are available at the time of implementation. Since tire shreds displace purchased rock, it has been assumed that shreds will generally be accepted at landfills at no tipping fee for this application. The total cost of this alternative is estimated to be $358,075 or $92/ton for whole tires and $2,882,226 or $87/ton for shreds. These cost calculations are detailed in Appendix F-1.

Alternative #2

Use as a Raw Material for Production of Crumb Rubber Used in Asphalt Rubber Highway Construction

Shredded tires may be used as a raw material in production of crumb rubber. Most crumb rubber has historically been manufactured from buffing dust and waste rubber generated by tire manufacturing and recapping operations. Use of this raw material minimizes processing equipment required for particle size reduction, wire removal, and fabric separation. Waste tires and shreds may become an acceptable feedstock if product demand becomes greater than the available supply of these traditional raw materials. However, most crumb rubber manufacturers will have to either modify or improve their process to include required preprocessing of whole tires/shreds, wire removal, and fabric separation. Since capital and operating costs associated with use of whole tires or shreds is significantly higher, manufacturers will be reluctant to make necessary investments until expanded volumes or increased buffings cost justify such expenditures.

Although current crumb rubber markets are comparatively small, demand could increase significantly if crumb rubber is accepted and broadly applied as an asphalt additive in highway construction. The Florida Department of Transportation (FDOT) has been conducting a comprehensive program to define performance characteristics of rubberized asphalt binders in asphaltic concrete friction courses and rubber modified asphalt membrane interlayers. FDOT expects to complete final environmental testing and demonstration phases of this program in the Spring of 1993. If successful, FDOT projects usage of up to 9,544 tons of crumb rubber per year in highway applications contracted by FDOT. Production of this quantity could require up to 15,900 tons of waste tires at an estimated 65% yield if it is produced from waste tires.

Under current federal and State procurement procedures, FDOT cannot dictate use of Florida tires or Polk shreds in Florida's highway program. Since FDOT purchases crumb rubber indirectly from contractors as installed asphalt concrete and cannot specify the raw material source used in crumb rubber manufacture, it is difficult to project the potential usage of shredded tires from the Polk Site. If FDOT begins purchasing rubberized asphalt concrete at an average monthly rate equivalent to 800 tons of crumb rubber/month (9,600 tons/year) beginning in July, 1993, the following table illustrates the elapsed time required to consume the waste tires and shreds at Florida Tire as a function of the percentage produced from this site.

% F.T. Source	Average Usage (tons/mo @ 65% yield)	Required Months	Abatement Completion
100	1230	30	Jan, 1996
50	615	60	Aug, 1998
25	308	120	Aug, 2003
10	123	300	Aug, 2018

If the projected quantities were produced entirely from shredded tires at the Florida Tire Site, 37,000 tons of whole tires and shreds could be consumed by January, 1996. At the other extreme, Florida Tire Site abatement would not be completed until August, 2018 if only 10% of the projected crumb rubber is produced from this site. A 25% usage rate may be an optimistic estimate unless FDOT alters its current specification/purchasing procedures or DER chooses to offer creative financial incentives. Unless this projected rate is accelerated, this alternative would offer only a partial solution for Florida Tire Site abatement due to its long elapsed time requirement.

Due to limited historical experience with production of crumb rubber from whole tires or shreds (especially within Florida), it is also difficult to project realistic economics associated with this alternative. One Florida manufacturer recently began to produce limited quantities of crumb rubber from whole passenger tires. The company believes that its process will have a nominal capacity of 2,000 tons/month, but the facility is still in its initial start-up phase. Actual processing rates, economics and product quality can only be defined after sustained commercial operation over a period of at least 6 months.

The Florida Tire Site contains a mixture of passenger and truck tires/shreds. Since bead wire present in truck tire shreds may present operating and/or maintenance problems in the existing process, use of Florida Tire shreds may require a tipping fee greater than their current estimated average of $50.00/ton to cover higher preprocessing or operating costs. However, at a rate of $50.00/ton, the tipping fees associated with processing 3,890 tons of whole tires and 33,110 tons of shreds would be $194,500 and $1,665,500, respectively. Transportation costs for trucking whole tires an estimated round trip distance of 500 miles is estimated to be $52.08/ton, or $202,591, at 12 tons/load and $1.25/mile. Shred transport is estimated to cost $28.40/ton, or $940,324, at 22 tons/load. Retrieval and loading of shreds at the site is estimated to be an additional $10.00/ton, but this cost would decrease if efficient loading rates of at least 1,000 tons/month can be achieved. Based on these assumptions, the estimated total cost associated with implementing this alternative would be $435,991 or $112/ton for whole tires and $2,926,924 or $88/ton for coarse shreds.

These projections could change significantly as the processor gains operating and economic experience. Since supply contracts can be awarded to other processors, this projection could also change significantly based on transport distances and required tipping fees for each specific contractor. Toll processing of Florida Tire tires and shreds through a proven crumb rubber manufacturer under a contract with DER was considered, but limited savings and marketing constraints associated with product sale in competition with the private sector appear to discourage use of this method. Cost calculations are provided in Appendix F-2.

Alternative #3

Transport to a Cement Kiln for Use as a Supplementary Kiln Fuel

Whole and coarsely shredded tires can be retrieved from the site and transported to Florida Crushed Stone's (FCS) cement kiln in Brooksville, Florida for use as a supplemental fuel. Based on FCS's maximum permitted combustion rate of 850 tons per month, total elapsed site abatement time would be 4.6 months for whole tires and an additional 39 months for shreds. It is estimated that FCS can accept about 300 tons/month of material from the Florida Tire Site without negatively impacting its ability to meet its other planned commitments. At this projected usage rate, elapsed abatement time would be 13 months for whole tires and 110 months for coarse shreds.

Other cement kilns in central and southern Florida are currently attempting to obtain permit modifications required to allow usage of waste tires and/or shreds as a supplemental energy resource in their kilns. The effective usage rate in cement kiln applications may be accelerated if these efforts are successful, so a projected usage rate of 600 tons/month has been chosen to reflect successful permitting of at least one other kiln. The elapsed time associated with actual abatement of the Florida Tire Site will be further reduced if any of the permitted kilns are able to receive and store shredded tires at their site(s) during the time of implementation. The estimated abatement time and costs for this alternative have been based on use of two facilities and historical estimating guidelines, so the permit status, costs and storage capabilities of other kilns should be reviewed prior to abatement implementation.

Most Florida cement kilns have developed their tire fuel feed systems to use whole tires, although the Rinker facility can only use passenger tires due to inlet size restrictions. The expense associated with retrieval, handling and usage is estimated to be $75/ton or $291,750 for the estimated 3,890 tons of whole tires at the Florida Tire Site. In addition, whole tire transportation charges are estimated to be $17.05/ton or $121,563 for a 300 mile roundtrip at $1.25/mile and 12 tons/load. This transportation cost may be reduced by use of backhauls. Total cost of whole tire disposal using this alternative is projected to be $413,313 or $106/ton, as detailed in Appendix F-3.

Some kiln feed systems can be readily modified to allow use of tire shreds as well. However, coarse shreds at the Florida Tire site are large and irregular in shape, so they must be reprocessed into a flowable 16-20 square inch flowable chip to be usable in these systems. As a result, reprocessing costs are estimated to be $60/ton or $1,986,600 for the 33,110 tons of coarse shreds at the site. With transportation costs of $17.05/ton or $564,526 (reflecting 22 tons/load for shreds) and tipping fees of $70/ton or $2,317,700, total cost of applying this option to the coarse shreds is estimated to be $147/ton or $4,868,826. Actual costs associated with use in any kiln will depend on applicable usage fees and transportation costs at the time of implementation.

Alternative #4

On-Site Production of Tire-Derived Fuel and Shipment to a Fuel Customer

Whole tires and coarse shreds may be processed on-site into tire-derived fuel (TDF) for shipment to a fuel customer capable of using the product as a supplemental energy source. TDF is generally a uniform minus 4 square inch product. It may be necessary to remove up to 25% of the original tire weight containing high levels of bead wire to avoid operating problems in some applications. The removed material is normally considered a waste which must be landfilled. Costs associated with disposal of this waste material have been included in projections. However, some applications can tolerate bead wire and/or loose wire, so an opportunity exists to decrease this cost if a tolerant application is utilized.

Production rates are projected to be 2,000 tons/month under a conservative assumption that all tires and shreds will be processed through an on-site operation to meet product uniformity requirements using two shredders. On this basis, an estimated 16 weeks will be required to process all whole passenger and truck tires and 132 weeks will be necessary for reprocessing coarse shreds. This time may be accelerated (or only one shredder may be required) if shreds can be efficiently pre-screened and magnetically processed to minimize quantities requiring re-shredding.

Required elapsed site abatement time will be dependent on the amount of TDF that can be absorbed without disrupting existing markets at the time of implementation. New potential customers in Florida and Georgia are reportedly pursuing permit modifications required to use TDF. If they are successful, the resulting TDF market growth may allow shipment of up to 2,000 tons of TDF/month without market disruption. Otherwise, shipment of 1,000 tons/month may be represent a practical maximum, and actual usage will depend on market conditions at the time of implementation. Usage of all whole tires and shreds will take 33 months at a rate of 1,000 tons/month.

The on-site costs of processing whole tires and coarse shreds are estimated to be $80/ton (or $311,320) and $75/ton (or $2,483,250), respectively. As previously stated, this projection conservatively assumes re-shredding of all material, but efficient pre-screening may significantly reduce processing costs. Disposal of 25%, or 9,250 tons, as a waste wire/rubber mixture at the St. Lucie County Landfill is projected to cost $5/ton for transport and $81.00/ton for disposal fees. Revenue of $25.00/ton from product sale will partially offset TDF transportation costs of $34.10/ton based on a 500 mile roundtrip, 22 tons/load and $1.25/mile. Actual net impact will depend upon availability of backhauls and specific customer-related considerations at the time of implementation. For example, product revenue is likely to exceed dedicated round-trip transportation costs to potential TDF customers in the Jacksonville area, but may only cover backhaul costs to existing customers in southern Georgia. Under these projections, total cost of this alternative is estimated to be $421,384 or $108/ton for whole tires and $3,421,091 or $103/ton for coarse shreds, as detailed in Appendix F-4.

Alternative #5

Shipment to Decker Energy's Planned Lakeland Facility for Reprocessing and Use as TDF

Decker Energy is currently constructing a large stoker-fired boiler that will be fueled by a combination of urban wood waste (demolition wood) and TDF (up to 20% by energy content). It involves fully demonstrated technology that has been used in the paper industry for many years. The facility will be able to consume 2,000-3,000 tons of waste tires per month. It will have an integral tire processing system for reducing whole or shredded tires to TDF meeting its required boiler specifications. Electrical power will be sold to Florida Power Corp under a completed, long-term, levelized purchase agreement. The air pollution control train contains dry SOx removal, DENOX (urea introduction) for NOx control, and a baghouse for particulate control.

Total project cost is estimated to be $80-85 million. Wheelabrator is the owner and operator of the facility. Wheelabrator is a unit of Waste Management with an established history of financing and operating waste-to-energy facilities. The project has reportedly obtained all required permits and has initiated construction. Mechanical completion is currently scheduled for March, 1994, with the contractor having significant economic incentive for early completion. If start-up and debugging phases are completed by June as currently projected, the facility should be able to consume up to 2,000 tons of TDF/month beginning in July, 1994.

The facility is located on a large parcel of property adjacent to the Polk County Landfill about 150 miles from the Florida Tire Site. Decker has recently initiated fuel supply planning. Since this facility represents a new TDF market, use of Florida Tire shreds could be factored into its initial supply plans without disrupting existing market balance. Decker anticipates being able to consume an average of 1,500 tons of Florida Tire shreds per month beginning in July, 1994 based on current projections. Although use of this alternative would require a delay in initiating abatement plans, the facility's high projected consumption rate should result in minimal delay of Site abatement completion. To further accelerate Site abatement, it may be possible for Decker to obtain storage permits allowing transfer of a significant quantity to their property prior to actual usage.

Utilization of this alternative would require transport of the shreds to the Decker facility for reprocessing to meet its boiler specifications. At its projected 1,500 tons/month consumption level, retrieval and transport costs for coarse shreds are estimated to be $3.00/ton and $17.05/ton, respectively. Comparable costs for whole tires are projected to be $7.00/ton and $31.25/ton due to differences in handling and density characteristics. Decker's preliminary estimate of the tipping fee required to cover all reprocessing and disposal costs is $60.00/ton for whole or coarsely shredded tires. Total projected cost associated with implementing this alternative for whole tires is $401,643 or $103/ton, and $2,650,456 or $80/ton for coarse shreds. Cost calculations are provided in Appendix F-5.

ALTERNATIVES SUMMARY AND RECOMMENDATIONS

Five available options were examined for removal of waste tires and shreds present at the site. All options are intended to minimize utilization of limited available landfill space through use of the material or energy value of waste tires. The component costs associated with recommended security measures and abatement alternatives were estimated based on historical costs and/or quotations associated with FDER implementation of other waste tire site abatement actions. Detailed security and abatement cost calculations are provided in Appendices D and F, respectively. A summary of elapsed time and cost (total and per ton) for each alternative and tire type is provided in Table 1 on the following page for comparison purposes.

The following is a brief discussion of the preliminary site abatement alternatives and recommendations supported by Table 1. The summary and recommendations have been delineated by tire type since it significantly impacts economic projections.

<u>Off-Road Tires</u> - Options for disposal of off-road tires are limited by their size and weight. The only identified option capable of handling the estimated 2,070 tons of these tires at the site is cutting them into pieces for volume reduction prior to landfill disposal at the St. Lucie County Landfill. It is estimated that the total cost of retrieval, cutting, transport and disposal is $265,995, requiring an estimated elapsed time of 17 weeks.

<u>Whole Passenger/Truck Tires</u> - Based on evaluation of five alternatives for abatement of whole tires, Alternative #1 (Produce 4 Square Inch Shreds On-site and Transport to South Florida Landfills for Use as Alternative Leachate Layer) is least expensive and most expedient. The cost of using this method of disposal for the estimated 3,890 tons of whole passenger and truck tires is $92/ton or $358,075, requiring an elapsed time of 8 weeks.

<u>Coarse Shreds</u> - All five alternatives were evaluated for disposal of shredded tires at the site. Based on current markets, no single alternative can absorb the estimated 33,110 tons in less than 1 year without totally disrupting existing market channels and resulting in a negative impact on DER's overall waste tire management program. As a result, it may be necessary to concurrently utilize multiple alternatives unless market conditions change significantly prior to implementation. Therefore, an economic projection has been presented in Table 2 based on estimated use of each of the 4 most economically attractive

TABLE 1

FLORIDA TIRE RECYCLING INC

SITE ABATEMENT COST COMPARISON SUMMARY

COMPONENT	Alternative #1	#2	#3	#4	#5

OFF-ROAD TIRES

Elapsed Time (weeks)	17	17	17	17	17
Cost/Ton	$129	$129	$129	$129	$129
COST SUBTOTAL	$265,995	$265,995	$265,995	$265,995	$265,995

WHOLE PASSENGER/TRUCK TIRES

Elapsed Time	8	52	26	16	10
Cost/Ton	$92	$112	$106	$108	$103
COST SUBTOTAL	$358,075	$435,991	$413,313	$421,384	$401,643

COARSE SHREDS

Elapsed Time	66	441	221	132	88
Cost/Ton	$87	$88	$147	$103	$80
COST SUBTOTAL	$2,882,226	$2,926,924	$4,868,826	$3,421,091	$2,650,456

SECURITY COSTS

Elapsed Time (weeks)	91	510	264	165	115
Guard Cost @$1712/wk	$155,792	$873,120	$451,968	$282,480	$196,880
Site Preparation	$130,930	$130,930	$130,930	$130,930	$130,930
COST SUBTOTAL	$286,722	$1,004,050	$582,898	$413,410	$327,810

TABLE 2

FLORIDA TIRE RECYCLING INC

PRELIMINARY SITE ABATEMENT COST ESTIMATE

DISPOSAL METHOD	PERCENT (by type)	TIME (weeks)	COST/TON	TONS	COST
OFF-ROAD TIRES					
Cut/Landfill	100	17	$129	2,070	$265,995
WHOLE PASSENGER/TRUCK TIRES					
Alternative #1	100	8	$92	3,890	$358,075
COARSE SHREDS					
Alternative #5	40	35	$80	13,244	$1,059,520
Alternative #1	40	27	$87	13,244	$1,152,228
Alternative #2	6	27	$88	1,987	$174,821
Alternative #4	14	19	$103	4,635	$477,446
Alternative #3	0	0	$0	0	$0
Subtotal	100	35	$87	33,110	$2,864,015
SECURITY COSTS					
Guard (2 years)	N/A	104	$5	39,070	$178,048
Site Preparation	N/A	Included	$3	39,070	$130,930
Subtotal	N/A	104	$8	39,070	$308,978
TOTAL	100	104	$97	39,070	$3,797,063

alternatives to achieve a maximum rate of site abatement. The resulting cost associated with disposal of shreds is estimated to be $2,864,015, requiring an elapsed time of 35 weeks assuming that concurrent operations prove to be feasible.

Although there is always uncertainty associated with facilities that are under construction, Decker's (Alternative 5) process uses proven technology, experienced design/construct contractors, a capable operator, and substantial financial support. These combined factors enhance the probability of successful operation with minimal construction and start-up delays. Since this represents a major new application within Florida, use of Florida Tire shreds should have minimal impact on existing markets if a decision is reached early enough to be factored into Decker's initial supply planning. Subject to review of projected economics and construction progress prior to contract decision-making, this alternative deserves consideration for a primary role in Florida Tire Site abatement.

Reprocessing shreds for use as an alternative leachate layer material in landfill cell construction (Alternative 1) represents an economically viable option. However, its utilization of available resources contained in tires are not a favorable as other alternatives. It deserves serious consideration based on economics, but relative balance may be adjusted if the other alternatives prove to be feasible at the time of implementation.

FDOT is making a significant commitment to use of crumb rubber in asphalt highway construction (Alternative 2). Previously discussed technical, economic, and market penetration questions appear to prevent this application (Alternative 2) from providing a primary method for Florida Tire Site abatement within a reasonable period of time. However, shreds should be made available to crumb rubber producers with FDOT supply contracts under terms comparable to primary alternatives. A specified quantity could be set aside for such arrangements during the duration of site abatement. If they are not used by the completion of other abatement activities, these shreds could be handled by one of the primary contractors under a supplemental agreement.

On-site reprocessing of shreds into TDF for direct shipment to a customer (Alternative 4) appears to represent a technically and economically viable alternative if a market survey confirms substantial usage without market disruption. If DER elects to award several abatement contracts due to the quantity involved, this alternative could potentially be implemented expediently to further stabilize the site by removing designated piles.

The remaining energy utilization alternative (Alternative 3) involves use of shreds in a cement kiln. Comparatively poor economics and low available usage levels make this alternative less attractive unless other alternatives prove not to be viable or kilns significantly revise their economic requirements.

Security costs delineated in Table 2 include: (1) construction of stabilized work areas and access and perimeter roadways to facilitate movement of heavy trucks, processing machinery, and fire-fighting equipment; (2) fencing to control access; and (3) maintenance of an on-site security guard for a 2 year period. Total security costs are estimated to be $308,978.

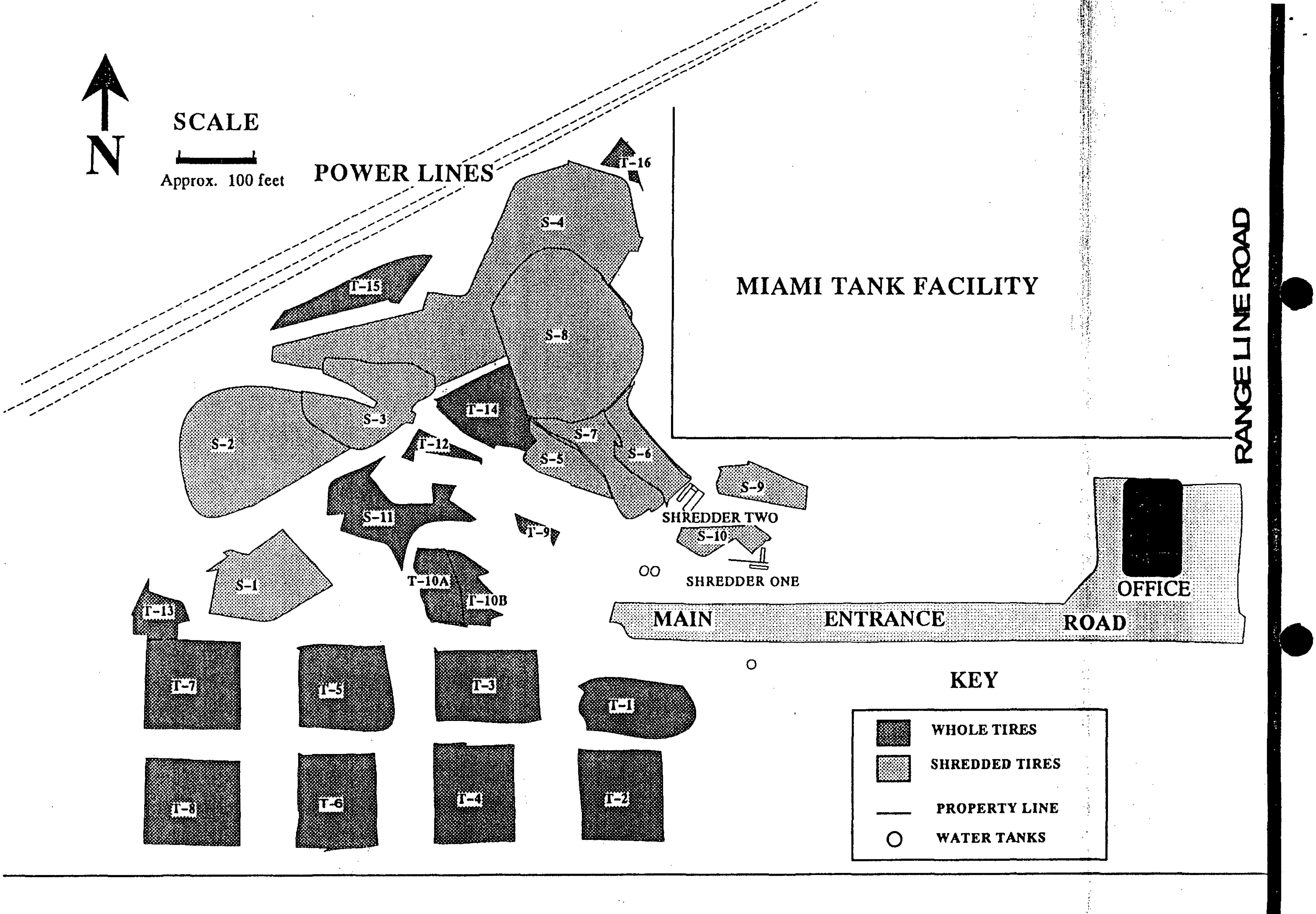
The resulting total preliminary cost associated with abatement or closure of the site is estimated to be $3,797,063 based on condition of the site as of June 30, 1993. Actual cost may differ from this projection due to changing site conditions, unavailability of specific alternatives at the time of implementation, specific contractor quotations, and other changing factors.

FLORIDA TIRE RECYCLING WASTE TIRE SITE

APPENDIX A

SITE SCHEMATIC AND QUANTITY CALCULATIONS

APPENDIX A - FLORIDA TIRE RECYCLING, INC. - SITE SCHEMATIC



APPENDIX A

PILE QUANTITY CALCULATIONS

The whole tire piles present on the site as of June 30, 1992 have been estimated to contain approximately 596,000 passenger tire equivalents (PTE). The basis of this estimate is provided in Table A-1 and discussed briefly below. The estimate is based on a combination of aerial photographs taken on June 30, 1992, on-site observation of pile characteristics and extensive experience. Pile surface area was obtained from aerial photographs. Scale was established from ground measurement of defined distances and objects during the site visit. Pile heights required for volume calculations were determined by actual measurements and comparative estimates.

Pile density was based on comparison of observed pile characteristics to defined densities associated with similar piles of waste tires and shreds at other sites. Laced passenger tire pile density ranges from 13-16 passenger tire equivalents/cubic yard depending on height, size and lacing technique. A density of 15 PTE/cubic yard was applied to passenger tire piles at this site. Truck tire piles uniformly contained 9 stacked truck tires (each weighing an average of 100 pounds or 5 PTE) in a surface area of 40 inches by 40 inches with a height of 7 feet, resulting in a density of 18 passenger tire equivalents/ cubic yard. Off-road tire pile density is more difficult to estimate because ply thickness can result in significant tire weight differences, but an average density of 18 PTE/cubic yard was applied for initial estimating purposes. Quantity estimates were calculated by multiplying pile volume times density. All estimates were stated in passenger tire equivalents with one passenger tire equivalent equalling 20 pounds (100 PTE/ton).

The shredded tire piles were estimated to contain approximately 3,311,000 passenger tire equivalents (or 33,110 tons) based on calculations included in Table A-2. Pile surface areas were obtained from scaled aerial photographs. Heights of various pile segments were measured or comparatively estimated during the site visit.

The density of shredded tire piles can vary from 25-50 pounds per cubic foot depending on shred size, pile height, and the degree of compaction resulting from a combination of weight and frequency of heavy vehicle traffic on their surfaces. As a result, the main shred pile was broken into defined segments of similar height and surface vehicle traffic pattern. Densities were then estimated for each segment based on experienced correlation of observed pile characteristics with similar known densities at other sites. Estimated densities for each pile segment are provided in Table A-2. Applied densities ranged from 25 pounds per cubic foot for a shallow loose pile to 42 pounds per cubic foot for the main access ramp that had been severely compacted by repeated heavy vehicle traffic. The quantity of waste tire shreds contained in each segment was then calculated, using an average passenger tire equivalent weight of 20 pounds.

The total quantity of waste tires and shreds on the site as of June 30, 1992 was estimated to be 3,907,000 passenger tire equivalents representing 39,070 tons.

TABLE A-1

FLORIDA TIRE RECYCLING INC

WASTE TIRE QUANTITY CALCULATION SUMMARY

Whole Tire Piles

Pile Number	Dimensions (feet) L	W	Area	H	Volume	Pile Type	Tire Type	Density PTE/yd³	Est Quant (PTE)
T-1	125	75	9375	8	75,000	OTR	Loose	18	50,000
T-2	95	125	11875	7	83,125	Pass	Laced	15	46,000
T-3	120	100	12000	7	84,000	Truck	Stack	18	56,000
T-4	95	130	12350	7	86,450	Pass	Laced	15	48,000
T-5	100	105	10500	7	73,500	Pass	Laced	15	41,000
T-6	95	125	11875	7	83,125	Pass	Laced	15	46,000
T-7	115	125	14375	7	100,625	Truck	Stack	18	67,000
T-8	110	115	12650	7	88,550	Truck	Stack	18	59,000
T-9	Irregular		1500	6	9,000	OTR	Loose	18	6,000
T-10A	40	100	4000	7	28,000	Truck	Stack	18	19,000
10B	20	100	2000	7	14,000	Truck	Loose	13	7,000
T-11	Irregular		11000	5	55,000	OTR	Loose	18	37,000
T-12	Irregular		3000	6	18,000	OTR	Loose	18	12,000
T-13	Irregular		4000	7	28,000	OTR	Loose	18	19,000
T-14	Irregular		8000	7	56,000	Mixed	Mixed	22	46,000
T-15	Irregular		7000	6	42,000	OTR	Loose	18	28,000
T-16	Irregular		2000	7	14,000	OTR	Loose	18	9,000
						TOTAL WHOLE TIRES (PTE)			596,000

TABLE A-2

FLORIDA TIRE RECYCLING INC

WASTE TIRE QUANTITY CALCULATION SUMMARY

Shredded Tire Piles

Pile Number	Dimensions (feet)			Pile Characteristics			Estimated Quantity (PTE)
	Area	Height	Volume	Shred Type	Pile Compaction	Density (lbs/ft^3)	
S-1	13000	15	195,000	Coarse	Moderate	30	292,500
S-2	24000	15	360,000	Coarse	Moderate	30	490,000
S-3	5000	10	50,000	Mixed	Loose	25	62,500
S-4	45000	15	675,000	Coarse	Moderate	30	1,012,500
S-5	4000	10	40,000	Coarse	Slight	27	54,000
S-6	5000	30	150,000	Coarse	Deep/ramped	40	300,000
S-7	6000	12	72,000	Coarse	Main ramp	42	151,200
S-8	21000	22	462,000	Coarse	Packed	38	877,800
S-9	3000	8	24,000	Coarse	Slight	27	32,400
S-10	3000	8	24,000	Fine	Loose	32	38,400
					TOTAL SHREDS		3,311,300
					TOTAL ESTIMATED WASTE TIRES (PTE)		3,907,300

FLORIDA TIRE RECYCLING WASTE TIRE SITE

APPENDIX B

AREA TOPOGRAPHICAL MAP

FLORIDA TIRE RECYCLING WASTE TIRE SITE

APPENDIX C

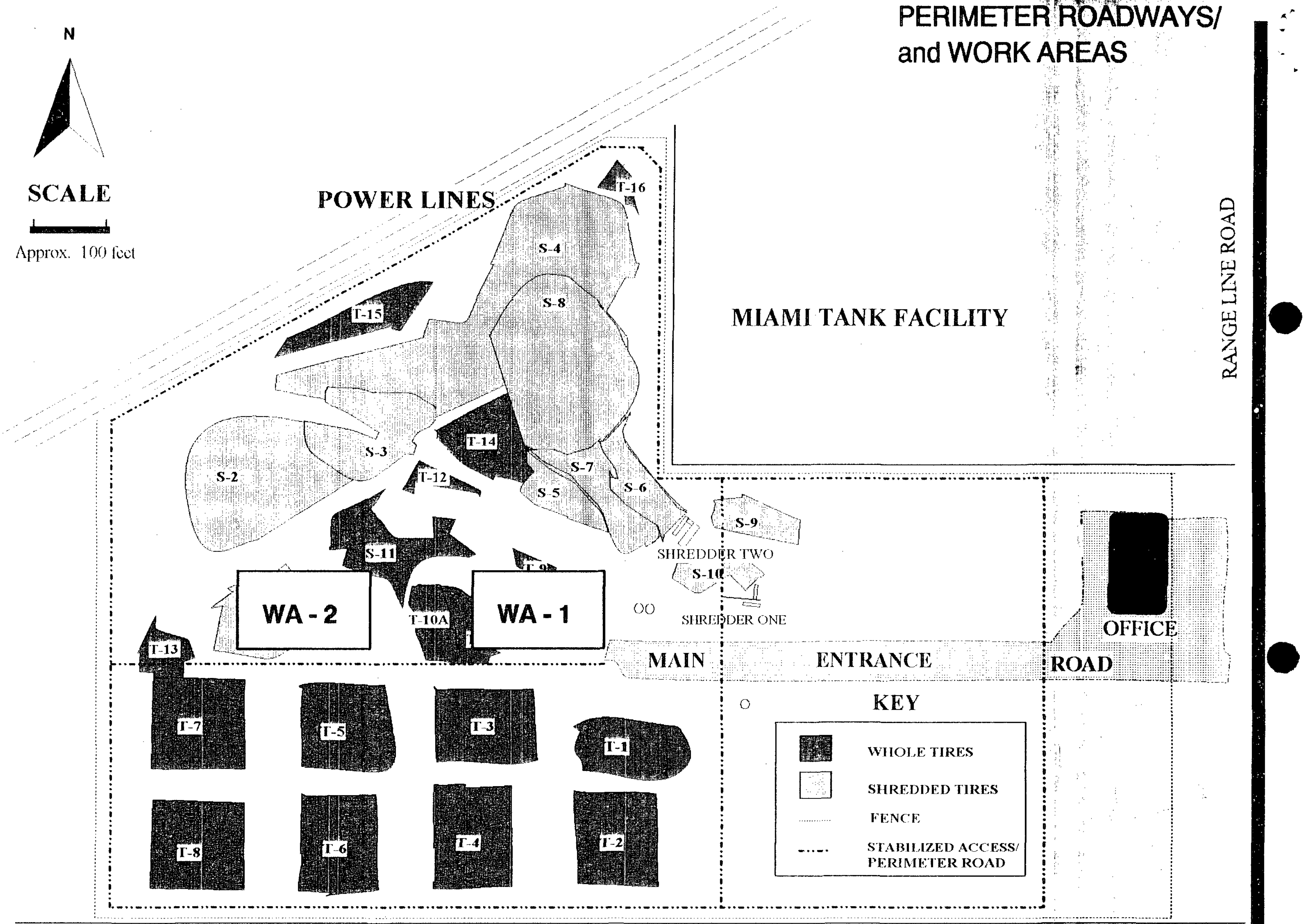
SOIL MAP AND CHARACTERISTICS

FLORIDA TIRE RECYCLING WASTE TIRE SITE

APPENDIX D

ROADWAY SCHEMATIC AND SECURITY COSTS

APPENDIX D - FLORIDA TIRE RECYCLING, INC. - STABILIZED ACCESS/ PERIMETER ROADWAYS/ and WORK AREAS



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APPENDIX D-1: SITE SECURITY COSTS

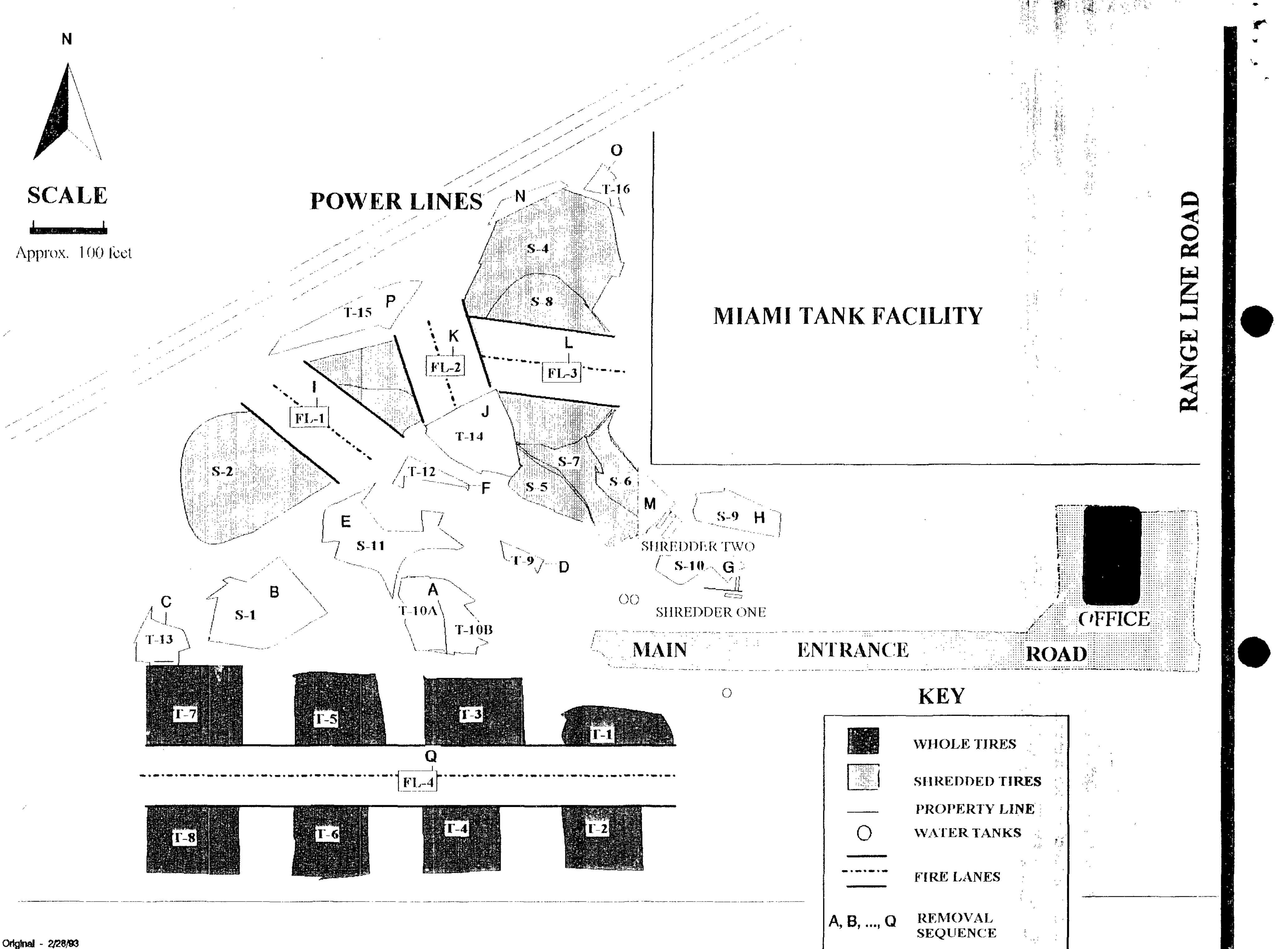
COMPONENT	BASIS	COST
ON-SITE SECURITY GUARD WEEKLY COST		
Guard Cost/Week	24 hr/day, $9.00/hr	$1,512
Office Expense/wk	$200/week	$200
SUBTOTAL		$1,712
FENCE CONSTRUCTION		
Perimeter Fence	3000 lin ft @ $12.00/ft	$36,000
Gates	2 @ $300 each	$600
SUBTOTAL		$36,600
STABILIZED ROADWAYS		
Central Access		
Length	500 yards	
Width	8 yards	
Surface Area	4,000 sq yards	
Preparation	at $3.00/sq yd	$12,000
Depth	1 foot	
Volume	1333 cu yd	
Limestone	at $10.00/cu yd	$13,330
Subtotal		$25,330
Unit Cost	$/lineal yard	$51
	$/sq yd	$6
Perimeter		
Dimensions	1000yds X 8 yds	
Subtotal	at $51/lin yd	$51,000
Work Areas		
Dimensions	2 @ 1500 sq yds each	
Subtotal	3000 sq yds @ $6	$18,000
SUBTOTAL		$94,330
TOTAL SITE PREP	Fence + Roadways	$130,930
ADD'L SECURITY	Guard Cost/Week	$1,712

FLORIDA TIRE RECYCLING WASTE TIRE SITE

APPENDIX E

STABILIZED SITE SCHEMATIC

APPENDIX E - FLORIDA TIRE RECYCLING, INC. - STABILIZED SITE SCHEMATIC



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FLORIDA TIRE RECYCLING WASTE TIRE SITE

APPENDIX F

ALTERNATIVE COST CALCULATIONS

APPENDIX F-1: ALTERNATIVE #1

Produce 4 Square Inch Shreds On-Site and Transport to South Florida Landfills for Use as Alternative Leachate Layer

COMPONENTS	BASIS	STABILIZE	ABATE	TOTAL
OFF-ROAD TIRES (Landfill Disposal of Cut Pieces Only)				
Quantity	tons	1,670	400	2,070
Rate	tons/day	30	30	30
Working Time	days	56	13	69
Elapsed Time	weeks(4 working days/wk)	13.9	3.3	17
Est Cost				
Processing	$40/ton($1200/day@30t/d)	$66,800	$16,000	$82,800
Transport	$7.50/ton($75/hr/10tons)	$12,525	$3,000	$15,525
Disposal	$81/ton	$135,270	$32,400	$167,670
SUBTOTAL	$	$214,595	$51,400	$265,995
	$/ton	$129	$129	$129
WHOLE PASSENGER AND TRUCK TIRES				
Quantity	tons	25	3865	3890
Rate	market limit @ 100t/day	100	100	100
Working Time	days	0.3	38.7	39
Elapsed Time	weeks(5 working days/wk)	0.1	7.7	8
Est Cost				
Processing	$75/ton	$1,875	$289,875	$291,750
Transport	$17.05/ton*	$426	$65,898	$66,325
Disposal	$0/ton (waived)	$0	$0	$0
SUBTOTAL	$	$2,301	$355,773	$358,075
	$/ton	$92	$92	$92
COARSE TIRE SHREDS				
Quantity	tons	25,000	8,110	33,110
Rate	market limit @ 100 t/day	100	100	100
Working Time	days	250	81	331
Elapsed Time	weeks(5 working days/wk)	50	16	66
Est Cost				
Processing	$70/ton	$1,750,000	$567,700	$2,317,700
Transport	$17.05/ton*	$426,250	$138,276	$564,526
Disposal	$0/ton (waived)	$0	$0	$0
SUBTOTAL	$	$2,176,250	$705,976	$2,882,226
	$/ton	$87	$87	$87
TOTAL				
Elapsed Time	Weeks-Sequential	64	27	91
Cost	$	$2,393,146	$1,113,149	$3,506,295
Cost/Ton	$/Ton	$90	$90	$90

* 300 miles at $1.25/mile and 22 tons/truckload

APPENDIX F-2: ALTERNATIVE #2

Use as a Raw Material for Production of Crumb Rubber Used in Asphalt Rubber Highway Construction

COMPONENTS	BASIS	STABILIZE	ABATE	TOTAL
OFF-ROAD TIRES (Landfill Disposal of Cut Pieces Only)				
Quantity	tons	1,670	400	2,070
Rate	tons/day	30	30	30
Working Time	days	56	13	69
Elapsed Time	weeks(4 working days/wk)	13.9	3.3	17
Est Cost				
Processing	$40/ton($1200/day@30t/d)	$66,800	$16,000	$82,800
Transport	$7.50/ton($75/hr/10tons)	$12,525	$3,000	$15,525
Disposal	$81/ton	$135,270	$32,400	$167,670
SUBTOTAL	$	$214,595	$51,400	$265,995
	$/ton	$129	$129	$129
WHOLE PASSENGER AND TRUCK TIRES				
Quantity	tons	25	3,865	3,890
Rate	market limit @ 15t/day	15	15	15
Working Time	days	2	258	259
Elapsed Time	weeks(5 working days/wk)	0.3	51.5	52
Est Cost				
Retrieval	$10/ton	$250	$38,650	$38,900
Transport	Whole, $52.08/ton*	$1,302	$201,289	$202,591
Tipping Fee	$50/ton	$1,250	$193,250	$194,500
SUBTOTAL	$	$2,802	$433,189	$435,991
	$/ton	$112	$112	$112
COARSE TIRE SHREDS				
Quantity	tons	25,000	8,110	33,110
Rate	market limit @ 15 t/day	15	15	15
Working Time	days	1,667	541	2,207
Elapsed Time	weeks(5 working days/wk)	333	108	441
Est Cost				
Retrieval	$10/ton	$250,000	$81,100	$331,100
Transport	Shreds, $28.40/ton**	$710,000	$230,324	$940,324
Tipping Fee	$50.00/ton	$1,250,000	$405,500	$1,655,500
SUBTOTAL	$	$2,210,000	$716,924	$2,926,924
	$/ton	$88	$88	$88
TOTAL				
Elapsed Time	Weeks-Sequential	348	163	511
Cost	$	$2,427,397	$1,201,513	$3,628,910
Cost/Ton	$/Ton	$91	$97	$93

* 500 miles at $1.25/mile and 12 tons/truckload

** 500 miles at $1.25/mile and 22 tons/truckload

APPENDIX F-3: ALTERNATIVE #3

Transport to a Cement Kiln for Use as a Supplementary Kiln Fuel

COMPONENTS	BASIS	STABILIZE	ABATE	TOTAL
OFF-ROAD TIRES (Landfill Disposal of Cut Pieces Only)				
Quantity	tons	1,670	400	2,070
Rate	tons/day	30	30	30
Working Time	days	56	13	69
Elapsed Time	weeks(4 working days/wk)	13.9	3.3	17
Est Cost				
Processing	$40/ton($1200/day@30t/d)	$66,800	$16,000	$82,800
Transport	$7.50/ton($75/hr/10tons)	$12,525	$3,000	$15,525
Disposal	$81/ton	$135,270	$32,400	$167,670
SUBTOTAL	$	$214,595	$51,400	$265,995
	$/ton	$129	$129	$129
WHOLE PASSENGER AND TRUCK TIRES				
Quantity	tons	25	3,865	3,890
Rate	market limit @ 30 t/day	30	30	30
Working Time	days	0.8	128.8	130
Elapsed Time	weeks(5 working days/wk)	0.2	25.8	26
Est Cost				
Retrieval	$5/ton	$125	$19,325	$19,450
Transport	Whole,$31.25/ton*	$781	$120,781	$121,563
Tipping Fee	$70/ton	$1,750	$270,550	$272,300
SUBTOTAL	$	$2,656	$410,656	$413,313
	$/ton	$106	$106	$106
COARSE TIRE SHREDS				
Quantity	tons	25,000	8,110	33,110
Rate	market limit @ 30 t/day	30	30	30
Working Time	days	833	270	1,104
Elapsed Time	weeks(5 working days/wk)	167	54	221
Est Cost				
Reprocessing	$60/ton	$1,500,000	$486,600	$1,986,600
Transport	Shreds,$17.05/ton**	$426,250	$138,276	$564,526
Tipping Fee	$70.00/ton	$1,750,000	$567,700	$2,317,700
SUBTOTAL	$	$3,676,250	$1,192,576	$4,868,826
	$/ton	$147	$147	$147
TOTAL				
Elapsed Time	Weeks-Sequential	181	83	264
Cost	$	$3,893,501	$1,654,632	$5,548,133
Cost/Ton	$/Ton	$146	$134	$142

* 300 miles (average round trip) at $1.25/mile and 12 tons/truckload

** 300 miles (average round trip) at $1.25/mile and 22 tons/truckload

APPENDIX F–4: ALTERNATIVE #4
On–Site Production of Tire–Derived Fuel and Shipment to a Fuel Customer

COMPONENTS	BASIS	STABILIZE	ABATE	TOTAL
OFF–ROAD TIRES (Landfill Disposal of Cut Pieces Only)				
Quantity	tons	1,670	400	2,070
Rate	tone/day	30	30	30
Working Time	days	56	13	69
Elapsed Time	weeks(4 working days/wk)	13.9	3.3	17
Est Cost				
Processing	$40/ton($1200/day@30t/d)	$66,800	$16,000	$82,800
Transport	$7.50/ton($75/hr/10tons)	$12,525	$3,000	$15,525
Disposal	$81/ton	$135,270	$32,400	$167,670
SUBTOTAL	$	$214,595	$51,400	$265,995
	$/ton	$129	$129	$129
WHOLE PASSENGER AND TRUCK TIRES				
Quantity	tons	25	3,865	3,890
Rate	market limit @ 50t/day	50	50	50
Working Time	days	0.5	77.3	78
Elapsed Time	weeks(5 working days/wk)	0.1	15.5	16
Est Cost				
Processing	$80/ton	$2,000	$309,200	$311,200
Transport	75% @ $34.10/ton*	$639	$98,847	$99,487
Wire Disposal	25% @ $81/ton	$506	$78,266	$78,773
Wire Trans	25%,15t/hr,$75/hr	$31	$4,831	$4,863
Sales Rev	75% @ $25/ton	$469	$72,469	$72,938
SUBTOTAL	$	$2,708	$418,676	$421,384
	$/ton	$108	$108	$108
COARSE TIRE SHREDS				
Quantity	tons	25,000	8,110	33,110
Rate	market limit @ 50 t/day	50	50	50
Working Time	days	500	162	662
Elapsed Time	weeks(5 working days/wk)	100	32	132
Est Cost				
Reprocessing	$75/ton	$1,875,000	$608,250	$2,483,250
Transport	75% @$34.10/ton*	$639,375	$207,413	$846,788
Wire Disposal	25% @ $81.00/ton	$506,250	$164,228	$670,478
Wire Trans	25%,15t/hr,$75/hr	$31,250	$10,138	$41,388
Sales Rev	75% @ $25.00/ton	$468,750	$152,063	$620,813
SUBTOTAL	$	$2,583,125	$837,966	$3,421,091
	$/ton	$103	$103	$103
TOTAL				
Elapsed Time	Weeks–Sequential	114	51	165
Cost	$	$2,800,428	$1,308,042	$4,108,470
Cost/Ton	$/Ton	$105	$106	$105

* 500 miles (average round trip) at $1.25/mile and 22 tons/truckload

APPENDIX F-5: ALTERNATIVE #5

Shipment to Decker Energy's Planned Lakeland Facility for Reprocessing and Use as Tire-Derived Fuel

COMPONENTS	BASIS	STABILIZE	ABATE	TOTAL
OFF-ROAD TIRES (Landfill Disposal of Cut Pieces Only)				
Quantity	tons	1,670	400	2,070
Rate	tons/day	30	30	30
Working Time	days	56	13	69
Elapsed Time	weeks(4 working days/wk)	13.9	3.3	17
Est Cost				
Processing	$40/ton($1200/day@30t/d)	$66,800	$16,000	$82,800
Transport	$7.50/ton($75/hr/10tons)	$12,525	$3,000	$15,525
Disposal	$81/ton	$135,270	$32,400	$167,670
SUBTOTAL	$	$214,595	$51,400	$265,995
	$/ton	$129	$129	$129
WHOLE PASSENGER AND TRUCK TIRES				
Quantity	tons	25	3,865	3,890
Rate	market limit @ 75t/d	75	75	75
Working Time	days	0.3	51.5	52
Elapsed Time	weeks(5 working days/wk)	0.1	10.3	10
Est Cost				
Retrieval	$7/ton	$175	$27,055	$27,230
Transport	Whole,$31.25/ton*	$781	$120,781	$121,563
Tipping Fee	$65/ton	$1,625	$251,225	$252,850
SUBTOTAL	$	$2,581	$399,061	$401,643
	$/ton	$103	$103	$103
COARSE TIRE SHREDS				
Quantity	tons	25,000	8,110	33,110
Rate	market limit @ 75 t/day	75	75	75
Working Time	days	333	108	441
Elapsed Time	weeks(5 working days/wk)	67	22	88
Est Cost				
Retrieval	$3/ton	$75,000	$24,330	$99,330
Transport	Shreds,$17.05/ton**	$426,250	$138,276	$564,526
Tipping Fee	$60/ton	$1,500,000	$486,600	$1,986,600
SUBTOTAL	$	$2,001,250	$649,206	$2,650,456
	$/ton	$80	$80	$80
TOTAL				
Elapsed Time	Weeks-Sequential	81	35	116
Cost	$	$2,218,426	$1,099,667	$3,318,093
Cost/Ton	$/Ton	$83	$89	$85

* 300 miles at $1.25/mile and 12 tons/truckload

** 300 miles at $1.25/mile and 22 tons/truckload