JOHN F. KENNEDY SPACE CENTER
KSC CLASS III LANDFILL
ENVIRONMENTAL ASSESSMENT

PCN 95812

PREPARED FOR:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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1.0 SUMMARY

The present Schwartz Road Landfill (SRLF) has been in operation at the Kennedy Space Center (KSC) since 1968. This facility is reaching capacity and is slated for designed closure which will include a final cover cap and surface water management controls.

Selected waste reduction schemes have been discussed to alleviate some of the wastes produced at KSC, but the largest volume of waste remains that of construction and demolition debris and other inert-type waste. An unlined, Class III landfill is therefore proposed as the action to accommodate these inert and essentially non-reactive wastes. The proposed Class III landfill site is adjacent to and directly east of the existing SRLF. Orientation to the site location and surroundings is provided in Figures 1, 2, and 3. Suggested alternatives: Double Stacking of the SRLF and No Action (trucking wastes to Brevard County facilities) are considered and compared to the proposed action. An alternative site was also considered for the Class III landfill, directly south of the existing SRLF.

The proposed action will eliminate habitat which has been disturbed following earlier land clearing and site modifications (drainage ditches). The resulting mosaic of vegetation and open space is habitat for several endangered and threatened species, but is not regarded as optimal habitat for any of them. Clearly, most of this habitat will be eliminated. Compensation is suggested to offset these losses.

Several state and federal wildlife species will be impacted. Coordination with United States Fish and Wildlife Service (USFWS) can minimize the impact to existing individuals.

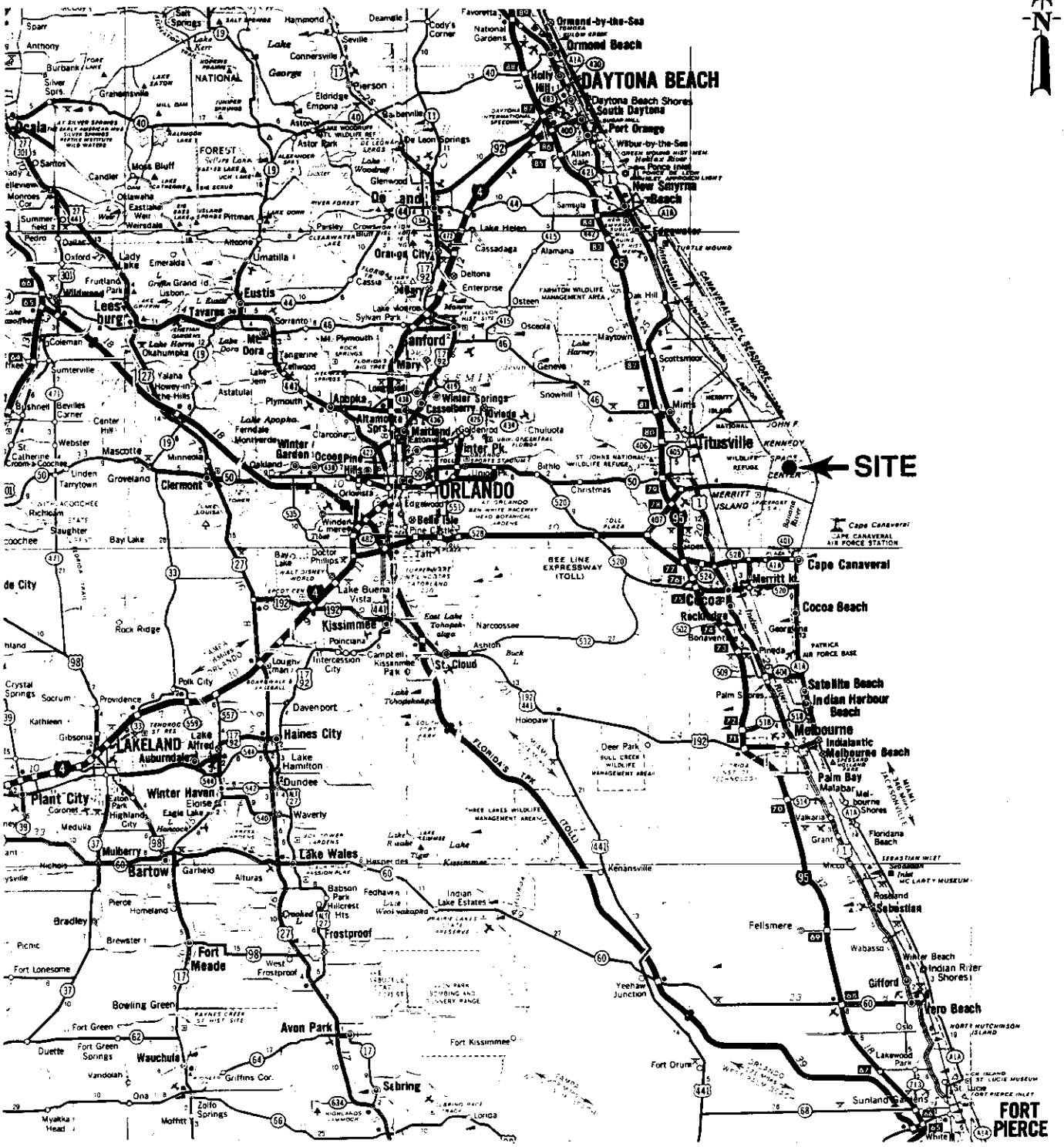

FIGURE 1. Site Location Map

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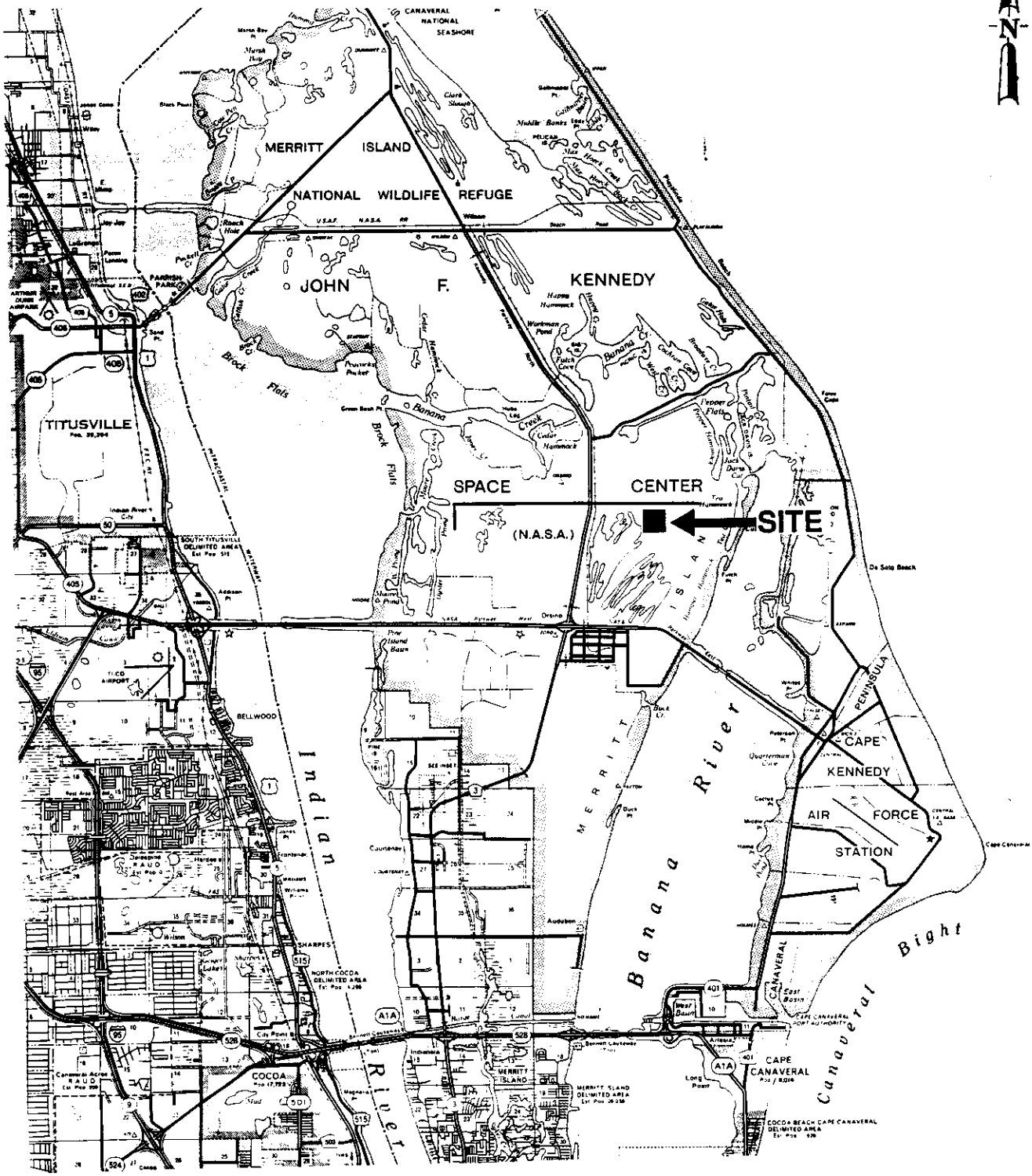

FIGURE 2. General Area of KSC

SOURCE: FDOT, 1975.

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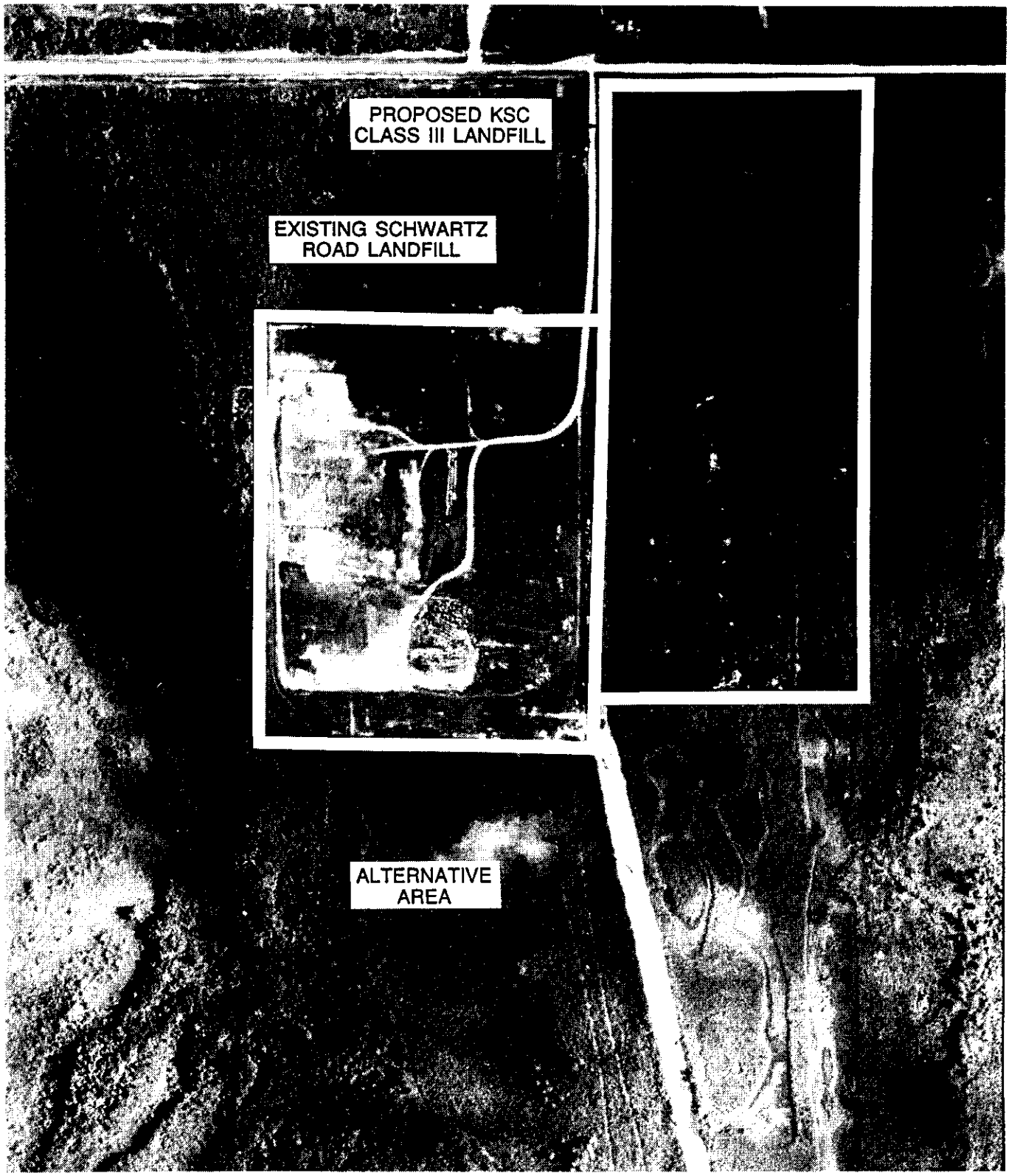

FIGURE 3. Aerial Photography of Proposed Site Area Showing Native Habitats and Land Use

SOURCE: JEA, Inc., 1993.

Jones Edmunds & Associates, Inc. JEA

2.0 PURPOSE AND NEED FOR ACTION

2.1 OBJECTIVES/PURPOSE

Continued pursuit of the objectives of the National Aeronautics and Space Administration (NASA) mission presently do and are expected to continue to result in a waste stream of assorted refuse and construction debris. Adjunct programs, such as waste reduction and recycling, may reduce the volume of these wastes, but continued activities will inevitably result in some waste materials being produced with the consequent need for facilities or concepts to handle it.

These wastes must be disposed of in realistic ways with due regard to the needs of public health and safety, as well as regard for sensitive environmental issues.

The proposed new landfill will be a Class III facility which is described below.

> Class III landfills are those which receive only yard trash, construction and demolition debris, shredded waste tires, asbestos, carpet, cardboard, paper, glass, plastic, furniture other than appliances, or other materials approved by the Florida Department of Environmental Regulation (DER) which are not expected to produce leachate which poses a threat to public health or the environment (Ref. 26).
>
> "Yard trash" means vegetative matter resulting from landscaping maintenance or land clearing operations and includes materials such as tree and shrub trimmings, grass clippings, palm fronds, trees and tree stumps (Ref. 26).

"Construction and demolition debris" means materials generally considered to be not water soluble and non-hazardous in nature, including but not limited to steel, glass, brick, concrete, asphalt roofing material, pipe, gypsum wallboard, and lumber, from the construction or destruction of a structure as part of a construction or demolition project or from the renovation of a structure. The term includes rocks, soils, tree remains, trees, and other vegetative matter which normally results from land clearing or land development operations for a construction project. Mixing of construction and demolition debris with other types of solid waste, including material which is not from the actual construction or destruction of a structure, will cause it to be classified as other than construction and demolition and debris (Ref. 26).

2.2 PERMITS REQUIRED

A. DER - Permit to construct and operate a solid waste recovery and management facility.

B. St. Johns River Water Management District (SJRWMD) - Management and Storage of Surface Waters (MSSW) permit. Due to an agreement between the SJRWMD and DER, the MSSW permit would actually be issued by DER.

C. United States Corps of Engineers (USCOE) - Dredge and Fill (§ 404). This permit may be required to fill existing drainage canals within the site. Geometries of the canals may be such that this permit will not be required.

D. United States Fish and Wildlife Service (USFWS) - Incidental Take Permits provided for in Section 7 of the Endangered Species Act. Refer to Appendix F for further information.

E. Isolated Wetland Permit - USCOE, SJRWMD. Agency determination of status of these presumed wetlands has not been completed at this date.

3.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 PROPOSED ACTION

Four actions were identified in connection with the closure of the existing SRLF. This landfill is nearing capacity and is expected to have a useful life of only a few more years.

The proposed action is to develop the area east of the existing SRLF into a fully functional Class III landfill. This action is coordinated with the present closure activities to the extent that certain lands east of the existing landfill will be developed into part of a stormwater management plan (ditches, swales, and detention pond), and these could be expanded and integrated with the proposed action. This action would result in the filling of man-made ditches and substantial re-working of the land surface to accommodate different working cells of the landfill.

This project shall be referred to as the KSC Class III Landfill.

3.2 ALTERNATIVES TO THE PROPOSED ACTION

3.2.1 Double Stacking

One alternative is to stack new landfill cells on top of the existing landfill cells at the SRLF. This operation is referred to as a vertical expansion by DER.

DER regulations for vertical expansions of landfills (Ch. 17-701.430 FAC) state that a vertical expansion shall not cause or contribute to any leachate leakage from the existing landfill and shall not adversely affect the closure design of the existing landfill. Since the existing SRLF contains non-Class III wastes that were deposited prior to the landfill

being designated a Class III landfill, it is likely that DER will require a liner and leachate collection system to be installed between the vertical expansion (double stack) and the existing landfill cells.

The cost of vertical expansion at the SRLF not only includes the typical costs of a landfill but also the construction and operational costs of a liner and leachate collection system as stated above. The additional capital cost to install a double-lined system with a leachate collection and leak detection system would add approximately $60 per ton to the normal disposal cost for Class III waste. This estimate was based on costs from similarly constructed bottom liner systems. Additional costs for managing, transporting, and treatment of collected leachate were not included in this estimate.

The Kennedy Space Center has a line-of-sight restriction, that would limit the height of the landfill to 7.8 meters (m) (25.5 feet) above ground surface around the Orbiter Processing Facility. This would correspond to a maximum landfill elevation of approximately 10.7 m (35 feet) mean sea level (msl). A vertical expansion at the SRLF would increase the height of the landfill to approximately 24.4 m (80 feet) msl, which greatly exceed the 10.7 m (35 feet) msl maximum requirement.

These two issues make the vertical expansion (double stacking) alternative impractical, being cost prohibitive due to the additional liner system and most likely unacceptable to NASA operations due to height restrictions. For these reasons, this alternative will not be considered further in this document.

3.2.2 No Action Alternative

The No Action alternative is relegated to trucking all Class III waste to the Brevard County Landfill once the SRLF is closed.

3.2.3 Discussion of Other Alternatives

A third alternative was also considered in the initial planning for the proposed action. This consisted of an almost uniform area of scrub immediately south of the existing SRLF. This site consisted of undisturbed scrub, and thus represented valuable native habitat for federally listed species as well as other wildlife. Thus, as a practical matter, this site alternative was rejected due to a combination of perceived permitting difficulty, obvious long-term impact to the native environment, and equally long-term and severe impacts to federally listed threatened and endangered species. This alternative will not be considered further in this document.

4.0 DESCRIPTION OF AFFECTED ENVIRONMENT

The total area of KSC is 56,452 hectares (ha) (139,490 acres). The total developed land within this area is 2,653 ha (6,556 acres) with a residual of undeveloped land of 54,005 ha (133,444 acres). The ecological importance of the Merritt Island property was realized during the early days of NASA development, and steps were taken to preserve vast areas to the public trust. The majority of the land (90.5 percent) is devoted to the Merritt Island National Wildlife Refuge (MINWR) administered by the U.S. Fish and Wildlife Service at 51,125 ha (126,328 acres). The National Park Service controls 2,693 ha (6,655 acres) or roughly 4.8 percent as the Canaveral National Seashore. NASA operational control involves only 4.7 percent of the KSC land management area at 2,633 ha (6,507 acres).

4.1 AIR QUALITY

4.1.1 Climatic Conditions

The climate of KSC is characteristically humid, subtropical with no predictable, long-term extremes, and no distinct spring and fall seasons. The temperatures are generally mild ranging from a winter average low of 10.6° Celsius (C) (51°F) and high of 20.6°C (69°F), to a summer average low of 22.8° (73°F) and high of 31.1°C (88°F). Annual average rainfall varies widely; however, on average, there are 148 days per year which have measurable precipitation with about 60 percent of these occurring from May to October. Typical of this latitude, humidity is high ranging in monthly averages from 75% to 84%.

Weather hazards include fog, temperature extremes, thunderstorms, lightning, hail, tornadoes, and hurricanes. Fog and temperature extremes both are generally mild and

short-lived; however, the other hazards can be damaging although infrequent.

4.1.2 Air Quality

The ambient air quality at KSC is influenced by NASA operations, land management practices, vehicle traffic, and emission sources outside of KSC. For all permitted sources of air pollution at KSC, the actual emissions are well below the allowable emissions. Also, with the exception of several exceedences of the ambient ozone standard, ambient levels of the criteria pollutants SO_2, NO_2, and CO are below the federal and state acceptable ambient concentrations (Ref. 38).

4.2 SURFACE WATER QUALITY

The surface waters of concern on and surrounding the immediate site consist of the following:

Banana River
Surface ditches
Natural depression (swamp, marsh and swales)
Mosquito control impoundments

The physical relationship of each of these waters to the subject site is presented in Figure 2.

Limited surface water quality data for the area has been obtained as part of the groundwater monitoring plan for the existing SRLF. The possibility for interaction between surface water and shallow aquifer groundwaters is regarded as high; and, in addition to local rainfall effects, surface waters at this location are seen as an expression of surficial groundwater supplies. Surface water sample locations (shown in Figures 4 and 5) surround the existing SRLF and are in the

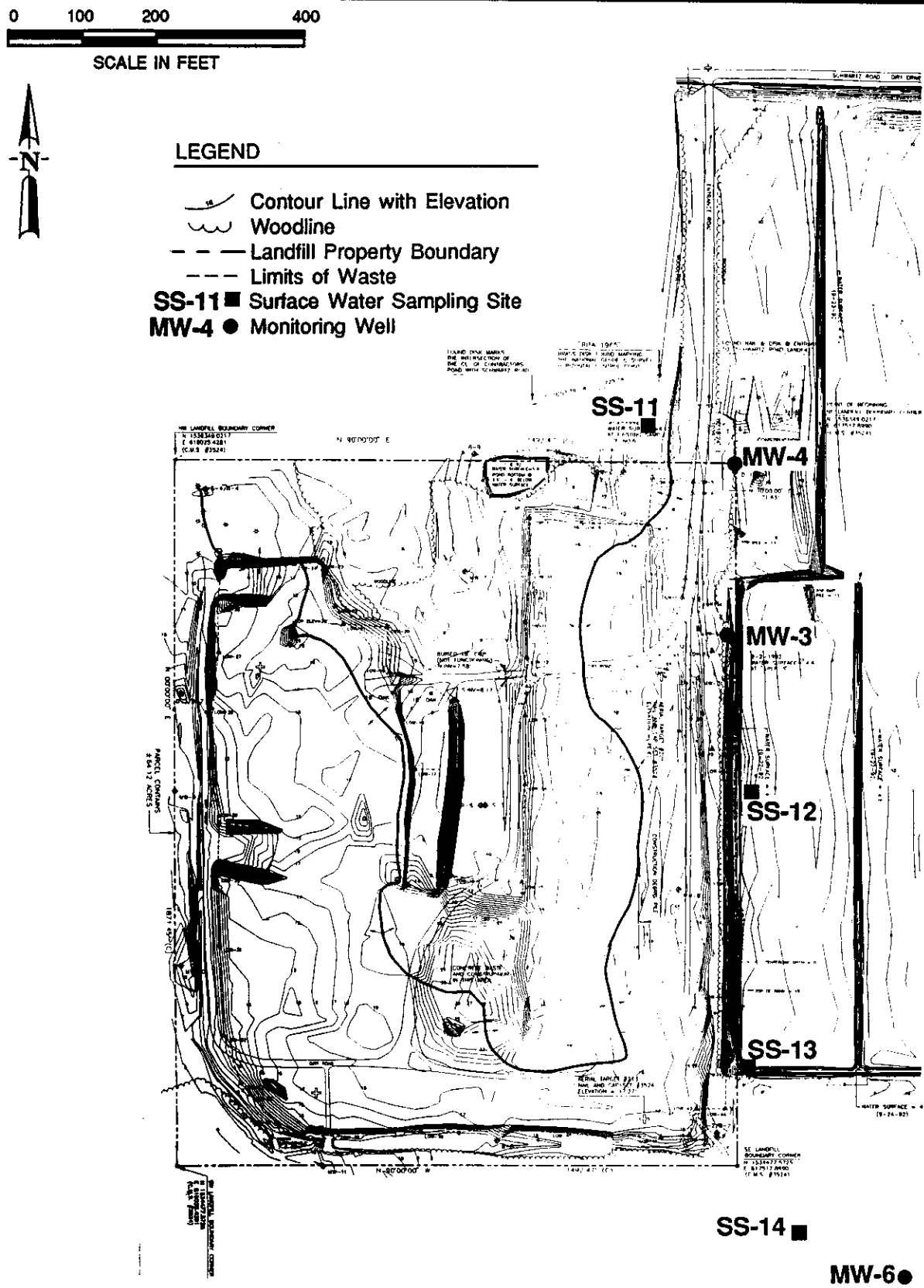

FIGURE 4. Surface and Groundwater Sampling Locations - Existing SRLF Site

SOURCE: JEA Inc., 1993.

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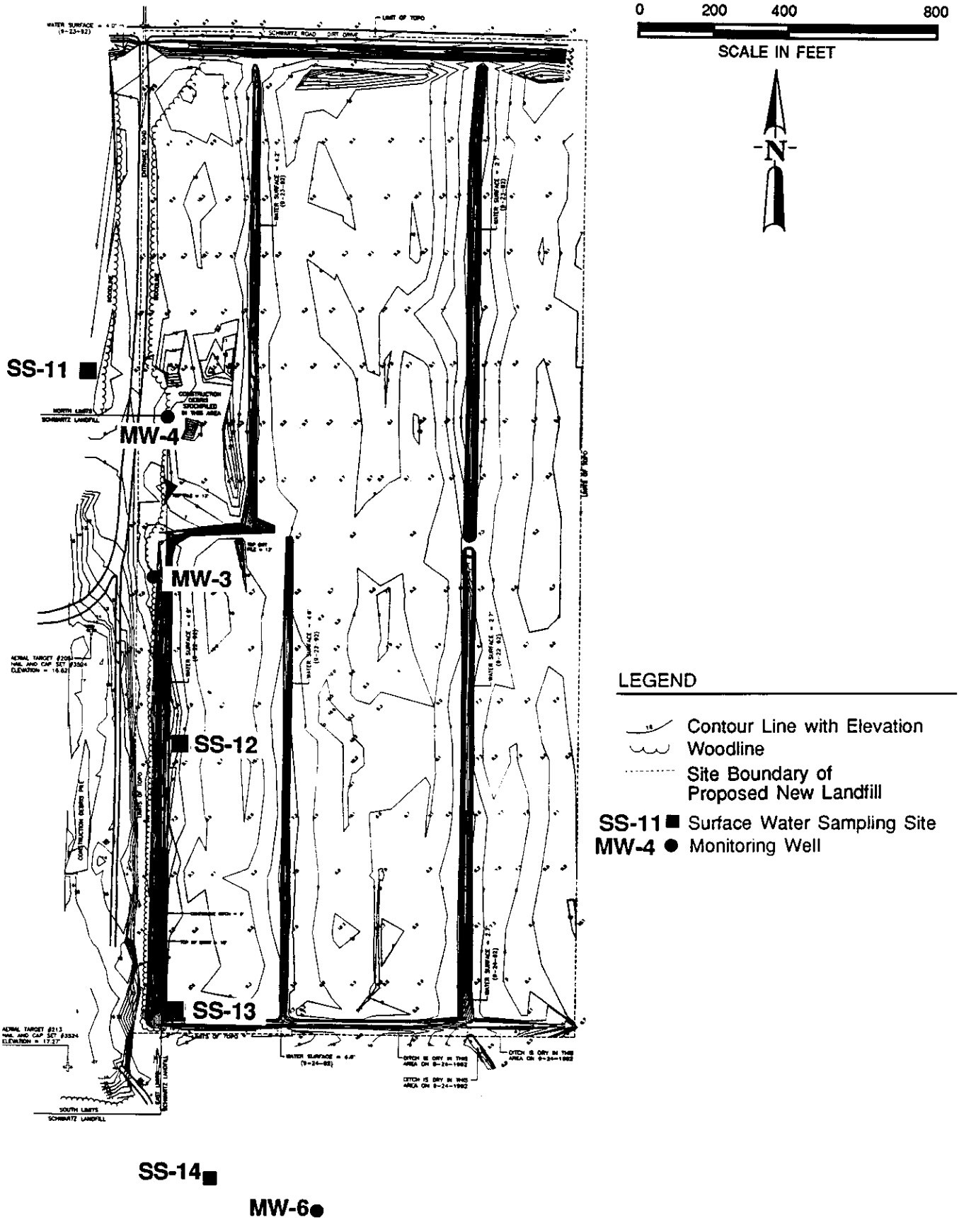

FIGURE 5. Proposed Expansion Site and Surface and Groundwater Sampling Locations

SOURCE: JEA Inc., 1993.

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vicinity of the proposed site. Station SS-11 is a small depressional pond. Stations SS-12 and SS-13 are existing ditches on the proposed site, and SS-14 is a completely natural vegetated swale south of the proposed site. Water quality data for typical indicator parameters are presented in Table A-1 Appendix A. For many analytes the results are similar and within the range of anticipated values observed from other natural waters at (Ref. 38). Concentrations of conductivity, TDS, turbidity, and color are believed to be strongly influenced by local rainfall events and/or antecedent conditions while the other parameters may be less so.

Stations SS-12 and SS-13 are part of the same ditch system, but may not always be connected. High Chemical Oxygen Demand (COD) at Stations SS-12, SS-13, and SS-14 is believed to be a reflection of their greater biological activity and consequently greater organic accumulation compared to SS-11.

Low dissolved oxygen levels have been measured at all surface water sample sites. This would be anticipated due to severe shading, consequent low primary production, high sediment oxygen demand, and high biological respiration. The relatively high TKN and high ammonia values at SS-12 are unexplained at this time. Evidence of wild hog use (rooting, trails) in this area suggests that their wastes are partly responsible for these high nitrogen values.

For most of the parameters measured the values are within the limits for Class III waters (Ref. 27).

Other surface water in and around the proposed site consists of man-made ditches which resulted from the preparation of this land for groves. Limited monitoring of surface waters in this area have been conducted (Appendix A), and these data appear to be typical of standing water bodies of similar depth

and which are supported by shallow aquifer groundwater and local surface runoff (Ref. 38).

The existing dredged ditches are heavily shaded and covered with extensive growths of floating vegetation (duckweed). These ditches contain relatively heavy organic laden sediments resulting from the allochthonous material falling in from bank vegetation as determined by Jones, Edmunds & Associates (JEA) field observation. It is believed that these conditions produce very low dissolved oxygen levels in the water column.

Clearing and preparation of this land was for citrus production, which is believed to have been aborted before any planting took place, according to conversation with NASA personnel. Thus, it is suggested that fertilizers, pesticides or other agricultural chemicals normally associated with such activities were never applied to the site.

4.3 GROUNDWATER QUALITY

4.3.1 Site Area Monitoring Wells

There are four known potential pollution sources within 1.6 kilometers (km) (1 mile) of the site: the Fire and Rescue Training Facility 1.6 km (1 mile) to the east-southeast; the Solid Rocket Booster (SRB) Assembly and Refurbishment Facility 1.0 km (0.65 miles) to the west along Schwartz Road; and the Schwartz Road Sandblasting Facility 0.8 km (0.5 mile) to the north, and the adjacent SRLF.

There are no public or private water supply wells within 1.6 km (1 mile) of the landfill. Water is either carried in to facilities in the area or is supplied by the base water system. There are 29 monitoring wells and piezometers at the sites surrounding the proposed site: 15 monitoring wells and piezometers at the SRLF, 11 monitoring wells at the Fire and

Rescue Training Facility, 3 monitoring wells at the SRB Assembly and Refurbishment Facility, and no monitoring wells at the Schwartz Road Sandblasting Facility.

4.3.2 Site Groundwater Quality

Most of the groundwater quality data for the existing SRLF are integral to that site, but monitor wells MW-4, MW-3, and MW-6 are useful to help characterize the groundwater or near the proposed site. Typical data is shown in Table A-2 of Appendix A for the period February 1989 to May 1992. High values for ammonia and TDS are found at MW-3 which is likely associated with the higher surface water values for these two analytes near this location.

Wells peripheral to the landfill tend to show slightly lower conductivities than those wells within the field of the landfill. Some ionic species often show an order of magnitude difference between wells with no clear patterns evident. Other analytes suggest very little seasonal variation, and that which is suggested may be a response to rainfall. The SRLF is included in the KSC Groundwater Monitoring Network (Figure 6). Ambient conditions for selected analytes reported for Dune-Swale and prime recharge areas are generally in line with those found with the present limited monitoring regime around the landfill (Appendix A, Ref. 38).

4.4 GEOLOGY

A hydrogeologic investigation and groundwater monitoring plan has been prepared for the existing SRLF (Ref. 30). No equivalent studies have been performed on the proposed site, but similar subsurface conditions are believed to exist.

The soil profile of the top several feet of the proposed site is expected to show a mixture of soils resulting from the

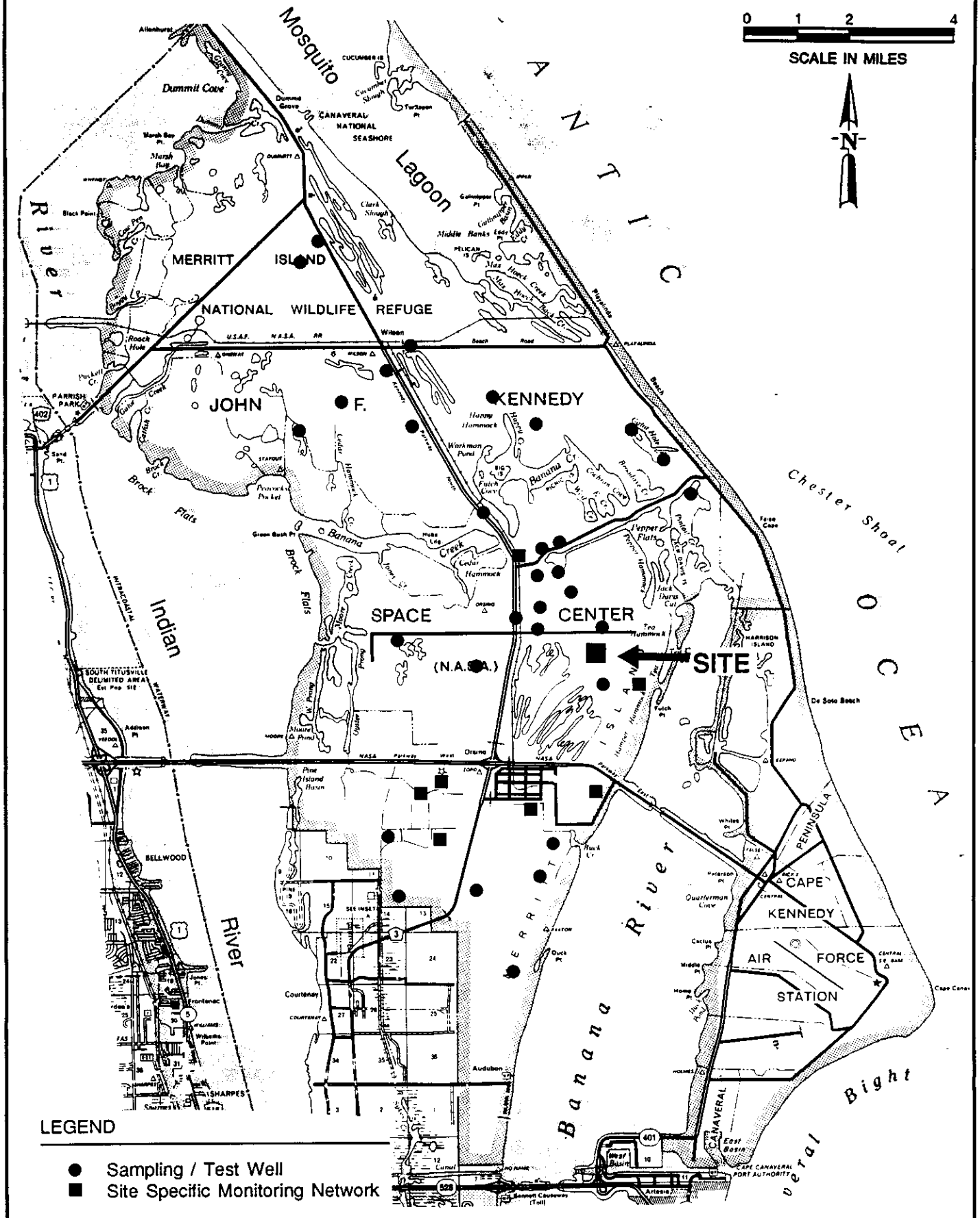

FIGURE 6. KSC Groundwater Monitoring Network

SOURCE: FDOT, 1975.
KSC-ERD, 1992.

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ditching and ground shaping which occurred in preparation for grove development. The following observations for the existing facility should hold for the proposed site until site-specific data becomes available.

4.4.1 Site Geology

The stratigraphy in the area is comprised of, in descending order, a surficial fine sand containing varying amounts of shell, a clay with varying amounts of sand and some shell, and a slightly clayey and shelly fine sand. These strata appear to underlie the site in horizontally continuous layers occurring at consistent depths. The amount of shell material varies horizontally and vertically, and the occurrence of the shell is unpredictable. The surficial fine grained sand is approximately 15 m (50 feet) thick. It is a relatively consistent lithology of clean to slightly clayey sand with minor amounts of shell and organic, peat-like material.

The clay underlying the surficial sand dips west and southwest. The clay contains stiff layers which appear to be very impermeable, but it also contains soft and sandy clay layers and minor amounts of shell material that would make it more permeable.

Beneath the sandy clay and clay layer is a slightly clayey fine sand containing, in places, abundant shell material (coquina-like). This sand and shelly sand is loose and gray in color (Ref. 30, Drilling Log Data).

4.4.2 Site Hydrogeology

The surficial aquifer in the area is approximately 12 to 14 m (40 to 45 feet) thick and is contained within the surficial fine grained sands. Local groundwater flow in the surficial aquifer is generally radial from the southeast corner and the

center of the SRLF site. The hydraulic conductivity of the upper portion of the surficial aquifer ranges from 1.3 to 5.8 m (4.2 to 19.0 feet)/day as determined from the slug test calculations at the SRLF.

The average linear velocities of groundwater flow in the upper portion of the surficial aquifer are 0.016 m (0.053 feet)/day to the northeast, 0.009 m (0.032 feet)/day to the northwest, and 0.013 m (0.043 feet)/day to the west. Assuming a mean of 0.013 m (0.043 feet)/day, the groundwater flow occurring in 1 year would be approximately 4.8 m (15.7 feet).

The sandy clay and clay underlying the surficial aquifer is a confining unit. The confining unit is not uniform throughout, but contains thin layers and lenses of sand and sandy clay with higher conductivities than the clay tested in the laboratory. The effective hydraulic conductivity for the thickness of the confining unit is probably on the order of $1x10^{-5}$ to $1x10^{-6}$ cm/sec, which would result in an average linear velocity of groundwater flow of 0.14 to 0.014 m (0.47 to 0.047 feet)/year or a travel time through the unit of 20 to 200 years.

An intermediate aquifer within the slightly clayey fine sand underlies the intermediate confining unit. The total depth of this aquifer is estimated to be approximately 30.5 m (100 feet) beneath the land surface (-90 to -100 feet msl). Groundwater flow in the intermediate aquifer is slightly east of north. An average linear velocity for groundwater flow in the intermediate is 0.0012 m (0.0039 feet)/day.

The results of field parameter testing (temperature, conductivity, and Ph) have shown that the intermediate aquifer groundwater is distinct from the surficial aquifer groundwater. The temperature is 1°C cooler in the intermediate aquifer, 24°C compared to 25°C in the surficial

aquifer. The conductivity in the intermediate, 2210 to 2820 μmhos/cm, is much higher than in the surficial aquifer, 90 to 810 μmhos/cm. The pH in the intermediate aquifer, 7.3 to 7.9, does not vary as much as in the surficial aquifer, 4.9 to 7.4. The higher conductivity groundwater in the intermediate aquifer indicates brackish groundwater.

4.4.3 Site Soils

The soils of the proposed site are composed primarily of Pomello sand, Immokalee, Felda, and Quartzipsamments. Historically the Quartzipsamments portion is believed to have been of the other series, but following land shaping is given that designation. Quartzipsamments implies that parent soils have been modified, usually by smoothing and shaping, as in urban lands development or, in the present case, site contouring. The major parent soils contain areas of other soils as described below (Ref. 42).

Pomello Sand (Ps)

This is a nearly level (except where worked), moderately well drained soil which is characteristic of the ridged portion of the ridge and slough development observed around this site. small areas of Myakka and Immokalee soils are found with this association.

Immokalee Sand (Im)

This nearly level - usually poorly drained soil is found on low ridge between sloughs and in flatwoods. St. Johns, Myakka, and Oldsmar soils are found scattered within this association.

Felda, Felda & Winder (Fa, Fe)

These poorly drained soils are found in low or depressional areas such as sloughs and poorly drained waterways and may be found in either sloughs or hammocks. Felda and Winder, each

make up about 35% of the sands with Chobee, Floridana, Wabasso, and others found in sloughs with no one soil making up more than 20% of an area. How much of this soil was excavated and cast on top of others during the original land clearing is unknown.

Myakka Sand (Mk)

This is a nearly flat, poorly drained sandy soil which is found as a component of others (Im, Ps) in flatwoods, slough and ponds, and especially between sand ridges.

Anclote Sand (An)

This is a very poorly drained sandy soil found primarily in the northwest corner of the site. Here it is indistinguishable from the roadside ditch system and natural marshes, and poorly designed drainage ways of which it is characteristic.

Ditching of the site nearly 40 years ago has changed the water regime and basic drainage of the soils comprising the site so that the classic descriptions are of questionable value. Evidence to support the contention that the site soils have been disturbed comes from the very recent survey of the property (Figure 5) which shows that the site has been crowned between the ditches (i.e., higher in the center and lower at the ditch edges); the observation by surveyors of old, dead citrus trees in several locations; and the historical review provided by Archeological Consultants, Inc., that beds were shaped and citrus planted at an earlier time (Appendix D).

The percentage of each soil type described by GIS analyses is presented in Table 1 which also includes the normally expected elevation of groundwater relative to the surface (Bionetics 1992).

Table 1. GIS Analysis of Soil Composition for the New Landfill Site and the Surrounding Area[1]

Soil Description	Percent Total	Depth to GW[2]
Pomello Sand	32.35	30-40" - 2-4 mos
Immokalee Sand	21.50	10" - 1-2 mos
Quartzipsamments	12.20	±50 inches
Felda, Felda & Winder	11.87	10 - 2-6 mos
Myakka Sand	8.28	10", 1-4 mos
Anclote Sand	6.23	10" - 6 mos
St. John's Fine Sand	3.98	
Orsino Fine Sand	1.67	
St. John's Ponded	0.83	
Paola Fine Sand	0.64	
Swamp	0.45	

Source: Bionetics, 1992. USDA, SCS, Soil Survey of Brevard Co., Florida, 1992.

Information on soils is of value only in so far as it helps explain the nature of existing habitats on this site and whether there may be severe engineering limitations for the proposed action.

The soils of the proposed site location present no severe engineering limitations for the intended use. Slopes will have to conform to an accepted degree for stability.

4.4.4 Prime Farmlands

There are no prime farmlands on or near the subject site.

4.5 AQUATIC COMMUNITIES

The aquatic resources of the proposed site are expected to be quite limited since the only standing water is that found in the ditches.

Fishes

A variety of freshwater fishes could have become established during earlier land preparation and subsequently during overflow periods or by wading birds. Seasonally depressed (low) dissolved oxygen is believed to make these waters unsuitable for much diversity or the attainment of size. Very small species, those with accessory air breathing capacity, and those species with special physiological adaptations to low oxygen concentrations may do better (Appendix B).

Reptiles

Small alligators have been observed as noted in the next section. Turtles and snakes are valuable wildlife resources which could utilize these waters, but would not be considered a numerically significant regional resource. The local

herpetofauna may provide important food resources and ecological links for other wildlife in this area.

Amphibians

Various frogs, toads, salamanders, and siren use the ditches in this area (KSC-ERD). Their major contribution to the system is as an important food base for aquatic and terrestrial predatory forms (e.g., alligator, water snakes, and siren).

Appendix C lists selected other aquatically oriented vertebrates which could occur on or near the site.

4.6 TERRESTRIAL COMMUNITIES

The KSC-ERD is the reference for the flora and fauna of this site, and those lists have been examined and reduced in size based on the field experience of the staffs of EG&G, Inc. (EG&G) and the Bionetics Corporation. The resulting working lists of terrestrial biota are presented in Appendix C, and reflect habitat suitability as well as features of the life history and use of the habitat as they are known for the site (Refs. 7 and 38).

The following generalities regarding each group are believed to be germane to a proper understanding and appreciation of this community.

Typical terrestrial inhabitants of selected habitats either found in the proposed site, adjacent to it, or nearby are identified in Tables C-1 through C-2 in Appendix C according to the specific habitats. Terrestrial vertebrates normally have greater mobility than many of their aquatic counterparts and it should not be surprising to find many species of birds, mammals, and reptiles in several related or contiguous

habitats even if only as transients, migrants (birds especially) or occasional visitors.

Existing habitats of the proposed site area are presented in Figure 7, which also identifies some adjacent habitats (Ref. 6). Note that this figure was prepared to depict upland habitats and does not accurately represent the ditch system.

Recent aerial photography of a slightly larger area coverage (Figure 3) shows numerous wetlands to the west, southwest, and southeast. Undisturbed native scrub is found to the south and southeast of SRLF, and the wild or relatively undisturbed nature of lands in all directions is clearly observable. The Dune-Swale nature (Section 4.3) of these lands is clearly seen as alternating light and dark bands, which generally trend north and south.

4.7 THREATENED AND ENDANGERED SPECIES

Several threatened and endangered species have been identified as resident on the proposed site. Table 2 lists these species and provides their status at federal and state levels of concern. Each of the listed species will be reviewed either as individuals or as groups in the following summary paragraphs. The KSC ERD is the primary general reference document, but other scientific literature sources as well as personal interviews with recognized authorities were examined or conducted to bring these data bases up to date.

Primary focus has been directed toward the federally listed species, but acknowledgment of the status of additional species listed by the state of Florida is considered appropriate. Brief comments on site specific occurrences follows the federally listed species accounts.

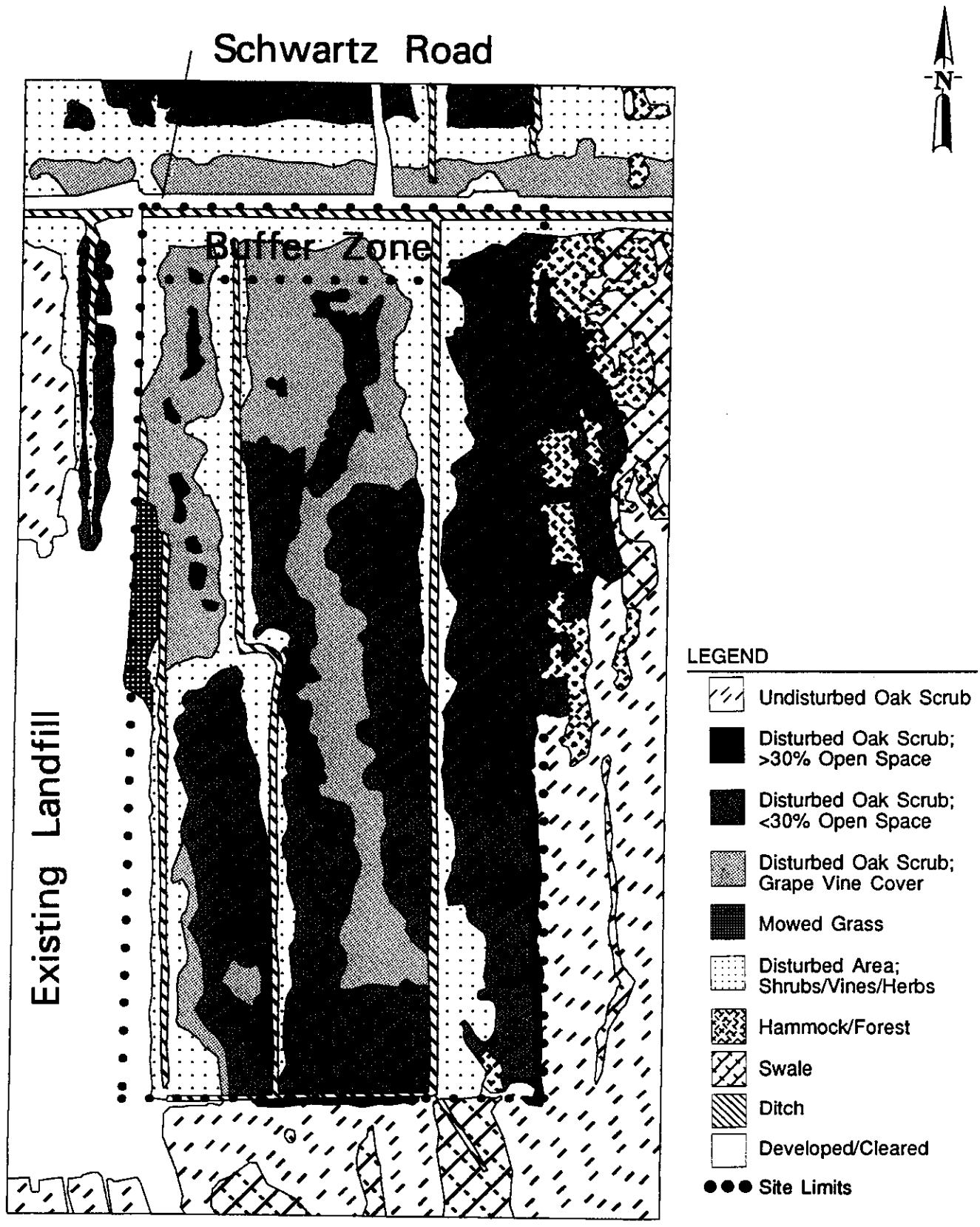

FIGURE 7. Terrestrial Habitats of the Proposed Site and Nearby Adjacent Areas

SOURCE: Bionetics, 1993.

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Table 2. Protected Fauna at Proposed Site (Page 1 of 2)

Scientific Name	Common Name	Designated Status				
		USFWS[1]	CITES[2]	FGFWFC[3]	FCREPA[4]	FNAI[6]
REPTILES & AMPHIBIANS						
Alligator mississippiensis	American alligator	T(S/A)	II	SSC	SSC	G5,S4
Drymarchon corais couperi	Eastern indigo snake	T		T	SSC	G4T3,S3
Gopherus polyphemus	Gopher tortoise	C2		SSC	T	G3,S3
Pituophis melanoleucus mugitus	Florida pine snake	C2		SSC	SSC	G5T3?,S?
BIRDS						
Aphelocoma coerulescens coerulescens	Florida scrub jay	T		T	T	G5T3,S3
Egretta caerulea	Little blue heron			SSC	SSC	G5,S4
Egretta thula	Snowy egret			SSC	SSC	G5,S4
Lanius ludovicianus	Loggerhead shrike	UR				
Falcon sparverius paulus	Southeastern American kestrel	C2	II	T	T	G5T3T4,S3?
MAMMALS						
Podomys floridanus	Florida mouse	C2		SSC	T	G3,S3

Table 2. Protected Fauna at Proposed Site (Page 2 of 2)

Scientific Name	Common Name	Designated Status				
		USFWS[1]	CITES[2]	FGFWFC[3]	FCREPA[4]	FNAI[6]

E = Endangered
T = Threatened
UR = Under Review or Status Unclear
SSC = Species of Special Concern (Florida)

[1] = United States Fish and Wildlife Service (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11-12).
[2] = Convention on International Trade in Endangered Species of Wild Fauna and Flora.
[3] = Florida Game and Freshwater Fish Commission (list published in Section 39-27.03-05, Florida Administrative Code).
[4] = Florida Committee on Rare and Endangered Plants and Animals.
[5] = The Florida Natural Areas Inventory (FNAI) assigns 2 ranks for each element. The global element ranks is based on an element's worldwide status; the state element rank is based on the status of the element in Florida.

Source: NASA, KSC Environmental Resource Document, 1992.

Scrub jay

This is a medium sized bird of subtle grey and blue color which feed on insects and acorns, primarily. Open spaces near scrub are utilized to cache acorns and other selected foods, hence its value in the total habitat. The birds utilize scrub that is higher than surrounding vegetation as sentinel posts.

This species exhibits strong family ties or cooperative breeding behavior.

The Florida scrub jay (Aphelocoma c. coerulscens) is a federally threatened species found in oak scrub and related habitats. Its status is imperiled by the loss of suitable habitat to upland development and fire suppression which changes the habitat. One of the largest populations in the state is found on KSC, and substantial populations are found in the surrounding scrub located to the southwest and south of the proposed site.

Alligator

This animal is believed to be an opportunistic resident of the ditch system. Feeding potentials are believed to be less than optimum due to a lack of surface water connections to other surface water systems and the expected poor water quality in the ditches.

The reported individuals are very small, and there is not believed to be an active breeding population of alligators on the subject site. Alligator breeding does occur along the roadside ditch system paralleling Schwartz Road, and young individuals could have found the ditch system of the proposed site from this nearby source.

Gopher Tortoise

Tortoise (Gopherus polyphemus) are found in suitable habitats south of the subject site, being especially visible along the more open areas of the north/south firebreak.

The gopher tortoise is a burrowing animal capable of creating substantial excavations. The burrows are used to escape adverse weather conditions and predators (Ref. 4). Many other animals utilize the burrows of the tortoise (see commensals below).

This specific area of historic dune/swale or ridge/slough geoformation has probably been enhanced by the ground shaping which occurred in anticipation of grove planting, since it actually raised soil above historic grades and provided easier and drier burrowing sites (Ref. 4). With the exception of grape vine, good quality forage appears to be somewhat limited on the subject site. Numerous burrows were observed while this site was being surveyed, but an intensive study of population size or use was not conducted.

Indigo Snake

This reptile (Drymarchon corais couperi) is known to inhabit the general subject area, but precise population estimates have not been made. Preliminary estimates based on the quantity and quality of existing habitat suggests that perhaps one or more individuals may possibly inhabit the subject area as regular or occasional users (Ref. 6).

Radio telemetry studies of other indigo snakes at KSC suggests that an area such as the present one may provide adequate habitat for both male and female snakes (Ref. 32).

Commensals

Several commensals of the gopher tortoise have special status in Florida by virtue of their declining population numbers. This may be a result of the loss of gopher tortoise habitat and consequent burrow decline for which the commensals have no equivalent or suitable replacement. The gopher frog is one such organism. According to Bionetics (Ref. 31), this animal has not been observed in this area of KSC. The Florida mouse also uses burrows, and can be expected in this area. Reptilian commensals include the rattlesnake and indigo snake. While the rattlesnake is not listed, there is expressed concern among biologists about its declining numbers and status. The indigo snakes often relies on burrows for winter refuge from the cold and as a year-round refugia during shedding periods.

Bald Eagle

The bald eagle (Haliaeetus l. leucocephalus) is a federally listed species which is found on KSC. The species breeds in Florida, and may occupy suitable large pine trees in open pine stands for nesting if provided with appropriate foraging areas within reasonable distances (Ref. 28). The eagle feeds primarily on fish and assorted carrion. Eagles have been observed perched on utility poles near the proposed site (Ref. 6) and may be observed flying over this area.

4.8 HISTORICAL AND ARCHEOLOGICAL RESOURCES

The proposed site has been reviewed by the Florida State Historic Preservation Officer (SHPO), and it has been concluded that no historic or archeological sites of consequence are located in this area. An archeological survey has been performed to establish zones of archeological potential (ZAPs) in the launch complex area of KSC, (Ref. 1).

Sites within the study area (which includes the Section in which the SRLF is located) were identified and rated as high, moderate, or low potentials. It was determined that the potential for a medium-level zone of archeological potential could exist, and a Phase I survey was conducted.

The SHPO suggested a Phase I investigation of selected areas (see Figure 8) near or on the proposed site. This work was completed during the preparation of this document. The results of this investigation included ground surface reconnaissance and the excavation of 42 standard sized (50 cm diameter x 1 m deep) test pits. The study did not result in the discovery of archeological sites, either prehistoric or historic.

Letters confirming these results are presented in Appendix D.

4.9 FLOODPLAINS

The proposed Class III landfill site lies at approximately 3 m (10 feet) MSL which is one of the higher elevations in this area. No flood zones have been identified by the Federal Emergency Management Program. The 100-Year Flood Plain map for this area is shown in Figure 9.

The water levels in the Schwartz Road roadside drainage ditch are controlled, in part, by the elevation of a control structure located due east on the Banana River. This is part of an extensive mosquito impoundment system. Extreme weather conditions, including excessive rainfall, hurricane or other storm surges coupled with abnormally high tides may result in abnormally high water levels in this ditch system.

Floodplain is regarded as an inappropriate term in the present context since the subject site is not in the floodplain of either of the local rivers. Flood zone, which implies that

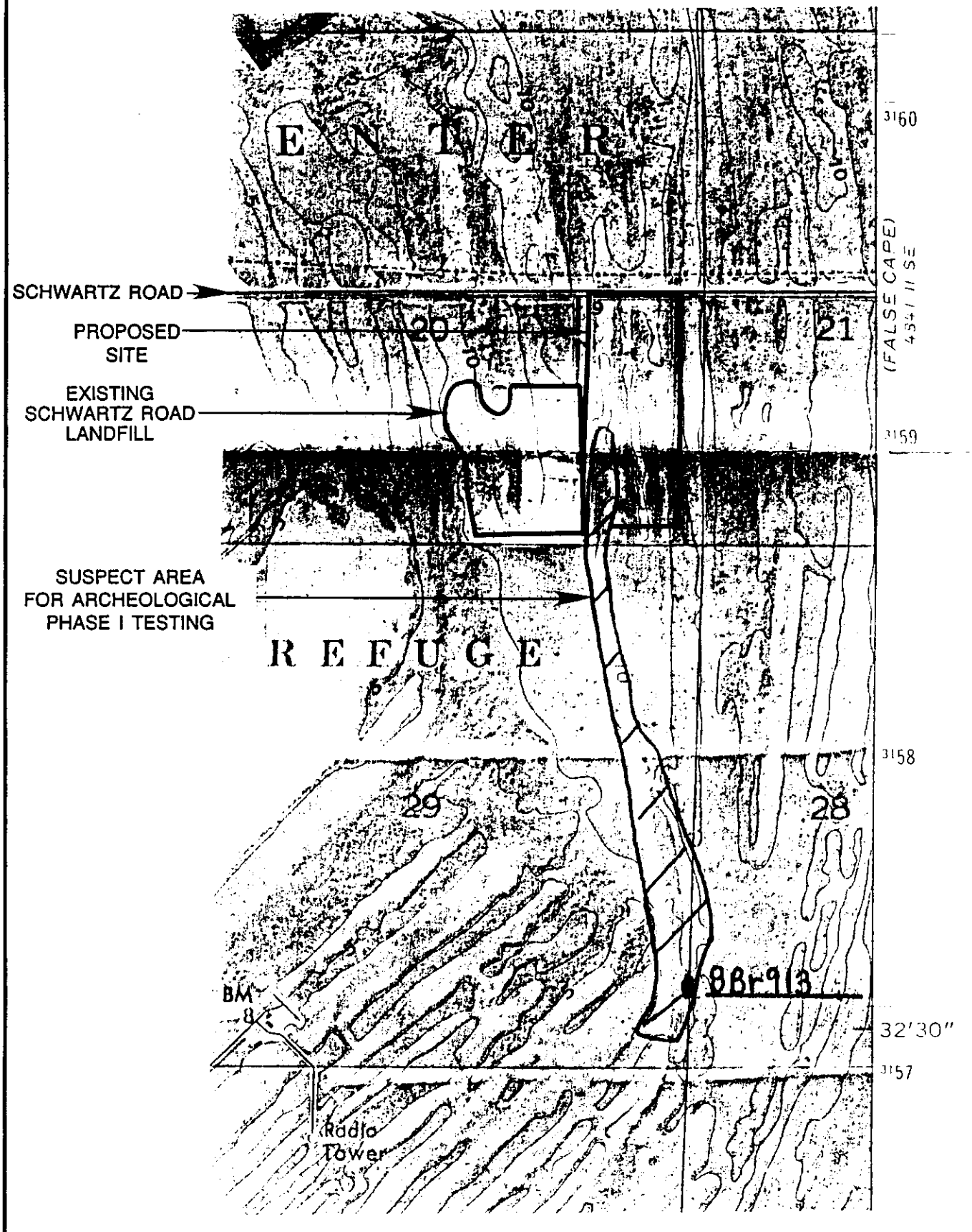

FIGURE 8. Location of Zones of Archeological Potential (ZAPs) Near Proposed Site

SOURCE: ACI, 1992.

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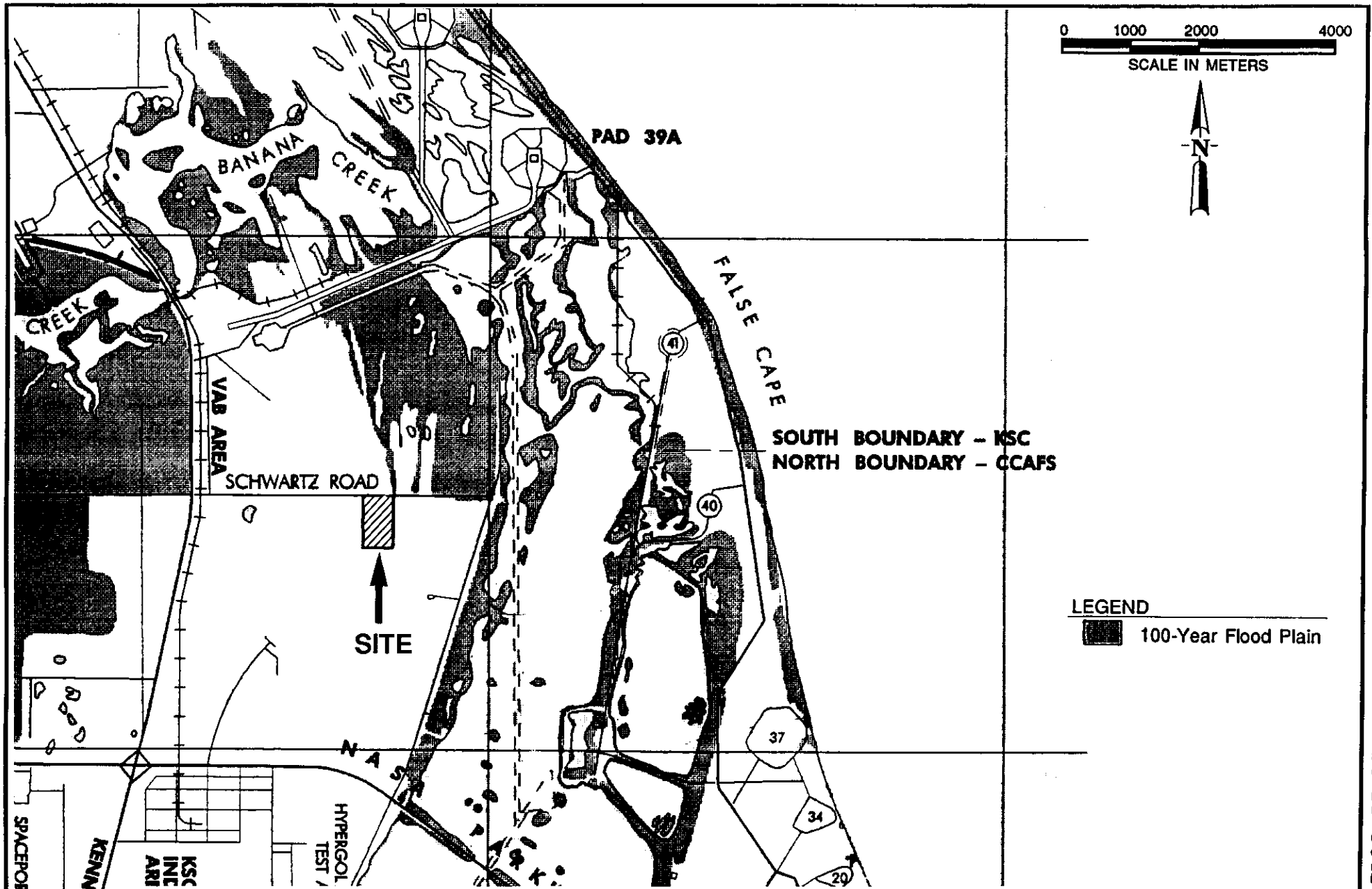

FIGURE 9. 100-Year Flood Plain Map for the Subject Site Area

SOURCE: NASA Flood Plain Map, October 1992.

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KSC-DF-3642

certain upland areas could be subject to local flooding as a result of locally ponded water may be more appropriate.

4.10 NOISE

Noise levels in the remote areas of KSC and National Wildlife Refuge areas are believed to be in the range of 35 to 40 dBA (Ref. 38).

The existing landfill as well as the proposed expansion area are well buffered on all sides by native vegetation.

A certain level of noise has historically been identified with operations at the adjacent SRLF. This is comprised primarily of heavy equipment and delivery truck engine noise and various metal to rubble contact noises. Table 3 presents typical noise levels from this type of equipment.

The present SRLF is located in a relatively isolated area and these noises have not been perceived by any known facilities nearby. The proposed action is expected to continue operations at similar noise levels. Local wildlife at the SRLF appears to have adjusted to existing noise levels based on observations and other indication of presence (i.e., scats, tradus, sign), and this is seen as a generally neutral impact to the surrounding area.

The environmental effects of noise on selected wildlife species have been conducted. Woodstork (Ref. 5), scrub jays (Ref. 3), wading bird colonies (Ref. 8), and bald eagles (Ref. 34) are the species which have been examined. Startle responses have been noted with some birds flying off, but returning shortly after. These results have suggested that despite the obvious short-term startle effects, no obvious immediate effects have been observed (Refs. 31 and 38).

Table 3. Construction and Vehicular Noise Sources, dBA

Source	Noise Level (Peak)	Distance from Source[a] 50 ft	100 ft	200 ft	400 ft
CONSTRUCTION					
Heavy Trucks	95	84-89	78-83	72-77	66-71
Pickup trucks	92	72	66	60	54
Dump Trucks	108	88	82	76	70
Concrete Mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80-89	74-82	68-77	60-71
Dozer	107	87-102	81-96	75-90	69-84
Paver	109	80-89	74-83	68-77	60-71
Generator	96	76	70	64	58
Shovel	111	91	85	79	73
Crane	104	75-88	69-82	63-76	55-70
Loader	104	73-86	67-80	61-74	55-68
Grader	108	88-91	82-85	76-79	70-73
Caterpillar	103	88	82	76	70
Dragline	105	85	79	73	67
Shovel	110	91-107	85-101	79-95	73-89
Dredging	89	79	73	66	60
Pile Driver	105	95	89	83	77
Ditcher	104	99	93	87	81
Fork Lift	100	95	89	83	77
VEHICLES					
Diesel Train	98	80-88	74-82	68-76	62-70
Mack Truck	91	84	78	72	66
Bus	97	82	76	70	54
Compact Auto	90	75-80	69-74	63-68	57-62
Passenger Auto	85	69-76	63-70	57-64	51-68
Motorcycle	110	82	76	70	64

[a] ASSUME 6 dBA decrease for every doubling of distance.

Source: Golden et al., 1980

4.11 INFRASTRUCTURE AND SERVICES

The issue of who is responsible for the management of refuse materials is central to this discussion. Clearly, the waste materials generated at KSC have to be deposited somewhere. The solid waste service must be provided.

Schwartz Road is a graded road that receives moderate use by KSC employees (Ref. 7).

4.12 SOCIO-ECONOMICS

There are no issues of schools, classroom/student numbers, water, sewer, wastewater treatment, highways or road networks and their use, jobs, labor disputes, health care and emergency medical attention for the elderly, etc.

The relatively remote location of the present landfill decries active "social" involvement. The proposed action would continue the same types of activities observed at the existing landfill.

4.13 LAND USE

The KSC master plan identifies the land use for the adjacent SRLF site as sanitary landfill. The land use for the area to the south of the SRLF is identified as sanitary landfill expansion on the master plan. The Schwartz Road Sandblast/Paint area is located approximately 122 m (400 feet) northwest of the proposed Class III landfill. An industrial complex that consists of the SRB Assembly and Refurbishment Facility, Roads and Grounds Storage area, and the security patrol headquarters is located approximately 1.6 km (1 mile) west of the proposed site. The remaining and predominant land use in this area is as green space, or native habitat and wildlife conservation.

The impact of earlier clearing and preparation for grove planting of the subject site is manifested in several of the following negative aspects which persist to this day:

- Allowed invasion by annual and perennial weed and noxious plant species.

- Allowed vining species (grape, greenbriar, creeper, etc.) to become established which severely diminishes the quality of scrub habitat for scrub jays, but which creates a more diverse habitat for general wildlife and listed species such as the indigo snake.

- Probably altered historical moisture regimes, with localized favor to plants with higher moisture requirements.

- Permanently altered plant species competition.

- Resulted in some areas which have not effectively re-vegetated after nearly 40 years, even though no further land manipulations have occurred. (Compare to areas south and to the east.)

The influence of invading vining species is regarded as a negative influence on the site at present, which results from the suppression or inhibition of fire in this area.

5.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ALTERNATIVES
(Impacts of the Proposed Alternatives)

The alternatives for this environmental assessment consist of the proposed action and utilizing the Brevard County landfill instead of any facilities on KSC (no action). These alternatives are summarized in Table 4.

The perceived impacts to air, water quality, biota and other elements (1-13) of the alternatives element matrix will be positive or no effect since no further manipulation of these elements would be forthcoming. In some respects this is a synopsis comparison (as noted above).

The impacts of the proposed alternatives are discussed briefly in the following paragraphs.

TABLE 4. Environmental Consequences of Proposed Action and Alternatives

ACTION \ ELEMENT	1. AIR	2. SURFACE WATER QUALITY	3. GROUNDWATER QUALITY	4. GEOLOGY	5. AQUATIC RESOURCES	6. TERRESTRIAL RESOURCES	7. THREATENED AND ENDANGERED SPECIES	8. HISTORICAL AND ARCHEOLOGICAL RESOURCES	9. FLOOD PLAIN FLOOD ZONE	10. NOISE	11. INFRASTRUCTURE	12. SOCIO-ECONOMIC	13. LAND USE
PRIMARY ACTION													
PROPOSED	N	N	N/M	N	M/N	M	* M	N	N	N	N	N	N
NO ACTION (OPTION #1)	B	B/N	B	N	N	N	N	N	N	B	N	N	B
OTHER ACTIONS													
STACKING	M/N	N	M	N	N	N	N	N	N	N	N	N	N
SW AREA	N	N	N/M	N	N	S	S	N	N	N	N	N	N

PERCEIVED IMPACTS

- **B** = Beneficial
- **N** = None/Neglible
- **M** = Moderately Adverse
- **S** = Significantly Adverse

* Viewed as an Obvious Local Adverse Impact Which is Being Compensated (Please see Appendix E)

5.1 AIR QUALITY

Climatic conditions existing at KSC are neither expected to influence or be influenced by landfill operations at the present or the proposed expansion site.

Proposed Action

The proposed action will require clearing, grubbing and burning of vegetable residues for site preparation. Both fugitive dust and smoke are consequences of these actions, but are regarded as capable of control, and are thus regarded as short term impacts of minor consequence.

The new landfill would be operated strictly as a Class III facility and landfill gas production is expected to be minimal or non-existent.

A longer term impact is that of the continual use of heavy equipment at the landfill. This will result in some exhaust emissions and some fugitive dust potentials from both the haul roads and the landfill itself. This action will not increase emissions above emission levels currently experienced at the SRLF since operations will be transferred from the SRLF to the proposed site once the SRLF is closed.

Mobile source emissions resulting from the truck transport of wastes to the landfill site are regarded as negligible compared to the daily emissions from other vehicles in the area. Trucking wastes to the Brevard County facility would actually increase this total loading as a result of the greater vehicular time spent travelling to and from this remote facility.

Alternative # 1 No Action

Using the Brevard County facility will increase haul distances and consequently the quantity of exhaust emitted to the atmosphere, and increase total fuel consumption. This alternative will also increase the potential for accidents between passenger and other road traffic and the haul vehicles and increase the need for more costly repairs to the haul road surfaces. These impacts are regarded as long term and moderate in intensity.

Fugitive dust and vehicular emissions from the SRLF would be reduced to negligible levels.

These impacts are slightly negative ones of long duration and involve a transfer from one location (SRLF) to another (general KSC and Brevard County road systems).

Several assumptions were required in order to assess the potential air pollution impacts resulting from the hauling of wastes to the Brevard County Landfill. These included the following: heavy-duty diesel vehicle (HDDV) traveling over undivided arterial roads, five days a week; emissions factors from 1988 Mobile 4 model from CO_2, NO_x, and HC; a round trip of distance of 54.4 miles, and an average of 13 round trips per day; and a waste disposal site of 25 tons per day. The additional air pollution impact was calculated to be: carbon dioxide (1.49 tons per year); Nitrogen oxides (3.46 tons per year); and hydrocarbons (0.35 tons per year). The total of 5.3 tons per year are concluded to produce a negligible impact.

5.2 SURFACE WATER QUALITY

Proposed Action

The existing surface water on or near the site consists of a combination of man-made and natural features described earlier. The ditches of this site will be buried and will no longer exist. The Schwartz Road roadside ditch system will remain as a necessary surface drainage feature.

Preparation of this site for landfill use will result in the elimination of most of the ditch system by filling.

Completion of closure activities for the existing SRLF will result in the construction of a required surface water management system consisting of stormwater detention ponds and associated collector ditches. The conceptual plan has these ponds serving the existing (closed) facility as well as the proposed expansion areas. Nutrient levels may be expected to be slightly higher than existing local surface water supplies as a result of the fertilization associated with the establishment of turf covers. However, these levels are not expected to be severely high. Banks and berms will be seeded and/or sodded, and designed for low maintenance. Littoral zone growth of unsuitable aquatic vegetation such as cattail will be managed in accordance with the requirements of the appropriate regulatory agencies.

The proposed action will include a DER and SJRWMD approved surface water management system consisting of a series of perimeter ditches connected to stormwater detention ponds. Minimal amounts of fertilizer are anticipated to establish slope and berm surfaces with turf grasses, and overall the use of agricultural chemicals is expected to be minimal.

A properly designed, constructed and operated landfill is not expected to have a measurable impact on surface water quality of this or adjacent areas.

Alternative #1 No Action

This alternative would have no impact on site surface water quality in this location. Conditions at the Brevard County facility are beyond the scope of this assessment.

5.3 GROUNDWATER QUALITY

Proposed Action

Groundwater quality can be directly influenced by landfill activities, and has been so demonstrated in many locations. The most serious violations of groundwater quality parameters has occurred where unlined facilities are used and where uncontrolled disposal of hazardous materials has occurred.

The proposed facility location is not expected to be influenced in any significant manner by Class III landfill refuse.

Alternative # 1 No Action

This alternative will have a neutral impact on water quality on the Schwartz Road area in that no additional refuse will be added to this area. The present facility is unlined, but will have a cap liner and surface water management system to reduce leachate formation.

5.4 GEOLOGY

Proposed Action

The surficial geology of the proposed site has already been impacted to some extent, since it had ditches dug and the spoil cast on top of existing surface materials. These materials would be redistributed again during landfill site preparation and operation, This area is not known for karstic activity and no known mineral resources of strategic or commercial importance have been identified.

No impact (of consequence) to the geology of the site or region are anticipated.

Alternative # 1 No Action

No impacts are anticipated on KSC from this alternative. No impacts can be realistically predicted for Brevard County.

5.5 AQUATIC COMMUNITIES

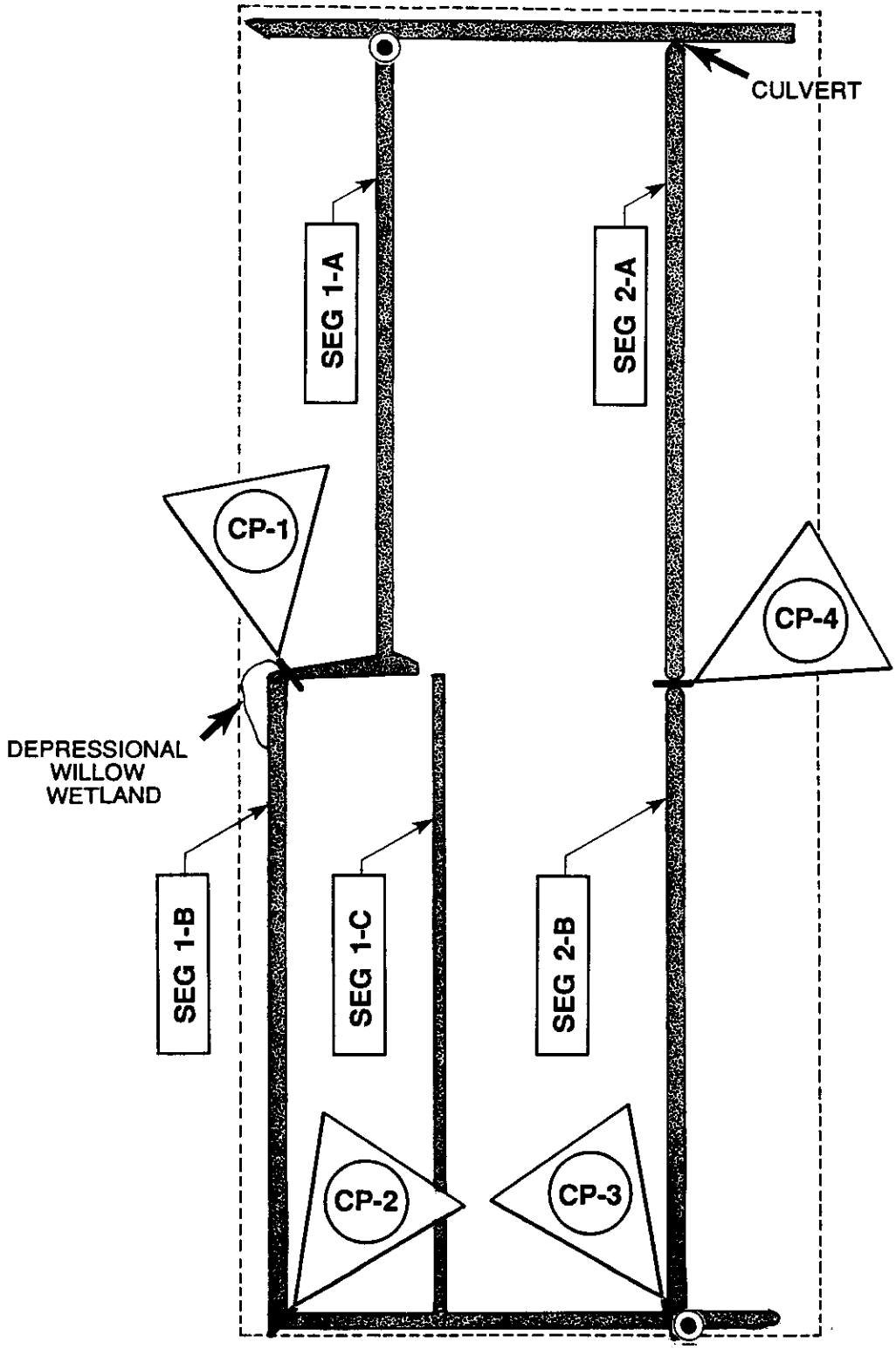
Proposed Action

Aquatic habitat at the proposed site is composed of dug ditches with steep sides, which are heavily vegetated along the embankment area. This is no doubt the result of the more moist micro-climate created by standing water. The influence of this does not extend very far. With limited aquatic ingress or egress, these systems may go for years without new fish additions which might be expected during times of extreme high water. Resident species may reproduce in these systems, however. Other aquatically oriented animals may enter or leave the system at any time the conditions are favorable.

The proposed action would totally eliminate these systems. This is regarded as a negative impact of limited biotic consequence to the region or to the general KSC area since the organisms are all very common in Florida and throughout the nearby region. Alligators may be removed to more suitable habitat during land clearing and site preparation. Their removal is regarded as of minimum impact (Ref. 29).

Existing and historical culverted connections to adjacent wetlands were discovered within the ditch system, but all ditches are not necessarily connected in common to each other.

The system was divided into segments (Seg) based on existing water surface and top of bank (TOB) elevations for purposes of this assessment. CAD computation of resulting surface areas and the combined areas is presented in Figure 10 and Table 5. Critical points (CP) which were used to segment the system were identified and are briefly discussed below. These are shown on Figure 10.



NOTE: See Figure 7 for contour details.

LEGEND
- Site Boundary of Proposed New Landfill
- Ditch Segment
- Critical Point (see text)
- Underbank Channel Suspected

FIGURE 10. Wetlands Segments and Critical Evaluative Locations - Proposed Site

SOURCE: JEA Inc., 1993.

Jones Edmunds & Associates, Inc. JEA

Table 5. An Analysis of Wetland Area by Segments - Proposed Landfill Site

SEGMENT	NORMALLY CONNECTED TO WATERS-OF-THE-STATE	TOP OF BANK ELEVATION/AREA*	TOP OF BANK AREA ha / Acres
1-A	Indirect	1.83m(6 ft)/2645m^2 (28,432 ft ^{2})	0.26/0.65
Isolated Willow Wetlands	Not	1.83m($\pm$6 ft)/445m^2(4,785 ft^2)	0.045/0.11
1-B	Not	1.83m(6 ft)/2,984m^2(32,079 ft^2)	0.36/0.88
1-C	Indirect	1.83m(6 ft)2,099m^2(22,562 ft^2)	0.30/0.74
TOTALS	Not Connected	3,429m^2/(36,864 ft^2)	0.41/0.99
	Indirect Connection	4,743m^2/(50,994 ft^2)	0.56/1.39
2-A	Direct (SR Ditch - North)	1.83m(6 ft)/4,344m^2(46,698 ft^2)	0.43/1.07
2-B	Direct (Natural Wetland - South)	1.83m(6 ft)/4,369m^2(46,325 ft^2)	0.43/1.06
TOTALS	Direct Connection	8,653m^2(93,023 ft^2)	0.86/12/13
GRAND TOTAL			1.83/4.51

NOTES:

* Elevation in meters and feet. Area as hectares with square feet in parentheses. Areas as hectares and acres of surface.

CP1: This represents a disturbed area which appears to provide a normal rainfall divide between Segs 1-A and 1-B. An elevational difference in TOB elevation is observed between these two segments, although it may be insignificant for this analysis.

CP2: This location represents another higher elevation "hump" or divide between ditch Segs 1-B and 1-C. Thus, in all but the most extreme and extended rainfall events, Segs 1-A and 1-B appear to be isolated from the remainder of the system.

CP3: This is another high elevation "hump" like CP-2. No connection between Segs 1-C and 2-B were found by probing. No under berm connections to the adjacent southern marsh were detected which functionally appears to isolate Seg 1-C from the remainder of the system.

CP-4: This is a clear land bridge with no detected connection between Segs 2-A and 2-B. It was probably used as a road access to the eastern parts of the site. Once again no culvert or other physical connection between Segs 2-A and 2-B were detected by visual inspection and probing. Seg 2-A has a culvert connection to the Schwartz Road roadside ditch system at its northern terminus, and is thus connected to waters-of-the-state by this route. Seg 2-B also appears to be connected to waters-of-the-state by at least two "under berm" connections to adjacent wetlands to the south. These areas were probed for solid (culvert) connections but were not found. These "under berm" connections or tunnels appear to be maintained by flow occurring during periods of heavy rainfall, or when the southern wetlands have high water levels. Flow was detected between the southern wetland and the ditch system at the time of the team site inspection within Seg 2-B, but is believed to be temporary and rainfall dependent.

Segment 1-A has no obvious connection by culvert to the Schwartz Road ditch system. Observations made by Bionetics personnel on March 27, 1993, following heavy rainfall, indicated water flowing from the interior ditch to the Schwartz Road ditch. This is believed to be similar to "underberm" conncected, noted in Segment 2-B, to the south. This connection is called indirect since it only appears to occur during heavy rainfall (Figure 10). Segment 1-C is also given indirect designation since it appears to connect to Segment 2-B only when extreme rainfall may result in topping the earthern berm within the ditch.

Major portions of Segs 1-A, 1-B, and 1-C are heavily overgrown and canopy closure between the east and west banks is virtually 100 percent. Access by larger wading birds is difficult. Segments 2-A and 2-B, on the other hand is more open due to their greater bank to bank distance, and may allow better access for water oriented bird life.

These latter segments are virtually completely covered on the surface by duckweed (Lemna spp., Spirodella spp.), water fern (Azolla caroliniana) and salvinia (Salvinia spp.). The southern discontinuous ditch (i.e., parts of Segs 1-C and 2-B) is narrow and virtually completely overgrown as the segment one areas. Canopy closure nears 100 percent in this area as well.

Aquatic vegetation grows at the waters edge and either to top-of-bank, or to approximately one-half the distance from water surface to top-of-bank. Much of the support for this vegetation derives from roots in the water as well as the moist microclimate and nearly saturated soils found near the water surface. Aquatic or wetland indicator vegetation of the ditch banks is dominated by Brazilian pepper (Schinus terebinthifolius), willow (Salix sp.), water primrose (Ludwigia sp), and Osmunda ferns (Osmunda spp.)

Soils in these upland cut ditches are not regarded as hydric soils, but they are expected to have accumulated much organic matter in the bottom sediments over their 35 year history. Hydraulic connections to waters-of-the-state appear to be limited to ditch Segs 2-A and 2-B by either historic culvert or natural erosional tunnel connections.

Table 5 indicates that less than 1.83 ha (4.51 Ac) would be involved if all ditches were claimed as jurisdictional to top-of-bank.

Wet detention surface water management systems will be built to serve both the closed (existing) landfill as well as the needs of the proposed expansion site. The analysis of ditch segments and their real and potential connections to waters-of-the-state indicate that of the total of 1.83 ha (4.51 Ac) involved, 0.41 ha (0.99 Ac) is not connected, 0.56 ha (1.39 Ac) is indirectly connected through periodic high water connections, and only 0.86 ha (2.13 Ac) is directly connected.

Alternative # 1 No Action

This alternative will have no impact on the subject site area.

5.6 TERRESTRIAL COMMUNITIES

Proposed Action

Earlier clearing of this site has created a mosaic of habitats which are not normally natural in this area, except in disturbed areas (Figures 3 and 7).

Site preparation will eliminate the majority of the existing habitat from the site. Not all of this habitat is of equal value. Of the habitat that will be lost, some will be more favorable than others.

It is suggested that one of the reasons there is adequate scrub jay habitat here is precisely because of the combination of openings and scrub oaks (Ref. 13).

The USFWS biological opinion which as been rendered indicates that the proposed action "may effect" the scrub jay and indigo snake, but not the bald eagle. Specifics will be addressed below under the listed species.

Alternative # 1 No Action

This alternative results in a positive impact for the subject site since no habitat destruction would occur. The habitat would remain as a general wildlife habitat for songbirds, small mammals, reptiles, and amphibians (Appendix C). Listed species such as the scrub jay, indigo snake, and gopher tortoise would no doubt persist.

5.7 THREATENED AND ENDANGERED SPECIES

Proposed Action

The proposed action will eliminate 50-60 acres of previously disturbed scrub habitat which has grown in 35-40 years into useable, but less than optimum habitat for scrub jays (Ref. 7). However this site provides suitable habitat for other federally listed animal species. Compensation for the eliminated habitat has been suggested (Section 6.0).

Alligator: The United States Fish & Wildlife Service (USFWS) and/or the Florida Game and Fish Commission (FGFC) could affect a recovery program of these individuals which will involve removals and relocation. Once the ditches are filled in, the habitat will cease to exist and alligators are not expected to be found on the active areas of the site in the future.

Gopher Tortoise: The problem with the tortoise is similar to that of the indigo snake, in that accurate population estimates for the proposed site area are not presently available. Up to this time, it has been imagined that capture and relocation would provide the most realistic solution to the problem of their presence on site. The recent revelation that many populations of gopher tortoise are, or may be infected with a potentially deadly upper respiratory virus has resulted in scientists who specialize in tortoise biology questioning the wisdom of tortoise relocation strategies. This issue is not resolved at this time, and will be actively pursued throughout the conduct of this assessment, engineering design, and construction phases of the project (Refs. 4 and 31).

Indigo Snake: One advantage of the general site location is that Schwartz Road is not that well traveled so that random movements of general wildlife and potentially displaced individuals is not expected to result in abnormally high road related mortality. One exception to this is that, this local reach of Schwartz Road has been identified with some of the highest road-related mortality to snakes of any area on KSC (Ref. 31). Relocation may be an inappropriate term in light of the possible disease problem. Relocation nearby may become translocation, or pushing the animals out into the surrounding habitats. The biological opinion (USFWS, 1992) indicates that the proposed site has many of the habitat qualities typical for this species, and the possibility does exist that it will be found on site. Specific instructions include, if the snake is encountered, that construction personnel should be instructed not to harm the species and to permit it to move away from the disturbance.

No incidental take is authorized for this snake during project implementation (Ref. 43).

Bald Eagle: The proposed site is believed to be outside of any critical nest boundaries (Ref. 28). Although there are a few taller trees in the hammock to the northeast, these are not believed to have the potential to support eagle nesting due to the lack of suitable foraging habitat.

No impact to the eagle is anticipated as a result of the proposed action or its alterations (Refs. 6 and 43).

Scrub jay: A habitat model for the scrub jay has been developed and used by Breininger (Ref. 16). This model is useful in estimating the suitability of sites not under extensive demographic study. Site features of disturbed oak scrub show an abundance of scrub oaks and openings that approach optimal conditions but most vegetation is of marginal

height so that the overall suitability of disturbed oak scrub is moderate. Most remaining habitat types are of marginal suitability due to tall vegetation, sparse scrub oak cover, and the presence of few openings interspersed among scrub oaks (Ref. 7).

Typical scrub jay habitats at the proposed site are included in Table 6 (marked with an asterisk) and Figure 7, although the birds may use portions of other habitats.

The Incidental Take provisions of the Biological Opinion (Ref. 43) identify harassment and harm to the scrub jay through a combination of activities which create the likelihood of injury to a species by annoying it, or degrading or modifying its habitat to the extent that these disrupt or impair normal and essential behavioral patterns such as breeding, feeding, or sheltering. The Opinion thus anticipates incidental take in the form of harassment for six Florida scrub jays on the proposed site. Based on the USFWS review, the proposed action is not likely to jeopardize the existence of the Florida scrub jay or eastern indigo snake (see Appendix F).

Plants: No endangered or threatened plant species are believed to be in the proposed site area.

Alternative #1 - No Action

This assumes closure of the existing facility and no further alteration of habitat in this area.

Table 6. Habitats Occurring Within the Boundaries of the Proposed Landfill.

	Habitat Class	Active Landfill (ha)	Buffer Zone (ha)	Total Area (ha)
*1.	Undisturbed scrub	0.205	0.000	0.205
*2.	Disturbed oak scrub with > 30% open space	2.335	0.018	2.373
*3.	Disturbed oak scrub with < 30% open space	11.418	0.237	11.655
*4.	Disturbed oak scrub with grape vine cover	5.762	0.537	6.299
*5.	Mowed grass	0.364	0.000	0.364
*6.	Disturbed area with mixed shrubs and herbs	4.901	1.145	6.046
7.	Hammock/forest	0.110	0.021	0.131
8.	Swale	0.004	0.000	0.004
9.	Ditches	1.373	0.334	1.707
10.	Developed/cleared	0.855	0.107	0.962
	TOTAL	27.342	2.399	29.741

NOTE: Because of the differences in scale and resolution associated with aerial imagery and GIS analysis, the error for total area reported in Table 1 is approximately 1.85%. Approximately 70% of the landfill site is comprise of scrub oaks.

Source: Bionetics 1992, Biological Assessment

5.8 HISTORICAL AND ARCHEOLOGICAL RESOURCES

Proposed Action

There would be no impact due to the lack of any significant resources in this area (see Appendix D).

It is concluded that the proposed action will have not adverse impact to cultural resources eligible or potentially eligible for listing in the National Register.

The results of this investigation are presented in Appendix D.

Alternative #1 No Action

There would be no impact since there would be no disruption of the proposed action site.

5.9 FLOODPLAIN AND FLOOD ZONES

Proposed Action

Following construction of the new landfill, all possible historical overflow connections to local drainage would be broken. New discharge invert elevations would be designed and installed as part of the required Storm Water Management Plan and its facilities. Accepted design storm volumes will be used to determine detention volumes and invert elevations.

The project area is not regarded as a normal flood overflow zone, and consequently no loss of potential water storage capacity for the area is anticipated. Hydrologic studies and the staff of the SJRWMD generally confirm this belief.

Alternative #1 - No Action

No consequences of this action are foreseen for any of the alternatives.

5.10 NOISE

Proposed Action

The proposed action will create normal construction noise associated with earthmoving and weekly (or daily) cover of the landfill. As a result of the location and abundant vegetation buffering, noise is not recognized as a realistic impact. Low levels would be generated continually for the life of the landfill. This action is not expected to increase noise in the area beyond current levels since operations will cease at the SRLF once the proposed site is opened.

Typical noise levels produced by having earth moving equipment are highlighted in Table 3.

These values may be exceeded periodically as refuse is delivered, unloaded, compacted and covered.

Clearing and grubbing of the expansion site will result in higher noise levels during these operations, but is regarded as a short term impact of little consequence.

Alternative #1 No Action

This alternative removes sound generation from the area and transfers it elsewhere. The consequences would be lower noise levels than presently occur, and this can be viewed as a beneficial impact to native fauna, albeit of a very low degree, since local wildlife does not appear to be influenced by present noise levels.

5.11 INFRASTRUCTURE AND SERVICE

Proposed Action

The proposed action would continue to bring waste to the general site area and should not increase the haul truck fleet needs or roadway maintenance above current levels.

Alternative #1 No Action

This alternative transfers certain infrastructure needs to other areas on and off of KSC. The increased haul distances would increase total energy demands, may result in the need for additional vehicles, and should increase total O&M costs on these vehicles and roadways because of their increased use.

Calculations used in developing vehicular emissions (Section 5.1) were based on a minimum of 13 round trips of 54.4 miles per day. This is expected to create a significant additional negative impact on the roadways as well as posing an added hazard for general motorist safety.

Conditions at the County Landfill are not being assessed in this document. It is assumed that the County Operation will meet all existing permit and operational requirements.

5.12 SOCIO-ECONOMICS

Proposed Action

No socially oriented impacts are perceived for this action.

A mini-matrix is presented as Table 4 to compare the proposed action and its alternatives to each element. These are presented only as qualitative values.

Alternative #1 No Action

As discussed above. The no action alternative must take into consideration the activities at the Brevard County facility as well as those considerations listed in Table 4. Items of concern include a reduction in the anticipated life of that landfill, costs associated with reaching target capacity goals before expected, increased tipping fee costs, increased traffic in the next twenty years, how this might influence accident rates, etc. The no action or off-site disposal alternative could result in the loss of one or more jobs at the present site.

5.13 LAND USE

Proposed Action

The proposed action is consistent with the current land uses to the west of the proposed site. The site has been disturbed previously. The site is returning to some utility, but will never fully recover to valuable scrub habitat. The site is judged to have some utility for general wildlife as well as the listed species. Using this site for a landfill will have a negative impact on existing and some future wildlife.

A new or expanded capacity landfill is needed to adequately serve the NASA mission. The proposed site is viewed as being better for this purpose than any other site in the vicinity.

Alternative #1 No Action

The No Action alternative is believed to result in an initial positive, long term impact on KSC ecosystems in the area of the present SRLF site.

6.0 MITIGATION AND MONITORING

KSC has a scrub jay habitat policy which is best understood as a form of compensation banking. Having determined which areas of the facility are regarded as most valuable scrub jay habitat, the effort is directed toward adequate management for these areas. Thus, the large population of scrub jays north of the Vertical Assembly Building (VAB) and their associated habitat is currently being managed by limited clearing and periodic burning. The KSC scrub jay compensation plan uses a combination of mechanical means and fire to improve scrub habitats. Mechanical chopping is used to return scrub to a condition where it can be effectively managed with prescribed burns (Ref. 7). Even though the animals in the proposed site may not be destroyed, the project is "billed" for that amount of environmental damage and the effort at mitigation directed toward the aforementioned northern site. A copy of the KSC Compensation Plan is presented in Appendix E. This plan for scrub jay habitat loss compensation covers a variety of new construction activities of which the landfill is only one.

A Detailed Environmental Analysis of the Schwartz Road Landfill Expansion (Ref. 22) and a Biological Assessment for the New Landfill (Refs. 6 and 7) have been prepared and reviewed in the course of this assessment. Both of these documents are minimum treatments generally addressing the alternatives west and south of the existing landfill (former) and the proposed expansion site to the east (latter). They did not involve ground studies, although some observations on existing wildlife were made. Non-listed species were not addressed. The Biological Assessment addresses impacts to federally threatened and endangered species which may occur on site. The Biological Assessment attempts to quantify the value of habitat existing on the previously disturbed area and provides the basis for the USFWS Biological Opinion, and thus, it has the greatest relevance to this assessment.

A Biological Opinion (Ref. 43) has been rendered by the USFWS. This opinion is presented in its entirety as Appendix F, and is noted to include provisions for Section 7 of the Endangered Species Act of 1973, Taking of Endangered Species.

Additional mitigation activities which do not directly influence wildlife or habitats, per se, are summarized in Table 7. These activities relate to the spectrum of potential consequences which may influence the total environment.

The only monitoring which is contemplated at this time is that associated with the groundwater and surface water monitoring program required for the anticipated closure of the existing SRLF. Additional water quality monitoring will be required during the life of the proposed action, but has not been identified at this time.

While there is monitoring associated with the Scrub Compensation Program, those activities would be conducted elsewhere on KSC and not a part of proposed site activities.

Table 7. Summary of Proposed Mitigation Activities for Proposed Action (Page 1 of 3)

Affected Element	Major Consequences or Need for Action	Suggested Activities
Air	1. Mobile sources exhaust 2. Smoke 3. Fugitive dust	1. Keep engines tuned. 2. Pyrolytic temperature for burning. 3. Water tankers or watering devices for dust suppression.
Surface Water Quality	Surface Water Management Plan (SWMP)	1. Leachate will be controlled. 2. Stormwater/Retention controls. 3. Design of Landfill to manage stormwater in accordance w/SJRWMP and DER regulations. 4. Systematic operation controls time cells are open.
Groundwater Quality	Possible Leachate	1. Design of closure tends to prevent leachate generation. 2. Class III Landfills - restricts types of waste accepted to wastes that are not expected to produce leachate (DER 17-701.340 FAC, Jan. 1993). 3. Provide effective means to control types of waste accepted at landfill in accordance with DER regulations.
Geology	None	None

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Table 7. Summary of Proposed Mitigation Activities for Proposed Action (Page 2 of 3)

Affected Element	Major Consequences or Need for Action	Suggested Activities
Aquatic Communities	Main area - eliminated	1. Animals are common residents throughout Central Florida. 2. SWMP will create open water resources and beneficial replacement and supportive devices (perches, nesting, etc.).
Terrestrial	Eliminated	1. More grass in future - Communities integrated with E&T and future landfill operation.
Threatened and Endangered	1. Gopher Tortoise (State) 2. Indigo Snake (Fed) 3. Alligator (Fed) 4. Commensals (State) 5. Bald Eagle (Fed) 6. Wading birds (State) 7. Scrub jay (Fed)	1. Care in clearing/grubbing. 2. Care in clearing/grubbing. 3. USF&WS recovery - move. 4. Care in digging borrows. 5. Not really suitable habitat. 6. SWMP will create open water. 7. Compensation performed elsewhere on KSC
Historic and Archaeologic Resources	None of Record	1. None 2. If anything discovered during. site prep - SHPO will be notified. 3. May require Phase I testing.
Floodplains	None	None

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Table 7. Summary of Proposed Mitigation Activities for Proposed Action (Page 3 of 3)

Affected Element	Major Consequences or Need for Action	Suggested Activities
Noise	Construction Operation	1. Remote Location - No Impact. 2. Buffering will be established and/or augmented for aesthetics and noise.
Infrastructure and Services	None	None
Socio-economics	None	None
Land Use	Loss of diverse, previously disturbed habitat	1. Ultimate conversion to grass, aquatic and vegetation, and open water. 2. Activities may warrant some modification of adjacent land. 3. Could be beneficial to T&E species.

Source: JEA, 1993.

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7.0 REFERENCES INFORMATION

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APPENDICES

APPENDIX A

SURFACE AND GROUNDWATER CHEMISTRY

TABLE A-1. Surface Water Monitoring Data, Schwartz Road Landfill (NASA)

Date	pH	Temper.	Cond.	TDS	Turbid.	Color	DO	BOD	COD	TOC	NH3	NO3	TKN	Total Phosph.	Chloride	Sulfate	Alk. CaCO3
	S.U.	deg. C	umhos/c	mg/L	NTU	Pt-Co	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Station SS-11																	
Feb 91	7.1	21.2	400	350	2.40	100	1.3	-	71.7	27.9	0.05	0.02	1.04	0.05	40.1	6.64	220.4
May 91	7.8	26.7	900	388	6.08	100	1.9	-	107	32.3	0.29	<0.02	2.14	0.20	194.0	8.47	219.0
Aug 91	6.0	24.9	39.1	368	1.03	120	1.9	-	99	32.3	0.09	<0.02	0.97	0.07	29.1	6.20	227.0
Nov 91	6.9	-	-	428	8.04	120	-	-	82.6	32.7	0.47	<0.02	1.36	0.19	77.0	3.78	260.0
Feb 92	7.6	19.0	1000	374	3.21	120	-	-	148	11.5	0.21	<0.02	1.89	0.58	44.5	3.87	244.2
May 92	6.4	22.6	805	400	1.83	-	-	1.0	-	28.3	0.06	<0.02	-	-	-	-	221.0
Station SS-12																	
Feb 91	5.8	18.9	800	589	4.44	200	2.0	-	187	78.3	1.27	0.03	2.37	0.13	93.1	19.8	248.0
May 91	7.1	25.1	400	196	16.55	600	1.7	-	195	77.8	0.97	0.05	1.99	0.19	29.3	2.59	<1.0
Aug 91	5.4	24.0	21.4	434	5.54	240	2.2	-	189	27.3	3.74	<0.02	1.81	0.20	62.6	15.8	219.0
Nov 91	6.5	-	-	604	3.49	160	-	-	197	68.7	6.79	<0.02	1.15	0.30	82.2	13.1	335.0
Feb 92	7.0	18.0	1500	474	2.73	80	-	-	296	67.0	5.63	0.02	3.74	0.87	58.3	17.7	248.5
May 92	6.2	21.1	948	466	39.8	-	-	12.0	-	63.5	5.69	<0.02	-	-	-	-	216.0
Station SS-13																	
Feb 91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 91	6.7	25.4	500	162	4.37	600	1.8	-	201	75.1	0.34	0.03	2.83	0.17	29.8	3.52	<1.0
Aug 91	4.4	32.1	2.6	72	1.46	500	2.4	-	171	65.6	0.73	0.02	1.28	0.09	18.5	8.79	<1.0
Nov 91	5.2	-	-	254	1.54	240	-	-	127	55.2	3.59	0.03	0.04	0.07	333	18.6	14.4
Feb 92	7.1	20.0	800	185	5.16	240	-	-	405	39.6	3.10	0.04	0.73	0.27	25.7	13.8	14.0
May 92	5.3	20.4	276	186	1.46	-	-	5.0	-	55.0	1.52	<0.02	-	-	-	-	6.2
Station SS-14																	
Feb 91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 91	5.0	28.8	5.2	158	3.43	600	1.5	-	258	77.8	0.20	0.05	2.58	0.32	23.2	2.48	<1.0
Nov 91	4.1	-	-	174	14.2	600	-	-	225	68.7	0.52	<0.02	2.35	0.11	15.7	2.52	<1.0
Feb 92	7.1	20.0	770	195	232	960	-	-	112	65.2	6.52	<0.02	1.96	0.84	29.4	5.72	<1.0
May 92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- NOT SAMPLED (DRY) OR NOT ANALYZED

TABLE A-1. Surface Water Monitoring Data, Schwartz Road Landfill (NASA)

Date	Na	Ni	Ag	As	Cd	Cr	Hg	Pb	Se	Cu	Fe	Z
	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Station SS-11												
Feb 91	24.6	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	<2.0	224	<10.0
May 91	27.0	<60.0	<70.0	<50.0	0.21	<40.0	<0.20	<3.00	<10.0	<2.0	538	<10.0
Aug 91	18.5	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	4.0	158	<10.0
Nov 91	28.4	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	<2.0	474	16.0
Feb 92	19.9	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	5.0	469	<10.0
May 92	25.4	-	-	-	-	-	-	-	-	-	170	-
Station SS-12												
Feb 91	56.0	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	<2.0	297	<10.0
May 91	20.2	<60.0	<70.0	<50.0	1.18	<40.0	<0.20	<3.00	<10.0	4.0	820	26.0
Aug 91	40	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	<3.0	372	<10.0
Nov 91	43.4	<60.0	<70.0	<50.0	0.105	<40.0	<0.20	<3.00	<10.0	8.0	269	16.0
Feb 92	35.5	<0.06	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	4.0	366	<10.0
May 92	39.2	-	-	-	-	-	-	-	-	-	260	-
Station SS-13												
Feb 91	-	-	-	-	-	-	-	-	-	-	-	-
May 91	19.8	<60.0	<70.0	<50.0	0.11	<40.0	<0.20	<3.00	<10.0	4.0	410	17
Aug 91	13.8	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	4.0	789	15
Nov 91	35.2	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	6.0	264	13
Feb 92	16.5	<60.0	<70.0	<50.0	0.17	<40.0	<0.20	<3.00	<10.0	0.0	1.04	62
May 92	19.0	-	-	-	-	-	-	-	-	-	200	-
Station SS-14												
Feb 91	-	-	-	-	-	-	-	-	-	-	-	-
May 91	-	-	-	-	-	-	-	-	-	-	-	-
Aug 91	13.9	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	6.0	163	<10.0
Nov 91	6.64	<60.0	<70.0	<50.0	<0.10	<40.0	<0.20	<3.00	<10.0	<2.0	107	<10.0
Feb 92	14.0	<60.0	<70.0	<50.0	0.52	<40.0	<0.20	46	<10.0	2.0	568	72
May 92	-	-	-	-	-	-	-	-	-	-	-	-

- NOT SAMPLED (DRY) OR NOT ANALYZED

TABLE A-2. Groundwater Monitoring Data, Schwartz Road Landfill (NASA)

Date	pH	Cond.	TDS	Turbid.	TOC	NH3	NO3	TKN	Chloride	Sulfate	BAK	Ca	Mg	K	Fe	Mn	Z	Na
	S.U.	umhos/c	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Well MW-2																		
Feb 89	5.8	1350	780	6.9	15	2.0	<0.02	0.88	60	108	536	210	9.2	12.9	>0.90	0.030	0.010	0
May 89	6.1	1160	60	1.2	13	3.3	<0.02	0.46	62	50	86	154	6.5	18.1	0.22	0.020	0.010	0
Aug 89	6.2	1367	780	9.0	31	3.2	0.02	0.53	99	53	536	200	8.8	20.1	0.02	0.030	0.017	58.57
Nov 89	6.2	1290	730	0.9	16	3.2	0.20	0.18	85	30	529	145	8.2	18.5	0.24	0.030	0.020	54.50
Feb 90	6.3	1195	790	10.0	32	2.4	0.00	0.84	78	51	595	196	9.7	16.2	1.15	0.030	0.10	58
May 90	6.7	1210	730	3.0	20	1.9	0.20	0.40	53	84	580	204	8.4	17.3	0.94	0.033	0.05	57
Aug 90	7.0	1210	650	6.6	17	1.7	0.10	0.85	34	87	480	195	6.9	10.0	0.95	0.030	0	54
Nov 90	7.1	1080	555	0.5	14	2.6	0.10	0.35	32	74	485	175	5.7	15.5	0.61	0.320	0	36
Feb 91	6.3	1120	690	5.0	17	3.7	0.05	0.51	35	87	490	181	6.8	15.9	0.62	0.325	0	35
May 91	6.6	965	610	2.7	16	3.3	0.00	0.02	43	74	405	150	8.7	18.5	0.43	0.320	0	36
Aug 91	6.20	1100	690	6.73	16.10	3.17	<0.02	0.560	63.2	60.90	485.0	192.00	11.80	20.30	0.526	<0.020	<0.010	39.60
Nov 91	7.60	1180	704	5.98	16.40	14.60	0.06	0.220	51.1	73.70	495.0	169.00	8.42	20.80	0.303	<0.020	<0.010	39.20
Feb 92	7.10	1076	723	2.18	28.00	2.78	0.04	0.540	53.5	69.70	489.1	147.00	7.01	20.50	0.29	<0.020	<0.010	30.90
May 92	7.61	-	710	4.26	87.80	3.08	<0.02	-	-	-	497.0	-	7.38	-	0.38	-	-	33.40
Well MW-3																		
Feb 89	5.8	1800	1080	3.2	85	14.0	1.30	0.9	112	22	815	291	15.8	27	0.261	0.020	0.010	0
May 89	6.1	1750	1048	1.4	76	16.1	<0.02	6.3	77	28	170	219	12.9	28	0.223	0.030	0.010	0
Aug 89	6.3	1688	1120	4.5	83	14.9	<0.02	4.1	68	25	815	295	12.7	29	0.220	0.020	0.012	48.57
Nov 89	6.2	1650	1050	8.8	82	15.7	<0.02	4.9	68	38	825	222	13.0	31	0.243	0.030	0.010	50.00
Feb 90	6.3	1350	1015	7.9	15	15.2	<0.2	0.4	60	16	812	247	12.0	25.8	0.44	0.030	<0.2	37
May 90	6.3	1420	860	7.0	64	14.5	<0.2	1.1	63	13	788	310	12.4	29.8	0.27	0.025	<0.2	40
Aug 90	6.5	1480	986	6.9	54	15.3	<0.2	1.3	67	15	300	240	10.8	31.3	0.25	0.030	<0.2	38
Nov 90	6.8	520	775	0.7	43	13.8	<0.2	1.1	70	41	770	244	12.1	22.9	0.26	0.020	<0.2	42
Feb 91	6.2	1540	960	11.2	60	13.9	<0.2	4.7	67	41	780	308	12.0	21.3	0.26	0.027	<0.2	40
May 91	6.7	1600	980	7.0	56	2.9	<0.2	9.9	68	12	800	288	12.1	19.2	0.17	0.020	<0.2	41
Aug 91	6.00	1670	1000	19.40	78.40	14.00	0.04	0.630	65.9	1.67	827.0	238.00	13.90	30.20	0.317	0.290	<0.010	40.30
Nov 91	7.30	1550	1060	24.20	81.80	7.07	0.03	15.400	66.1	2.30	768.0	266.00	12.00	34.60	0.150	0.022	0.018	42.50
Feb 92	7.40	1508	1064	2.15	85.60	10.79	0.07	6.740	65.3	2.30	836.6	228.00	10.60	21.10	0.19	0.022	<0.010	36.00
May 92	7.25	-	1030	2.65	79.10	15.60	<0.02	-	-	-	817.0	-	11.60	-	0.44	-	-	36.90

- NOT ANALYZED OR SAMPLED * ANALYSES FROM FEB 89 TO MAY 91 EXTRAPOLATED FROM QUARTERLY GROUNDWATER MONITORING REPORT GRAPHS

TABLE A-2. Groundwater Monitoring Data, Schwartz Road Landfill (NASA)

Date	pH	Cond.	TDS	Turbid.	TOC	NH3	NO3	TKN	Chloride	Sulfate	BAK	Ca	Mg	K	Fe	Mn	Z	Na
	S.U.	umhos/c	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Well MW-4																		
Feb 89	6.4	1195	755	0.70	54	0.83	<0.02	1.4	125	5	430	167	9.6	0.69	0.350	<0.020	<0.010	0
May 89	6.3	1205	745	1.70	49	0.87	<0.02	1.65	122	11	90	153	8.3	0.68	0.356	<0.020	<0.010	0
Aug 89	6.4	1150	782	2.15	56	0.83	<0.02	1.68	120	9	453	178	8.5	0.72	0.336	<0.020	<0.010	55.50
Nov 89	6.9	1100	764	3.50	63	0.78	<0.02	1.92	122	7	438	142	7.7	0.78	0.375	<0.020	<0.010	49.80
Feb 90	6.1	950	730	2.0	16	0.85	<0.2	2.0	110	10	448	148	7.2	0.95	0.28	0.020	<0.2	44
May 90	6.9	1020	680	1.0	54	0.81	<0.2	1.7	108	9	444	179	8.3	0.70	0.45	0.020	<0.2	58
Aug 90	7.2	1040	705	1.9	53	0.58	<0.2	2.2	112	1	400	166	7.3	1.70	0.35	0.020	<0.2	56
Nov 90	7.2	1030	435	9.5	60	0.72	<0.2	1.7	97	<1	438	165	7.8	0.81	0.41	0.020	<0.2	54
Feb 91	6.7	1130	710	7.3	57	0.71	<0.2	2.1	106	<1	450	175	7.9	0.80	0.87	0.020	<0.2	56
May 91	6.9	1120	755	5.1	55	0.88	<0.2	2.2	100	<1	438	152	6.6	0.69	0.27	0.020	<0.2	57
Aug 91	6.60	1060	714	3.41	56.20	0.91	0.02	1.180	1.5	<1.00	445.0	191.00	7.32	0.685	0.398	<0.020	<0.010	52.70
Nov 91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb 92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 92	7.58	-	786	2.26	56.70	0.87	<0.02	-	-	-	454.0	-	7.70	-	0.75	-	-	48.70
Well MW-6																		
Feb 89	5.1	74	71	0.55	24	0.48	<0.02	0.5	15	18	11	4.25	1.02	0.92	245	<0.020	<0.010	0
May 89	4.6	80	77	3.00	19	0.53	<0.02	103	16	20	10	4.20	1.07	0.88	335	<0.020	<0.010	0
Aug 89	6.0	128	86	0.90	49	0.47	<0.02	0.5	20	18	82	4.80	1.24	0.97	270	<0.020	0.011	64.00
Nov 89	5.5	83	80	2.35	19	0.52	<0.02	0.5	18	22	7	3.25	1.03	1.83	335	<0.020	<0.010	52.50
Feb 90	6.1	83	81	9.0	16	0.45	<0.2	0.59	13	13	7.3	4.2	1.58	1.30	0.32	0.020	<0.2	77
May 90	5.3	74	88	4.0	20	0.43	<0.2	0.39	10	11	7.1	3.8	1.32	0.93	0.27	0.010	<0.2	72
Aug 90	5.7	91	75	1.4	18	0.35	<0.2	0.43	9	7	3.8	3.2	1.30	1.21	0.47	0.020	<0.2	6
Nov 90	5.8	81	50	6.2	19	0.33	0.2	0.48	8	5	10.3	3.7	1.30	0.98	0.44	0.020	<0.2	70
Feb 91	5.4	79	98	8.7	26	0.35	<0.2	0.02	8	4	6	3.1	1.10	0.83	0.35	0.020	<0.2	60
May 91	5.3	69	69	4.8	22	0.31	<0.2	0.38	6	4	5.6	2.5	1.05	0.72	0.24	0.020	<0.2	48
Aug 91	6.50	46	74	1.96	24.30	0.35	0.03	0.420	4.6	2.14	5.6	2.74	0.876	0.595	0.221	<0.020	<0.010	4.52
Nov 91	5.90	52	66	3.84	24.70	0.25	0.03	0.460	4.4	<1.00	7.8	2.88	0.848	0.582	0.183	<0.020	0.022	3.32
Feb 92	6.60	56	122	2.71	24.70	0.38	<0.02	0.620	5.0	<1.00	8.7	3.94	0.80	0.689	0.30	<0.020	<0.010	3.08
May 92	5.47	-	76	1.42	16.00	0.43	<0.02	-	-	-	21.5	-	<1.00	-	5.45	-	-	2.64

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TABLE A-2. Groundwater Monitoring Data, Schwartz Road Landfill (NASA)

Date	pH	Cond.	TDS	Turbid.	TOC	NH3	NO3	TKN	Chloride	Sulfate	BAK	Ca	Mg	K	Fe	Mn	Z	Na
	S.U.	umhos/c	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Well MW-7																		
Aug 91	6.10	696	488	8.22	31.20	1.08	<0.02	1.160	33.8	114.00	193.0	91.40	6.61	8.260	0.501	0.04	0.033	20.40
Nov 91	6.40	394	266	46.80	16.50	4.07	0.02	3.460	32.8	35.40	121.0	41.60	4.82	2.860	0.318	<0.020	<0.010	14.60
Feb 92	6.60	510	448	2.22	31.40	1.37	0.03	1.530	49.8	64.90	138.7	61.90	7.35	3.520	0.60	<0.020	<0.010	19.40
May 92	6.04	-	348	11.80	5.38	1.94	<0.02	-	-	-	142.0	-	6.50	-	1.63	-	-	19.40
Well MW-8																		
Feb 89	4.9	590	440	1.2	45	13.9	0.80	5.9	70	55	132	16.5	0.54	29	0.245	<0.020	0.012	0
May 89	4.7	590	505	0.9	355	15.8	0.10	2.0	65	85	120	14.8	0.43	23	0.190	<0.020	<0.010	0
Aug 89	4.4	575	495	1.8	310	13.8	0.05	10.9	180	65	135	19.9	0.40	23.5	0.275	<0.020	0.052	69.00
Nov 89	5.9	1580	910	1.1	320	14.8	<0.02	7.7	65	45	110	15.1	0.42	18.5	0.262	<0.020	0.028	61.50
Well MW-9																		
Feb 89	4.6	62	72	2.4	16.0	0.57	<0.02	0.47	16	3	4.9	0.58	1.00	2.7	0.210	<0.020	<0.010	0.00
May 89	4.5	70	75	14	13.3	0.67	<0.02	0.70	16	6	6.5	0.88	0.61	1.9	1.480	<0.020	<0.010	0.00
Aug 89	5.1	62	72	2.1	16.1	0.68	<0.02	0.46	17	3	9.6	0.71	0.44	2.4	0.330	<0.020	0.011	5.40
Nov 89	5.0	63	70	1.2	15.3	0.69	<0.02	0.29	16	8	3.8	0.58	0.48	3.2	0.180	<0.020	<0.010	4.90
Feb 90	5.8	54	56	6.8	22.2	0.67	<0.2	0.64	11	8	4.7	0.55	0.52	2.6	0.50	0.020	<0.2	45
May 90	4.8	53	44	3.0	13.7	0.70	<0.2	0.23	9	6	3.8	0.88	0.55	2.6	0.36	0.020	<0.2	65
Aug 90	5.2	70	56	2.3	14.2	0.60	<0.2	0.36	10	3	4.2	0.77	0.53	3.1	0.22	0.020	<0.2	6
Nov 90	5.4	56	44	5.7	14.3	0.61	<0.2	0.45	9	2	1.0	0.57	0.69	2.2	1.17	0.020	<0.2	57
Feb 91	4.7	64	57	6.1	14.5	0.65	<0.2	0.20	9	2	4.8	1.17	0.50	2.0	0.60	0.020	<0.2	59
May 91	5.2	68	75	3.2	14.2	0.62	<0.2	0.40	11	2	7.8	1.52	0.66	2.4	0.20	0.020	<0.2	66
Aug 91	4.70	92	92	15.70	14.80	0.85	<0.02	0.190	11.5	1.23	3.3	1.37	0.604	2.18	0.944	<0.020	<0.010	6.40
Nov 91	4.40	58	70	32.70	15.50	0.72	<0.02	0.610	27.1	<1.00	3.6	0.48	0.421	3.26	0.115	<0.020	<0.010	4.88
Feb 92	6.90	70	74	2.53	25.10	0.71	0.03	0.500	9.6	1.35	4.4	1.52	0.46	2.09	0.14	<0.020	<0.010	4.79
May 92	6.57	-	62	1.58	14.90	0.80	0.16	-	-	-	8.9	-	<1.00	-	0.11	-	-	5.10

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TABLE A-2. Groundwater Monitoring Data, Schwartz Road Landfill (NASA)

Date	pH	Cond.	TDS	Turbid.	TOC	NH3	NO3	TKN	Chloride	Sulfate	BAK	Ca	Mg	K	Fe	Mn	Z	Na
	S.U.	umhos/c	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Well MW-10																		
Feb 89	5.7	148	95	0.8	2.6	0.06	<0.02	0.3	16	8	40	16	0.62	0.57	1.260	<0.020	<0.010	0
May 89	5.8	161	105	5.2	1.9	0.10	<0.02	0.1	16	8	47	25	0.98	0.59	2.280	<0.020	<0.010	0
Aug 89	5.9	162	105	3.7	5.3	0.15	0.20	1.1	17	9	52	21	0.70	1.22	1.340	<0.020	0.060	8.30
Nov 89	6.2	236	145	2.9	2.2	0.07	<0.02	0.1	15	23	86	44	0.77	0.45	0.620	<0.020	0.014	7.80
Feb 90	6.2	258	193	15	12	0.1	<0.2	0.45	22	9	120	43	0.8	0.6	2.6	0.020	<0.2	82
May 90	6.1	186	105	8	4	0.3	<0.2	0.35	20	10	56	22	0.9	0.6	2.1	0.020	<0.2	102
Aug 90	6.5	458	272	10	39	0.8	<0.2	0.87	51	20	133	48	1.8	1.4	1.2	0.020	<0.2	37
Nov 90	6.4	1150	586	25	21	3.6	0.6	1.07	138	2	370	137	5.7	1.9	6.0	0.020	<0.2	88
Feb 91	6.1	858	594	51	98	1.3	<0.2	1.03	88	2	275	107	2.5	1.6	8.0	0.020	<0.2	66
May 91	5.2	615	414	19	80	0.3	<0.2	1.93	100	2	115	47	1.7	2.3	1.8	0.020	<0.2	68
Aug 91	5.60	1100	958	50.40	193.00	2.92	<0.02	0.890	140.0	<1.00	299.0	99.00	2.450	3.36	5.350	<0.020	<0.010	113.00
Nov 91	4.90	1155	914	101.00	286.00	12.38	0.02	1.450	131.0	<1.00	319.0	117.00	5.110	34.20	9.040	0.04	<0.010	95.50
Feb 92	7.10	756	640	14.09	119.00	4.70	0.03	2.180	113.9	7.01	87.2	57.90	3.88	8.35	0.92	<0.020	<0.010	62.60
May 92	5.19	-	664	5.32	245.00	5.39	0.16	-	-	-	163.0	-	4.92	-	0.99	-	-	66.80
Well MW-11																		
Feb 89	4.9	79	33	0.8	0.8	0.14	<0.02	0.14	17	3	6.2	0.41	1.28	2.49	0.520	<0.020	<0.010	0
May 89	4.2	77	56	4.6	1.2	0.12	<0.02	0.34	16	3	6.3	0.81	1.12	2.20	0.650	<0.020	<0.010	0
Aug 89	5.1	72	56	1.6	4.2	0.12	0.40	0.05	16	5	5.6	0.92	0.89	3.20	0.780	<0.020	<0.010	7.30
Nov 89	5.3	62	70	0.4	1.7	0.13	<0.02	0.02	14	8	6.6	1.15	0.87	3.25	0.790	<0.020	<0.010	6.30
Feb 90	6.2	60	41	42.5	2.5	0.11	<0.2	0.32	11	7	5.2	0.84	0.87	3.75	5.8	0.020	<0.2	52
May 90	5.2	64	37	2.5	1.7	0.08	<0.2	0.17	11	6	6.5	0.80	1.27	2.70	1.1	0.020	<0.2	63
Aug 90	5.7	133	88	2.0	2.6	0.09	<0.2	0.10	28	7	6.2	0.75	1.40	3.25	1.2	0.020	<0.2	7
Nov 90	6.0	880	41	12.0	3.9	0.09	<0.2	0.12	12	5	6.5	1.47	1.66	2.60	3.1	0.020	<0.2	78
Feb 91	5.9	85	38	24.5	2.3	0.07	<0.2	0.13	13	7	4.2	1.26	1.65	3.10	3.8	0.020	<0.2	80
May 91	5.1	90	54	2.0	1.1	0.09	11.3	0.02	15	4	1.0	0.74	1.20	2.30	0.9	0.020	<0.2	73
Aug 91	6.50	75	57	0.74	3.42	0.20	0.04	0.080	14.9	<1.00	4.5	0.64	1.280	1.98	0.892	<0.020	<0.010	7.67
Nov 91	5.60	88	70	3.08	3.57	0.13	0.02	0.190	18.5	7.60	4.6	0.69	1.290	2.42	1.200	<0.020	0.015	8.75
Feb 92	7.60	101	64	30.40	11.80	0.33	0.03	0.450	28.0	<1.00	1.3	1.42	1.31	2.46	7.24	<0.020	<0.010	8.80
May 92	4.29	-	60	1.34	7.19	0.28	0.02	-	-	-	16.6	-	1.34	-	1.61	-	-	12.00

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Table A-3. Ambient Conditions of the Groundwater at the Kennedy Space Center

SubAquifer		PRIME RECHARGE AREA			DUNE-SWALE			WEST PLAIN		
Parameter	Drinking Water Stds.	Upper	Inter-mediate	Lower	Upper	Inter-mediate	Lower	Upper	Inter-mediate	Lower
INORGANICS										
Chlorides	(S) 250	28	232	80	102.75	317	3734	41.40	307.00	1020.00
Manganese	(S) 0.05	<0.03	<0.042	<0.037	<0.03	<0.04	<0.04	<0.05	<0.05	0.08
Nitrate	(P) 10	<0.02	<0.01	<0.06	<0.03	<0.01	<0.04	<0.05	<0.05	<0.01
Sodium	(P) 160	14.00	128.00	39.60	79	265	1936	31.10	104.61	407.00
Sulfate	(S) 250	19.30	13.00	14.60	22	16	250	19.05	26.70	33.00
PHYSICAL PARAMETERS										
TDS	(S) 250	167	868	559	550	1361	6046	403	1071	2544
pH	(S) 6.5	6.70	7.57	7.49	7.26	7.62	7.60	7.18	7.65	7.55
Alkalinity		16	371	352	182	269	321	210	333	346
TRACE METALS										
Arsenic	(P) 0.05	<0.05	<0.05	<0.05	<0.64	<0.05	<0.05	<0.056	0.06	<0.05
Barium	(P) 1.	<0.70	<0.07	<0.70	<1.0	<1.0	<0.7	<0.01	<1.0	<0.7
Cadmium	(P) 0.01	<0.012	<0.012	<0.17	<0.01	<0.01	<0.017	<0.01	<0.01	<0.14
Chromium	(P) 0.05	<0.04	<0.04	<0.02	<0.05	<0.04	<0.02	<0.05	<0.05	<0.04
Copper	(S) 1.	<0.05	<0.02	<0.03	<0.10	<0.04	<0.03	<0.10	<0.02	<0.05
Iron	(S) 0.30	<0.62	6.10	1.58	3.35	4.50	1.50	5.88	3.20	5.20
Lead	(P) 0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	(P) 0.002	<0.001	<0.001	<0.002	<0.001	<0.001	<0.0011	<0.002	<0.002	<0.001
Selenium	(P) 0.01	<0.02	<0.03	<0.02	<0.05	<0.044	<0.04	0.04	<0.01	0.07
Silver	(P) 0.05	<0.027	<0.03	<0.05	<0.027	<0.03	<0.03	<0.05	<0.05	<0.03
Zinc	(S) 5.	<0.14	<0.032	<0.03	<0.04	<0.03	<0.036	<0.05	<0.05	<0.03
Gross Alpha(pCi/l)	(P)15	5.50	4.70	11.70	10.70	4.30	8.20	13.00	4.26	5.85
Fecal Coliform(n/.1l)	(P)1	<10	<10	<15	<15	<12	<17	<10	<10	<10

ALL CONCENTRATIONS EXPRESSED IN mg/l UNLESS OTHERWISE NOTED.
Source: Ref. 4-4

APPENDIX B

FISHES WHICH MAY BE FOUND IN OR NEAR THE PROPOSED SITE IN SELECTED HABITATS

APPENDIX B

FROM FISH FAUNA OF THE KSC AREA[1] MODIFIED TO REFLECT POSSIBLE SPECIES ON PROPOSED SITE

I. Salinity Regime

(M) - Mesohaline >15 ppt
(O) - Oligohaline 1-14 ppt
(F) - Fresh <1 ppt

II. Habitat Types

Ditches (D)	Man-made ditches and canals
Impoundments (I)	Mosquito Control Improundments
Ponds (P)	Man-made borrow ponds, flooded swales, fresh marsh roadside ditch (RD) along Schwartz Road.

III. Relative Abundance

R - Rare	5 or fewer specimens
O - Occasional	Collected or observed at irregular intervals
F - Frequent	Observed or collected on numerous occasions or recorded in large percentage of collections from the appropriate habitat.
C - Common	Present in virtually every collection from the appropriate habitat
A - Abundant	Common species present in large numbers
D - Doubtful	Not likely, but possible

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[1] Adapted from: Snelson, F.F., Jr. 1983. Ichthyfauna of the Northern part of the Indian River Lagoon System, Florida. Florida Scientist. 46: 187-206

FISHES OF KSC WATERS (1 of 3)
SELECTED HABITATS

	HABITAT		
	D	I	P
Lepisosteidae - Gars			
Florida Gar (F,O) *Lepisosteus platyrhincus*	F	F	F
Amiidae - Bowfins			
Bowfin (F) *Amia calva*			O
Anguillidae - Freshwater Eels			
American Eel (M,O) *Anguilla rostrata*	O		
Clupeidae - Herrings			
Gizzard Shad (M,O) *Dorosoma cepedianum*	O		
Cyprinidae - Minnows			
Golden Shiner (F) *Notemigonus crysoleucas*	F	F	F
Catostomidae - Suckers			
Lake Chubsucker (F) *Erimyzon sucetta*	F	F	F
Ictaluridae - Bullhead Catfishes			
Yellow Bullhead (F) *Ictaluris natalis*	O	O	O
Cyprinodontidae - Killifishes			
Golden Topminnow (F) *Fundulus chrysotus*	F	F	F
Marsh Killifish (O,M) *Fundulus confluentus*	F	F	D

FISHES OF KSC WATERS (2 of 3)
SELECTED HABITATS

	HABITAT		
	D	I	P
Seminole Killifish (F,O) *Fundulus seminolis*	O	O	O
Flagfish (F) *Jordinella floridae*	F	F	F
Bluefin Killifish (F) *Lucania goodei*	C	C	C
Rainwater Killifish (O,M) *Lucania parva*	A	A	
Poeciliidae - Livebearers			
Mosquitofish (F,O,M) *Gambusia affinus*	A	A	A
Least Killifish (F) *Heterandria formosa*	F	F	F
Sailfin Molly (M,O,F) *Poecilia latipinna*	A	A	R
Centropomidae - Snooks			
Snook (M,O) *Centropomus undecimalis*	D		
Centrarchidae - Sunfishes			
Warmouth (F) *Lepomis gulosus*	F	F	F
Bluegill (F) *Lepomis macrochirus*	C	C	C
Dollar Sunfish (F) *Lepomis marginatus*	O	O	O
Redear Sunfish (F) *Lepomis microlophus*	F	F	F
Spotted Sunfish (F) *Lepomis punctatus*	R		

FISHES OF KSC WATERS (3 of 3)
SELECTED HABITATS

	HABITAT		
	D	I	P
Largemouth Bass (F,O) *Micropterus salmoides*	F	F	F
Black Crappie (F) *Pomoxis nigromaculatus*		R	D
Mugilidae - Mullets			
Striped Mullet (M,O) *Mugil cephalus*	RD	RD	
Gobiidae - Gobies			
Clown Goby (M,O,) *Microgobius gulosus*	D	D	
Soleidae - Soles			
Hogchoker (O) *Trinectes maculatus*	D	F	

Source: KSC-DF-3080

APPENDIX C

TERRESTRIAL FLORA AND FAUNA OF KSC RELATIVE TO PROPOSED SITE AND SURROUNDING HABITAT

APPENDIX C

FAUNAL COMPOSITION IN MAJOR HABITAT TYPES

C.1 WILDLIFE/HABITAT/OCCURRENCE ASSOCIATIONS

The following species lists are correlated to major habitat types at the John F. Kennedy Space Center (KSC) and the relative occurrence of each species within each habitat type is indicated. These lists were prepared from literature reviews and field surveys at KSC (Ref. 10).

TABLE	TITLE
C-1	Amphibian Habitat Associations
C-2	Reptilian Habitat Associations
C-3	Breeding Bird Habitat Associations
C-4	Non-Breeding Winter Bird Habitat Associations
C-5	Transient Bird Habitat Associations
C-6	Mammalian Habitat Associations
C-7	Selected Anticipated Vertebrate Species At Proposed Site

C.2 HABITAT DESCRIPTIONS

Brief descriptions of the major habitat types used in this association model are provided below.

CANALS, DITCHES, BORROW PITS: Primarily man-made drainage systems and lakes.

OPEN WATER IMPOUNDMENTS: Mosquito control impoundments which are managed by flooding. These systems exhibit variable water depths, salinities, and vegetative regimes.

KSC-DF-3080

FRESHWATER MARSH: Intermittently flooded depressions often dominated by beardgrass (Andropogon spp.), cordgrass, sawgrass (Cladium jamaicense) and cattail (Typha, spp.)

MIXED SWAMP: Freshwater wetlands dominated by mixed hardwood species including red maple-red bay-laurel oak (Acer rubrum - Persea Borbonia - Quercus laurifolia), cabbage palm, and willow (Salix caroliniana) swamp.

HAMMOCK: Predominantly upland communities consisting of cabbage palm (Sabal palmetto), live oak-cabbage palm, southern red cedar-live oak (Juniperus silicicola - Q. virginiana) and live oak-pignut hickory (Q. virginiana - Carya glabra) associations.

SLASH PINE: Upland habitats dominated by slash pine-oak scrub (Pinus elliottii - Quercus spp.) and slash pine-saw palmetto (Pinus elliottii - Serenoa repens) associations.

SCRUB STRAND: Upland habitats comprised on mixed oak-saw palmetto (Q. virginiana, Q. myrtifolia, Q. chapmanii - S. repens), saw palmetto, and saw palmetto-sea grape (S. repens-Coccoloba uvifera) communities.

WAX MYRTLE, BRAZILIAN PEPPER: Typically monoculture systems which establish following disturbance to vegetation and soils.

RUDERAL GRASS: Generally maintained grass areas adjacent to roadways, buildings, and utility corridors.

Source: Adapted from: Breininger, David R. 1985b. Wildlife/Habitat Association Model and Bibliography for John F. Kennedy Space Center, Florida. NASA/KSC biomedical Office. John F. Kennedy Space Center, Florida. (KSC-DF-3080)

Table C-1. Amphibian Habitat Associations

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Eastern Spadefoot		C	O	O	P			?	
Greenhouse Frog		C	C	P	?				
Oak Toad		O	C	C	P	C		P	P
Southern Toad		C	C	C	P	C		C	C
Florida Cricket Frog	C	C	C			C	P	C	C
Green Treefrog	C	C	C	R	R	C		R	C
Pine Woods Treefrog	C		C			?		P	
Barking Treefrog		R	R		R		R	P	
Squirrel Treefrog	O	O	O	O	P	O	P	P	O
Little Grass Frog	P	C	C			P			O
Florida Chorus Frog		P	C			P		C	P
Eastern Norrowmouth Toad		C	C	C		P		C	O
Pig Frog	R	C	P			C	P		C
Southern Leopard Frog	C	C	O			C	P		C
Eastern Lesser Siren	R					R			R
Greater Siren	O					C	?		O
Two-toed Amphiuma	C					C			R

C = Common
O = Occasional
R = Rare
P = Abundance Unknown
? = Presence Questionable

Table C-2. Reptilian Habitat Associations (Page 1 of 3)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
American Alligator	R					C	O		O
Florida East Coast Terrapin						O	P		
Atlantic Loggerhead									
Atlantic Green Turtle									
Atlantic Ridley									
Atlantic Leatherback									
Florida Snapping Turtle	R					C	P		R
Striped Mud Turtle	C					O	P		C
Florida Mud Turtle	C					O	P		C
Florida Cooter	R					C	P		O
Florida Chicken Turtle	R					C	P		O
Florida Box Turtle	O	O	C	C	P			P	O
Gopher Turtle		R	C	C	P			O	
Florida Softshell						C	P		R
Green Anole	C	C	C	C	C	P	P	P	P
Six-lined Race-runner		O	C	C	C			R	
Southeastern Five-lined Skink		O	O	O	O			O-?	
Ground Skink	R	O	O	O	P			P	
Eastern Slender Glass Lizard		P	P	P	P			O	?
Island Glass Lizard		?	?	?					
Eastern Glass Lizard	O	R	O	?		?		O	O
Florida Scarlet Snake	R	O	O	O	P			P	

Table C-2. Reptilian Habitat Associations (Page 2 of 3)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Southern Black Racer	R	C	C	C	C	R	R	C	O
Southern Ringneck	R	R	R	R	R			R	R
Eastern Indigo Snake	O	O	O	O	O			O	O
Corn Snake	O	C	O	O	O			P	
Yellow Rat Snake	C	C	O					P	
Eastern Mud Snake	C					C			C
Eastern Hognose Snake		R	R	R	R			R	
Florida Kingsnake	P		R						C
Scarlet King-Snake			C	O	P				
Eastern Coachwhip	R	R	O	C	P			P	
Florida Green Water Snake	C					O	P		C
Banded Water Snake	C					C	P		C
Florida Water Snake									
Mangrove Water Snake						Rr	Pr		
Atlantic Salt Marsh Snake						Rr	Rr		
Pinewoods Snake	R		R	R	R				
Rough Green Snake	C	O	O	O	P	C		P	C
Florida Pine Snake		R	R	O	P			P	
Striped Crayfish Snake	R			C	C	R	R	C	R
Florida Brown Snake	R			R	R	R	R	R	R
Eastern Garter Snake	O	O	C	O	O	C	P	O	O
Peninsular Ribbon									

Table C-2. Reptilian Habitat Associations (Page 3 of 3)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Snake	C		O	O	O	C	P	P	C
Eastern Coral Snake	?	?	?					P	
Florida Cotton Mouth	O					C	P		O
Eastern Diamondback				R	R			R	
Eastern Diamondback Rattlesnake	O	O	C						O
Dusky Pigmy Rattle-snake	O	O	C	O	P				

C = Common
O = Occasional
R = Rare
P = Abundance Unknown
? = Presence Questionable
n = Habitat utilized for nesting
r = Use of habitat partially restricted to certain conditions within the habitat type, for example: edges, shallow water, mud flats, open water, dense emergent cover or recent burns.
a = Species uses airspace; habitat may be used to provide insects, carrion, thermals; or use of airspace may bear little or no relation to the habitat type.
i = Use spoil islands for nesting or resting.
c = Colonial nesting bird.
w = Generally nests near water in woody vegetation, cavities, emergents, or in banks depending on specific habitat requirements so that other vegetation types than those listed may be used for nesting if adjacent to the water.

Table C-3. Breeding Bird Habitat Associations (Page 1 of 4)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Pied-billed Grebe [w]						Cn	Cn		
Brown Pelican [ciw]						Or	Or		
Double-crested Cormorant [ciw]						Or	Cr		
American Anhingal [iw]						C	Or		
Green Heron [iw]						Cnr	Cn		
Great Blue Heron [ciw]						Cr	C		
Great Egret [ciw]						Cr	C		
Cattle Egret [ciw]						Cr	Or	C	
Snowy Egret [ciw]						Cr	C	R	
Louisiana Heron [ciw]						Cr	C		
Reddish Egret							R		
Wood Stork [ciw]						Cr	C		
Little Blue Heron [ciw]						Or	O		
Black-crowned Night Heron [ciw]						Or	O		
Least Bittern [w]									
Glossy Ibis [ciw]						Cr	Cr		
White Ibis [ciw]	C					Cr	C		C
Mottled Duck [iw]						Or	On		
Wood Duck [sw]	Rnr					Rr	Rr		
Black Vulture	Ca	Capn	Cap	Ca	Ca	Ca	Ca	Ca	Ca
Turkey Vulture	Ca	Capn	Cap	Ca	Ca	Ca	Ca	Ca	Ca
Red-tailed Hawk		R	On	R	R			O	
Red-shouldered Hawk	On	Cn	O	O	R			O	O
Osprey [w]			O			O	C		R
Bald Eagle [w]			On			R	O		Rr
Common Bobwhite	Rr	R	Cn	Cn	C		Rr	C	
Wild Turkey	R	P	P	P				P	
Common Moorhen [w]	Rr					Cn	Cn		Cn
Clapper Rail [w]									R

Table C-3. Breeding Bird Habitat Associations (Page 2 of 4)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Black Rail [w]						Rr	R		R
King Rail									O
American Oystercatcher [1]									
Wilson's Plover							O		
Killdeer							Cn	C	Or
Willet [iw]							Cn	Cn	
Black-necked Stilt						R	Cn		Rr
Laughing Gull [ciw]						O	C	C	R
Gull-billed Tern [ciw]				R		O	O		R
Least Tern [ciw]						R	C		
Royal Tern [ciw]							C		
Caspian Tern [ciw]							O		
Black Skimmer [ciw]						O	C		
Rock Dove								R	
Common Ground Dove	Rr	R	Onr	Onr	Onr		Rr	C	Rr
Mourning Dove	Rr	R	Cn	On	On		Rr	C	Rr
Yellow-billed Cuckoo	On	On	O	R	R				
Barn Owl [s]	On	On	O	O	?	O	O	O	O
Barred Owl [s]	Cn	On				P	P		P
Great Horned Owl	R	P	On	P	?	P	P	C	P
Screech Owl [s]	pn	Cn	On	Cn	P			P	
Chuck-will's-widow	P	Cna	Cna	Onra	Pa	P	P	Pa	P
Common Nighthawk	Ca	Ca	Ca	Ca	Ca	Ca	Cn	Can	Ca
Chimney Swift	P					P	P	Pn	P
Belted Kingfisher [w]						C	C		Or
Common Flicker	R	R	Cn	Cn	C		R	R	R
Pileated Woodpecker [s]	Onr	On	On	R					

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Table C-3. Breeding Bird Habitat Associations (Page 3 of 4)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Red-bellied Woodpecker [s]	Cn	Cn	Cn	On				R	
Downy Woodpecker [s]	R	R	On						
Eastern Kingbird				Rr	Rr		Or	R	
Great Crested Flycatcher [c]	Rn	Rn	Cn	R	R				
Purple Martin	R	Ra	Ra	Ra	Ra	R	R	Ra	R
Blue Jay	On	On	Cn	Orn	O			R	R
Scrub Jay	R	R	On	Cn	R			Cr	R
Fish Crow [1]	R	Rn	On	R	R	R	R	R	R
Carolina Wren	Cn	Cn	Cn	Cn	Cn				Rn
Northern Mockingbird		R	On	On	O			Cn	
Brown Thrasher		R	On	On	O			R	
Blue-grey Gnatcatcher	R	R	R	R	R				
Loggerhead Shrike			R	R			O	O	?
Euopean Starling							C		
White-eyed Vireo	Onr	On	Cn	Cn	Cn				R
Black-Whiskered Vireo		R							
Pin Warbler			On						
Prairie warbler			O	O	O				
Common Yellowthroat	O	O	C	C	R				Cn
Yellow-breated Chat [?]			R	R	R				
House Sparrow			R	R				Cn	
Eastern Meadowlark			R					Cn	R
Red-winged Blackbird [w]	Rnr	R	On	O	O	Cn	Cn	O	Cn
Boat-tailed Grackle [w]	Rn	R	?	Rr	Or	C	Cn	C	C
Common Grackle	O	On	On	O	O	O	O	C	O
Summer Tanager [?]	R	R	R						

Table C-3. Breeding Bird Habitat Associations (Page 4 of 4)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Northern Cardinal	Cn	Cn	Cn	Cn	Cn			R	R
Blue Grosbeak [?]	Rr		R	R	R				
Indigo Bunting [?]	R	R	R	R	R			R	
Painted Bunting [?]	R	R	R	R	R			R	
Rufous-sided Towhee	R	R	Cn	Cn	Cn			R	R
Backman's Sparrow			Rn	Rn					

C = Common
O = Occasional
R = Rare
P = Abundance Unknown
? = Presence Questionable
n = Habitat utilized for nesting
r = Use of habitat partially restricted to certain conditions within the habitat type, for example: edges, shallow water, mud flats, open water, dense emergent cover or recent burns.
a = Species uses airspace; habitat may be used to provide insects, carrion, thermals; or use of airspace may bear little or no relation to the habitat type.
i = Use spoil islands for nesting or resting.
c = Colonial nesting bird.
w = Generally nests near water in woody vegetation, cavities, emergents, or in banks depending on specific habitat requirements so that other vegetation types than those listed may be used for nesting if adjacent to the water.

Table C-4. Non-Breeding Winter Bird Habitat Associations (Page 1 of 5)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Common Loon									
Red-throated Loon									
Horned Grebe									
American White Pelican						Or	O		
Magnificent Frigatebird									
Yellow-crowned Night Heron	?					Or	O		O
American Bittern									O
Roseate Spoonbill							O		
Mallard						Rr	O		Or
American Black Duck						Rr	R		Rr
Gadwall						Rr	O		Or
Common Pintail						Or	C		Or
Green-winged Teal						Rr	O		Or
Blue-winged Teal						Cr	C		Cr
American Wigeon						Or	C		Cr
Northern Shoveler						Or	C		Cr
Canvasback									
Bufflehead									
Common Goldeneye									
Oldsquaw									
White-winged Scoter									
Redhead							?r		
Ring-necked Duck							Cr		
Lesser Scaup							C		
Greater Scaup							R		
Surf Scoter									
Ruddy Duck							R		

Table C-4. Non-Breeding Winter Bird Habitat Associations (Page 2 of 5)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Hooded Merganser							C		
Red-breasted Merganser									
Swallow-tailed Kite	R						R		R
Sharp-skinned Hawk	R	R	O	R	R		R	R	
Cooper's Hawk	O	O	R	R	R			R	
Northern Harrier			O	O			C	O	C
Peregrine Falcon						Rr	R	?	
Merlin		R	R	O	R		R	R	
American Kestrel	Rr	R	Or	Or	R	Or	C	C	Cr
Limpkin	R					Rr			
Virginia Rail							O		R
Sora						R	R		R
American Coot						C	C		O
Semipalmated Plover							Cr		
Piping Plover						R	R		
Black-bellied Plover							C		
Ruddy Turnstone							c		
American Woodcock	R	R						Rr	
Common Snipe						Or	C	Or	C
Long-billed Curlew							R		
Whimbrel							R		
Spotted Sandpiper						Or	O		R
Greater Yellowlegs								C	R
Lesser Yellowlegs							C		R
White-rumped Sandpiper							O		
Least Sandpiper							C		

Table C-4. Non-Breeding Winter Bird Habitat Associations (Page 3 of 5)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Dunlin							C		
Short-billed Dowitcher							C		
Western Sandpiper							C		
Marbled Godwit							R		
Sanderling							C		
American Avocet							C		
Herring Gull						R	C	Rr	R
Ring-billed Gull						R	C	Rr	R
Bonaparte's Gull						R	O		R
Greater Black-back Gull						R	R		
Sandwich Tern							C		
Forester's Tern							C		
Common Tern									
Black-billed Cuckoo	R								
Smooth-billed Ani								R	
Short-eared Owl								R	R
Whip-poor-will	R	R	R						
Ruby-throated Hummingbird	O	R	R	R	R				
Red-headed Wood-pecker	R	R	R						
Yellow-bellied Sapsucker	O	O	O	Or					
Hairy Woodpecker	R	R	R	R					
Eastern Phoebe	O					C	R		R
Gray Kingbird									
Acadian Flycatcher	R								
Tree Swallow	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca

Table C-4. Non-Breeding Winter Bird Habitat Associations (Page 4 of 5)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Rough-winged Swallow	Oa	Oa	Oa	Oa	Oa	Oa	O	Oa	Oa
Tufted Titmouse	R	R	Rr						
House Wren	Rr	Or	C	C	R			Or	
Sedge Wren									R
Gray Catbird	C	Or	C	C	C			Rr	Rr
American Robin	C	R	C	C	C			C	R
Ruby-crowned Kinglet	C	O	C	C	O				
Water Pipit								R	R
Cedar Waxwing	R	R	R	R	R				
Yellow-throated Vireo	O	O	R	R	R				
Solidary Vireo	O	O	R	R	R				
Orange-crowned Warbler	O	Or	O	O	R			Rr	
Northern Parula Warbler	R	R	R						
Yellow-rumped Warbler	C	R	C	C	C	O	R	C	C
Yellow-throated Warbler	O	R							
Palm Warbler	R					R	R	R	R
Ovenbird	O	R	R		R				
Brown-headed Cowbird			R	R	?			R	
Pine Siskin								O	
American Goldfinch			Rr					R	
Savannah Sparrow						R	C		R
Grasshopper Sparrow									
Henslow's Sparrow			Rr				R	R	R

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Table C-4. Non-Breeding Winter Bird Habitat Associations (Page 5 of 5)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Sharp-tailed Sparrow						Rr	Or		
Seaside Sparrow						Rr	Or		
Lark Sparrow								R	
Chipping Sparrow	R	R	R	R	R			O	
Field Sparrow			Rr	R	R			R	Rr
Fox Sparrow	R	R	R	R	R				
Swamp Sparrow	R					C		Rr	C
Song Sparrow	R		R	R	R	R		C	R

C = Common
O = Occasional
R = Rare
P = Abundance Unknown
? = Presence Questionable
n = Habitat utilized for nesting
r = Use of habitat partially restricted to certain conditions within the habitat type, for example: edges, shallow water, mud flats, open water, dense emergent cover or recent burns.
a = Species uses airspace; habitat may be used to provide insects, carrion, thermals; or use of airspace may bear little or no relation to the habitat type.
i = Use spoil islands for nesting or resting.
c = Colonial nesting bird.
w = Generally nests near water in woody vegetation, cavities, emergents, or in banks depending on specific habitat requirements so that other vegetation types than those listed may be used for nesting if adjacent to the water.

Table C-5. Transient Bird/Habitat Associations (Page 1 of 3)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
American Flamingo							R		
Greater Shearwater									
Audobon's Shearwater									
Wilson's Storm-Petrel									
Northern Gannet									
Canada Goose							R		
Brant							R		
Snow Goose							R		
Fulvous Tree Duck							R		
Broad-winged Hawk	R		R						R
Swainson's Hawks[s]								R	
Parasitic Jaeger									
Pomarine Jaeger									
Upland Sandpiper							R	Rr	
Solitary Sandpiper	R					O	O		R
Pectoral Sandpiper							O		O
Stilt Sandpiper							C		
Semipalmated Sand-piper							C		
Wilson's Phalarope						R	R		R
Northern Phalarope									
Black-legged Kittiwake									
Roseate Tern									
Sooty Tern									
Bridled Tern									
Western Kingbird								R	R
Adler Flycatcher	R								R
Least Flycatcher	R	Rr	Rr	Rr	Rr				
Bank Swallow	Oa	Oa	Oa	Oa	Oa	Oa	Oa	Oa	Oa
Barn Swallow	Oa	Oa	Oa	Oa	Oa	Oa	Oa	Oa	Oa

Table C-5. Transient Bird/Habitat Associations (Page 2 of 3)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Cliff Swallow	Oa	Oa	Oa	Oa	Oa	Oa	Oa	Oa	Oa
Wood Thrush	R	R	R						
Swainson's Thrush	O	R							
Gray-cheeked Thrush	0	O							
Veery	O	O							
Red-eyed Vireo	O								
Black-and-White Warbler	C	O	R						
Prothonotary Warbler	O	R	R						
Swainson's Warbler	R	R			R				
Worm-eating Warbler	O	R			O				
Tennessee Warbler	O				R				
Nashville Warbler	R	R			R				
Yellow Warbler	O	R	R	R	R				R
Magnolia Warbler	O	R	R	R	R				
Black-throated Blue Warbler	O	O			O				
Black-throated Green Warbler	O	O			O				
Blackburnian Warbler	O	O	O	O	O				
Chestnut-sided Warbler	R	R	R	R	R				
Bay-breasted Warbler	O	O							
Blackpoll Warbler	O	O							
Northern Waterthrush	R	O	R	R	O	R			R
Louisiana Waterthrush					R				
Hooded Warbler		O							
American Redstart		C	O	R	R				
Cape May Warbler									
Kentucky Warbler									
Connecticut Warbler		R			R			R	
Bobolink								R	
Orchard Oriole		R	R	R	R			R	
Northern Oriole		R		R	R				

Table C-2. Reptilian Habitat Associations (Page 3 of 3)

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Snake	C		O	O	O	C	P	P	C
Eastern Coral Snake	?	?	?					P	
Florida Cotton Mouth	O					C	P		O
Eastern Diamondback				R	R			R	
Eastern Diamondback Rattlesnake	O	O	C						O
Dusky Pigmy Rattle-snake	O	O	C	O	P				

C = Common
O = Occasional
R = Rare
P = Abundance Unknown
? = Presence Questionable
r = Use of habitat partially restricted to certain conditions within the habitat type, for example: edges, shallow water, mud flats, open water, dense emergent cover or recent burns.

Table C-6. Mammalian/Habitat Associations

COMMON NAME	MIXED SWAMP	HAMMOCK	SLASH PINE	SCRUB STRAND	WAX MYRTLE BRAZILIAN PEPPER	CANALS DITCHES BORROW PITS	OPEN WATER IMPOUND-MENTS	RUDERAL GRASS	FRESH WATER MARSH
Virginia Opossum	C	O	O	C	P	O	O	C	O
Least Shrew		O	R	C	P			P	R
Eastern Mole		O	R	C	P			P	
Nine-Banded Armadillo	O	C	C	R	P	P	P	C	O
Eastern Cottontail		R	O	C	P			C	
Gray Squirrel	O		R						
Marsh Rice Rat	P	C	R			O	P		O
Cotton Mouse	C	R	O	C	P	P		O	C
Cotton Rat	R	C	C	O	P	P		C	C
Beach Mouse		O		R					
Florida Mouse			R	C					
Golden Mouse		O	O	R	P				
Round-tailed Muskrat						R			R
Black Rat				P	?			P	
Gray Fox	R	?	R	O	?			O	
Raccoon	C	C	C	O	P	Cr	C	C	C
Eastern Spotted Skunk			?	C	?			?	
River Otter	R					O	O		R
Bobcat	R	R	O	C	P	P	O	C	O
Wild Board	C	C	C	C	C	C	C	C	C
White-tailed Deer	R	R	R	R	R				
Eastern Pipistrelle	O	P	P					R	R
Black Bear	?	R	R	R	R		?	R	?

C = Common
O = Occasional
R = Rare
P = Abundance Unknown
? = Presence Questionable
r = Use of habitat partially restricted to certain conditions within the habitat type, for example: edges, shallow water, mud flats, open water, dense emergent cover or recent burns.

Table C-7. Selected Anticipated Vertebrate Species Based on Walk-Over Determination (Bionetics, 1992)

[to be included later]

APPENDIX D

LETTERS TO AND FROM THE FLORIDA STATE HISTORIC PRESERVATION OFFICER AND RELAT ED HISTORIC AND ARCHEOLOGICAL INVESTIGATIONS

KSC-DF-3642

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State

DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

December 10, 1991

Ms. Joan Deming, Vice President
Archaeological Consultants Incorporated
P.O. Box 5103
Sarasota, Florida 34277-5103

In Reply Refer To:
Denise M. Breit
Historic Sites
Specialist
(904) 487-2333
Project File No. 913192

RE: Cultural Resource Assessment Review Request
Archaeological Survey to Establish Zones of Archaeological Potential (ZAPs) in the Launch Complex Area (Option 1) of the Kennedy Space Center. By Joan Deming, November 1991.

Dear Ms. Deming:

We have reviewed the results of the field survey of the above referenced project, and find them to be complete and sufficient. We note that 8 previously unidentified archaeological sites, two of which are potentially eligible for listing in the National Register (8BR913 and 8BR914), were located during the course of this survey. We also note that six sites were previously recorded for the Launch Complex Area. Of these, two could not be relocated (8BR61 and 8BR84), two had already been sufficiently studied so they were not reevaluated (8BR170 and 8BR773), and two were reevaluated (8BR79 and 8BR774). Of these latter two, 8BR774 was concluded to be potentially eligible for listing in the National Register. This office concurs with these recommendations.

The several blocks of land referred to on page 6 which were surrounded by deep and wide ditches or interior wetlands should be subjected to Phase I testing prior to development since they are described as being desirable for survey. We note that this course of action is addressed in the Site Management section of the report.

Finally, we have also reviewed the locations and descriptions of those areas designated as High and Moderate Zones of Archaeological Potential as well as the site management recommendations for the Launch Complex Area and concur with your suggestions.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's archaeological and historic resources is appreciated.

Sincerely,

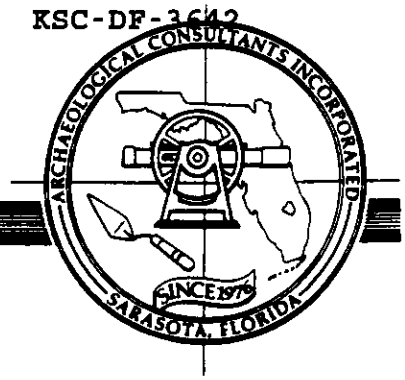
Suzanne P. Walker

for George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb

KSC-DF-3642

ARCHAEOLOGICAL
CONSULTANTS
INCORPORATED



ARCHAEOLOGICAL
SURVEYS AND
EXCAVATION

HISTORICAL
RESEARCH
AND
DOCUMENTATION

CULTURAL
RESOURCE
MANAGEMENT

ADA/DRI's

IMPACT
ASSESSMENTS

LOCAL GOVT
COMPREHENSIVE
PLANS

February 26, 1993

Ms. Laura Kammerer
Division of Historical Resources
R.A. Gray Building
500 S. Bronough
Tallahassee, Florida 32399-0250

RE: Cultural Resource Assessment Survey of a Proposed Landfill Site, Kennedy Space Center, Brevard County, Florida.

Dear Laura:

Enclosed find a summary letter report detailing the results of a small cultural resource assessment survey in Brevard County. This project was conducted on behalf of Jones Edmunds & Associates, Inc., Gainesville.

The proposed landfill site measures approximately 65 acres in areal extent. Within this acreage, a linear ridge in the southwest portion of the tract was previously identified, during survey of the Launch Complex Area of the KSC (ACI 1991), as having a moderate site location potential. Survey efforts focused within this zone, as well as other better drained localities identified in the field. Ground surface reconnaissance and the excavation of 42 standard sized shovel test pits did not result in the discovery of archaeological sites, either prehistoric or historic. Thus, we concluded that proposed land alteration will have no adverse impact to cultural resources eligible or potentially eligible for listing in the National Register.

On behalf of our client, we would appreciate a review of this project. If you have any questions, please do not hesitate to contact us. Thank you for your attention to this matter.

Sincerely,

Joan Deming

Joan Deming
Vice President

cc: Dr. Richard M. Matter

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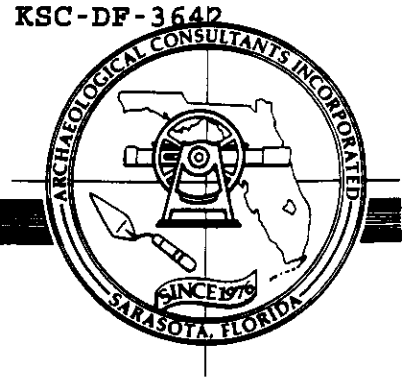

February 26, 1993

Dr. Richard M. Matter
Jones Edmunds & Associates, Inc.
730 North Waldo Road
Gainesville, Florida 32601

RE: Cultural resources assessment survey of a 65 acre proposed landfill site, Kennedy Space Center, Brevard County, Florida.

Dear Dr. Matter:

On February 22-24, 1993, Archaeological Consultants, Inc. (ACI) conducted a systematic, professional archaeological and historical survey of a proposed landfill site at the Kennedy Space Center in Brevard County. The location of the project tract is identified in Figure 1. The purpose of this survey was to locate and assess the significance of any cultural resources present, in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended by Public Law 89-655; the Archaeological and Historic Preservation Act, as amended by Public Law 93-291; Executive Order 11593; and Chapter 267, Florida Statutes. All work was carried out in conformity with the standards contained in "The Historic Preservation Compliance Review Program of the Florida Department of State, Division of Historical Resources" manual (Revised September 1990).

No new cultural resources were discovered within the proposed landfill property. Thus, it is recommended that clearance be given for project development without further archaeological considerations. This letter report summarizes the survey findings.

Introduction: The proposed landfill site, comprised of approximately 65 acres, is situated in the southeast quarter of Section 20, Township 22 South, Range 37 East (USGS Orsino, Fla., 1976). It is bordered on the north by Schwartz Road, and at the west by an existing landfill area. The KSC Industrial Area lies two miles to the south.

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Prior to land alteration (cultivation and ditching), the survey tract would have been largely characterized by nearly level and poorly drained land. Today, more xeric conditions prevail. Examination of Sheet Number 28 of the Brevard County Soil Survey (Huckle et al. 1974) indicated that Immokalee sand is the predominant soil type. Immokalee sand is a "nearly level, poorly drained sandy soil in broad areas in the flatwoods, low ridges between sloughs, and in low, narrow areas between sand ridges and lakes and ponds" (Huckle et al. 1974:26). It supports a natural vegetation of saw palmetto, gallberry, longleaf and slash pine, and wiregrass. Quartzipsamments, smoothed are "nearly level to steep sandy soils that have been reworked and shaped by earthmoving equipment" (Huckle et al. 1974:39). This soil type is found along the drainage ditches. Better drained soil of the Pomello sand type is characteristic of the southwest corner of the tract, and along the west and east property boundaries. A north/south trending ridge of Pomello sand is also contained in the northwest quarter of the tract. Pomello sand is described as a "nearly level, moderately well drained sandy soil on broad low ridges and low knolls" which supports a natural vegetation of scattered longleaf pine and an undergrowth of scrubby live oak, saw-palmetto, and native grasses (Huckle et al. 1974:38).

Examination of a 1962 aerial map (Manned Lunar Landing Program Area Mosaic Sheet MLM-D4) indicated that the entire landfill property was once an orange grove, marked by three north/south trending, water-filled ditches. Today, the citrus trees are no longer extant. Prior ditching, cultivation, tree removal, and the deposition of spoil in some localities have caused considerable disturbance to the project tract. The existing vegetation is primarily scrub oak, with pine, cedar, wax myrtle, willow, and a dense understory of grape and smilax. The elevated, sandy zones contain some xeric vegetation, including prickly pear cactus and reindeer moss and other lichens in patchy open areas.

Background Research and Project Considerations: In 1991, the area surrounding the existing Schwartz Road landfill was included as part of a larger archaeological survey of the 20,000 acre Launch Complex Area of the Kennedy Space Center, performed by ACI under contract with EG&G Florida, Inc. This work was, in turn, part of a three year study to establish zones of archaeological potential (ZAPs) within the Kennedy Space Center, on behalf of the National Aeronautics and Space Administration (NASA). Predictive model survey in the

vicinity of the existing landfill area resulted in the discovery of one archaeological site, located about one mile south of the current survey tract. This cultural resource, assigned the Florida Site File number 8Br913, was evidenced by a thin surface and subsurface deposit of aboriginal pottery and animal bone. It was tentatively classified as a seasonal or short-term campsite dating to the St. Johns period, circa 500 B.C to A.D 1565 (ACI 1991:19). The general site area is coterminous with a broad, low ridge adjacent to a freshwater marsh. Pomello sand is the local soil.

On the basis of the results of archaeological survey, differential zones of high, moderate and low archaeological site location potential were defined for the Launch Complex Area. For example, Moderate ZAPs were defined as including interior ridge tops and slopes characterized by moderately well to well drained soil of the Pomello, Paola, Orsino, and/or Tavares types, proximate (within 200 meters) to a freshwater source (ACI 1991:10). Among the specific localities within the Launch Complex Area identified as a Moderate ZAP was a linear ridge of Pomello sand extending into the southeast quarter of Section 20 in Township 37 South, Range 22 East (ACI 1991 Figure 2a:8). This site probability zone falls within the southwest portion of the proposed landfill area. The remainder of the present survey tract was considered a Low ZAP in ACI's 1991 study.

Thus, on the basis of this background research, the southwest part of the survey tract, characterized by Pomello sand, was considered to have the greatest potential for archaeological site occurrence. The remaining acreage was deemed to have low site expectancy. Sites, if found, were expected to be small camps, evidenced by a low density artifact scatter. No historic period sites or features were anticipated.

Field Survey Methodology: Field survey efforts were initially planned to focus on the areas of better drained soil within the proposed landfill tract, including the acreage largely coterminous with the area marked as a Moderate ZAP in the KSC Launch Complex Area report (ACI 1991:8). The remainder of the tract, deemed to have a low site potential, would be archaeologically sampled with a lesser degree of effort.

Field survey tactics included an intensive ground surface reconnaissance of all sandy exposures within and outside the Moderate ZAP. Notably, this initial inspection of the overall tract indicated that the linear ridge marked as a Moderate ZAP in the KSC Launch Complex Area report was not clearly defined in the southwest quadrant of the proposed landfill area. Further, other areas of relatively elevated, better drained land were observed within the study property. Thus, the survey strategy, initially designed to focus solely on the southwest quarter of the property, was modified accordingly to include all well drained land.

Following the search for surface cultural materials, a total of 42 subsurface shovel tests were excavated. These were placed such that all accessible areas of better drained soil, both inside and outside the original ZAP, were archaeologically sampled. Overall, approximatley 80% of the better drained land throughout the proposed landfill site was investigated. Of the total 42 test pits, 35 were spaced at approximate 50 meter intervals within the areas of better drained land; seven were placed at 100 meter intervals and at judgementally determined locales throughout the remainder of the tract (Figure 2). Previously cleared land survey lines facilitated archaeological survey and testing throughout the thickly vegetated tract.

All shovel tests measured approximately 50 centimeters in diameter by at least one meter in depth. All soil removed was screened through one-quarter inch mesh hardware cloth to maximize the recovery of cultural materials present. Following data recording, all holes were refilled, and their locations plotted on the aerial map provided by Jones Edmunds and Associates, Inc. (submitted with this report). Areas of ground surface inspection are also indicated.

Results: Archaeological field survey did not result in the discovery of new cultural resources. Subsurface shovel testing revealed the typical stratigraphic profile as an upper horizon of disturbed mottled medium or dark gray/tan sand over a light tan to white sand. Prehistoric or historic cultural materials were neither observed on the ground surface, nor recovered from the test pits.

Conclusions and Recommendations: Based upon the results of field survey, it is the conclusion of Archaeological

Consultants, Inc. that no cultural resources eligible or potentially eligible for listing in the National Register of Historic Places are located within the proposed landfill site. Thus, development of the landfill area will have no adverse impact to significant archaeological or historical sites. It is recommended that proposed landfill development be permitted to proceed without further archaeological or historical considerations.

On behalf of ACI, thank you for this opportunity to be of professional service. We have forwarded a copy of this letter report for review to Ms. Laura Kammerer, Florida Division of Historical Resources. You will be notified of the results of the SHPO's review. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,

Joan Deming

Joan Deming
Vice President

cc: Laura Kammerer, FDHR

References Cited

Archaeological Consultants, Inc.
1991 Archaeological Survey to Establish Zones of Archaeological Potential (ZAPs) in the Launch Complex Area (Option 1) of the Kennedy Space Center. Manuscript on file, NASA, Environmental Management, KSC.

Huckle, Horace F., Hershel D. Dollar and Robert F. Pendleton
1974 Soil Survey of Brevard County, Florida. United States Department of Agriculture, Soil Conservation Service, Washington, D.C.

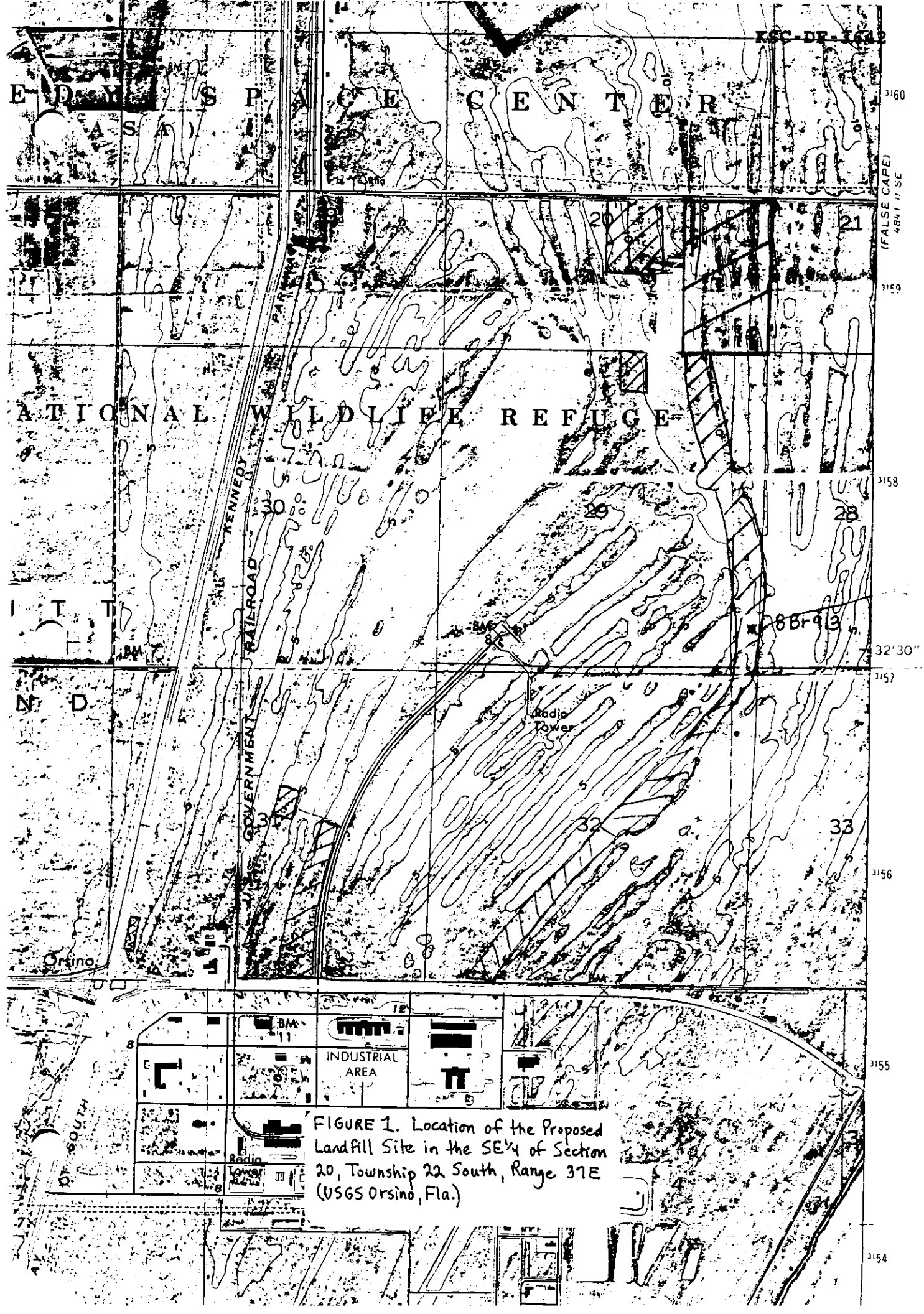

FIGURE 1. Location of the Proposed Landfill Site in the SE¼ of Section 20, Township 22 South, Range 37E (USGS Orsino, Fla.)

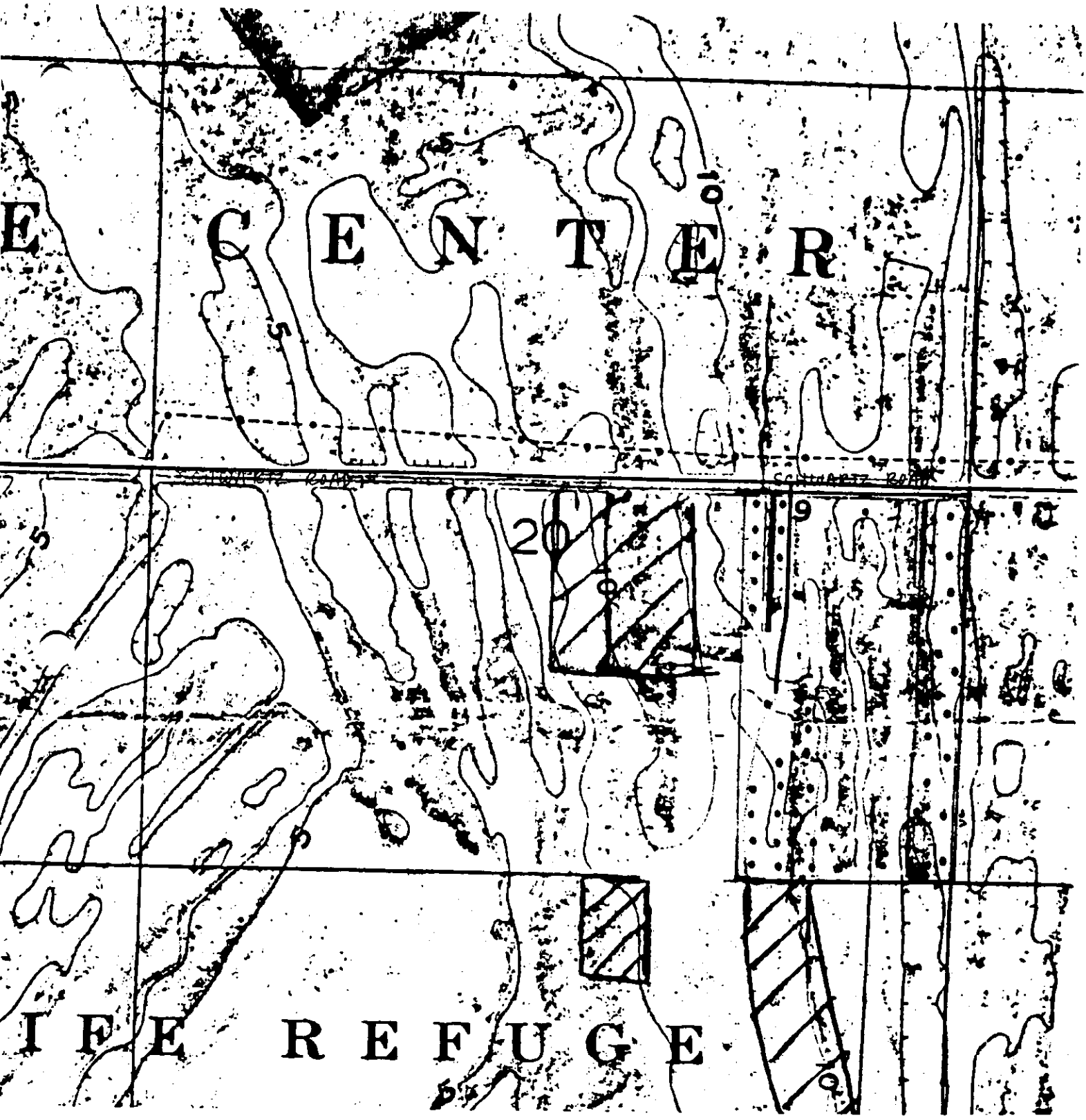

FIGURE 2. Location of Test Pits (Red dots) within the Proposed Landfill Tract. Blue Shaded Area is Moderate ZAP, as per ACI 1991.

APPENDIX E

COMPENSATION (PLAN) FOR SCRUB JAY HABITAT LOSS FROM PROPOSED NEW CONSTRUCTION AT THE JOHN F. KENNEDY SPACE CENTER

1.0 Compensation for Scrub Jay Habitat Loss from Proposed New Construction at the John F. Kennedy Space Center.

1.1 Introduction

Construction of new Facilities on Kennedy Space Center (KSC) will remove habitat of the Florida Scrub Jay. Under 50 CFR 402.11 federal agencies may enter into an Early Consultation process whereby a preliminary biological opinion may be issued to the agency as a guide to actions to be taken related to projects expected to impact an endangered or threatened species. The projects proposed for implementation over the next several years are listed in Table 1. Preliminary analyses indicate that these projects have the potential to impact as much as 193 acres of Scrub Jay habitat. The size of these projects and their inclusion on the list will undoubtedly change as the space program evolves. Some may also be removed and new projects may be added. The list then, has merely been used as a baseline to determine the scope of the potential the compensation requirements which may be needed over the next several years.

In discussions with the Fish and Wildlife Service's Endangered Species Office resulting from the Section 7 Consultation for the Space Station Processing Facility, a compensation plan was developed and approved. The plan involved both the creation and restoration of scrub habitat on several sites at the Kennedy Space Center. This approach seems valid for future projects on KSC. However, because the exact size and nature of these projects is not presently known, specific Biological Assessments for each project cannot be made at this time. Therefore, NASA proposes a phased approach to compensation for these future projects which would create and restore up to 300 acres of scrub habitat at various areas on KSC (see Figure 1 and Table 2). The first year NASA will create 10 acres of new habitat and restore 74 acres of existing habitat for a total of 84 acres of compensation. Each succeeding year as projects are approved and designed, their associated impacts to scrub habitat will be determined by development of project specific Biological Assessments (BA's). These BA's will be submitted to the FWS under the Section 7 Consultation process. Depending on the total impacted acreages for any given year, compensation sites will be selected so an appropriate amount of scrub habitat will be created and/or restored. In the first year of the program ratios are higher (3:1) and decrease towards the end. The final ratio will be 2:1. This means that not all of the potential 193 acres will be covered under this program. When 150 acres of impacted habitat has been reached, NASA will be required to develop additional compensation acreage. The phasing is required for two reasons: first, the exact nature, extent and timing of all

future projects is not presently known and second, the monies for this activity must come from the Construction of Facilities funds for each project and these funds will not be available until final design is complete. Therefore, compensation must be funded and implemented along with construction. The proposed phasing of compensation activities is shown in Table 3. This table provides a schedule based on what is presently known about the implementation of construction activities at KSC. Funds will be provided to both the Fish and Wildlife Service (FWS) and the KSC Biomedical Office (MD) for creation/restoration and monitoring activities, respectively. As stated earlier, only 150 acres of habitat removal with be covered by the program. The schedule and order of compensation sites may change as construction priorities change. These changes will be addressed in an annual review of the program between NASA and the Fish and Wildlife Service. Following the annual review, NASA will update the plan to reflect those changes agreed to by both NASA and the Fish and Wildlife Service.

Finally, if after the implementation of this program, it is demonstrated that the habitat creation and/or restoration efforts are unsuccessful, that is, Scrub Jays cannot or are not using these areas, NASA agrees to pursue acquisition of lands off of KSC which are occupied by Scrub Jays, to compensate for the loss of such habitat which has been removed from KSC. Such compensation will be at a ratio of 2:1.

In the discussion that follows, detailed recommendations for restoration and creation of 300 acres of Scrub Jay habitat are presented based on what is currently known of the biology of Scrub Jays and scrub vegetation.

1.2 Recommendations

NASA's will utilize a combination of the restoration and creation of scrub habitat approaches to compensate for habitat losses resulting from proposed new construction activities. Areas proposed for creation and restoration are shown in Figure 1 and described in Table 2.

Table 1. Proposed Construction Projects Which May Impact Scrub Jay Habitat\
(Project Implementation Projected over a Five Year Period)

Project	Photo/GIS Analysis	Site Visit	Estimated Construction Area (acres)	Estimated Impacted Area (acres)
SSPF	mixed scrub	yes	28.0	28.0
IFLOT camera site	scrub/wetlands/ruderal	yes	2.0	1.4
PSTF-R	mixed	yes	11.0	6.0
ASRM dock	Vitis /scrub	yes	4.0	2.0
RR car unloader	scrub/wetlands mixed	yes	2.0	1.0
New landfill	disturbed/scrub	yes	67.0	35.0
SS Haz proc. fac.	oak scrub	yes	5.5	5.5
Assured crew ret.	oak scrub	yes	5.5	5.5
Astro crew quart.	mixed scrub (site a)	yes	10.0	10.0
Astro crew quart.	pine woodland (site b)	yes	10.0	0.0
LRU repair depot	scrub/ruderal	yes	9.0	9.0
LC 39 incr. impr.	mixed scrub	no	40.0	40.0
SS logis. ware.	mixed	yes	10.0	7.0
SS maint. & repair	scrub	yes	6.0	4.0
Duct tray	mixed/ruderal	no	40.0	*2.0
Streets S. of 5th	oak scrub	yes	36.6	36.6

Totals ---------- 183 - 193 potentially impacted acres.

*Duct tray should impact this acreage provided it is installed ONLY along existing rights-of-way.

Figure 1. Locations of Scrub Jay Habitat Restoration and Creation Sites

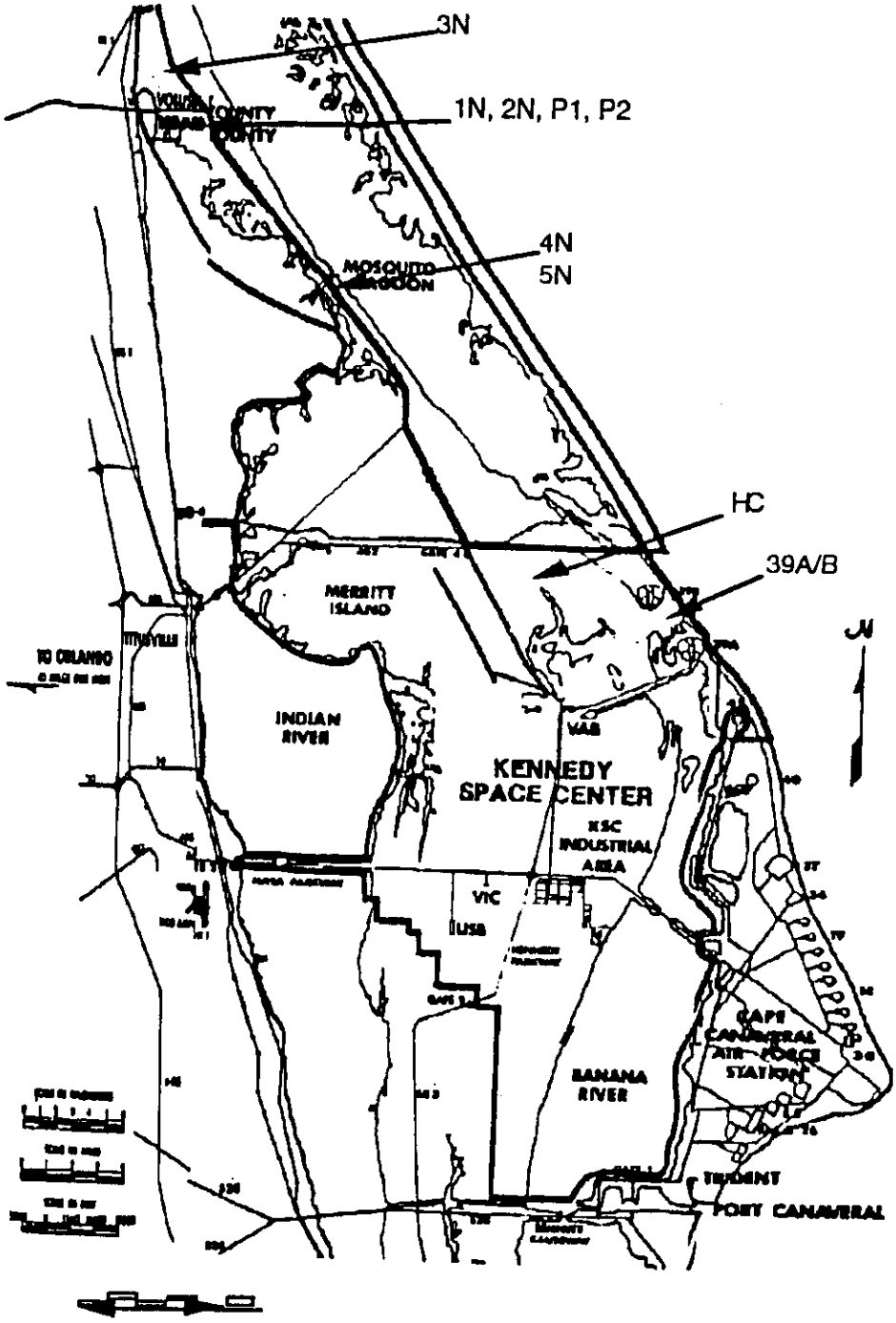

Table 2. Sites Proposed for Scrub Jay Habitat Restoration and Creation

Site	Type	Size (ac)	Location
IN-1	Restoration	27.7	Brevard/Volusia County Line
1N-2	Restoration	17.7	Brevard/Volusia County Line
2N	Restoration	10.4	South of site 1N
3N	Restoration	7.8	Volusia County
4N-1	Restoration	30	Haulover Canal
4N-2	Restoration [1]	30.8	Haulover Canal
5N	Restoration	36.3	Haulover Canal
HC	Restoration	54.0	Happy Creek
39A/B	Restoration	45.0	Pad 39A/B
P1	Creation	10.0	Brevard/Volusia County Line
P2	Creation	30.3	Adjacent to P1
TOTAL		300	

[1] Restoration at this site may require some supplemental planting of scrub species

TABLE 3. KSC SCRUB JAY HABITAT COMPENSATION PLAN/SCHEDULE AND FUNDING PLAN

	PROPOSED COMPENSATION SITES	FY 91 FWS / MD	FY 92 FWS / MD	FY 93 FWS / MD	FY 94 FWS / MD	FY 95 FWS / MD	FY 96 FWS / MD	FY 97 FWS / MD	FUNDING TOTALS FWS / MD	TOTAL FUNDS PER PROJECT YEAR
1991 PROJECTS SSPF (28) 28 ACRES X 3.1 94 ACRES	1N-1 = 27.7 HC = 54 P1 = 10 93.7	5 K	82.4 K / 50 K	21 K / 35 K	20 K	5 K	69.7 K / 20 K		178.1 K / 130 K	308 K
1992 PROJECTS PSTF-R (5) 9 ACRES IFLOT (2) X 2 ASRM DOCK (2) 18 ACRES	1N-2 = 17.7			21.2 K / 15 K	5 K			6.3 K / 5 K	27.2 K / 25 K	52 K
1993 PROJECTS 35 ACRES LANDFILL (35) X 2 70 ACRES	P2 = 30.3 4N-1 = 30 2N = 10.4 70.7				80.6 K / 25 K	53.5 K / 20 K	5 K		134.1 K / 50 K	164 K
1994 PROJECTS SS HAZ PROC(5.5) 30 ACRES ASSURE CREW(5.5) X 1.8 ASTRO QUART(10) 54 ACRES LRU DEPOT(9)	3N = 7.8 39A/B = 45 52.8					29.3 K / 25 K		26.3 K / 10 K	55.6 K / 35 K	90 K
1995 PROJECTS 40 ACRES LC 39 X 1.6 IMPROV(40) 64 ACRES	5N = 36.3 4N-2 = 30.8 67.1						58.7 K / 25 K		58.7 K / 25 K	84 K
1996 PROJECTS -6.6 ACRES X 0 UNKNOWN 0 ACRES (6.6 LEFT)										
150 PROJECT ACRES 300 COMPENSATION ACRES	TOTALS	5 K	82.4 K / 50 K	42.2 K / 50 K	80.6 K / 50 K	82.8 K / 50 K	128.4 K / 50 K	33.6 K / 15 K	455 K / 265 K	718 K

NOTE: FWS = REFUGE WILL IMPLEMENT CREATION/RESTORATION MD = NASA WILL PERFORM ALL VEGETATION AND SCRUB JAY MONITORING

1.2.1 Scrub Creation

Scrub creation is recommended because there are substantial areas of well drained soils in the northern part of KSC that are abandoned agricultural lands, particularly citrus groves. These areas once probably supported scrub or scrubby flatwoods. However, succession is not returning these areas to scrub vegetation. Rather, cabbage palms are established in many, and large areas are rapidly becoming dominated by grape vines. These resulting communities do not provide good habitat for Scrub Jays or many of the other species dependent on scrub or slash pine flatwoods. These areas may remain permanently dominated by vines. Action is needed in order to turn these areas into good wildlife habitat. By removing competing species and planting scrub plants into such sites, it is thought that scrub can be reestablished. In various places on KSC some scrub areas were cleared 20-30 years ago have revegatated into scrub, indicating that scrub vegetation can develop in areas that were once cleared.

NASA will initiate a small (10 acre) experimental plot (Site P1) on KSC adjacent to a restoration site to investigate scrub creation in the first year of the program. In a later year, an additional 30.3 acres of the site (Site P2, the remaining well drained portion) will be treated.

The Site (P1) is in an abandoned orange grove just south of the Volusia-Brevard County line east of State Route 3 that is mainly on well drained soils (Astatula and Paola series). The grove is about 50 acres in size, of which 10 will be used.

Site preparation will require removal of about 250 small cabbage palms (Sabal palmetto) that have invaded the site. Scattered larger cabbage palms (1 or fewer per acre) will be left. Holes left by removal of cabbage palms will be filled. Other site preparation should be minimal.

Growing of required horticultural material, scrub oaks and other scrub species, will be contracted for one year in advance of time of planting with a native plant nursery. Arrangements have to be made by August-September of 1991, since that is when seeds mature. NASA will plant 500 trees per acre in two stages. In the first year scrub oak species (400/acre) will be planted using mechanical equipment as follows:

300 myrtle oak (Quercus myrtifolia)/acre
50 sand live oak (Quercus geminata)/acre
50 Chapman oak (Quercus chapmanii)/acre.

Plant material will be grown as 6" tublings.

Planting will be done in summer during the rainy season. If planting is done at another time of year, supplemental watering will be required to insure survival.

After one year, survival of planted oaks will be determined by sampling. If survival rate of oaks equals or exceeds 50%, no further planting of oaks will be required. If survival is less than 50%, scrub oaks will be planted by hand to bring oak density up to 200/acre. At this time additional scrub plants (100/acre) will be planted by hand as follows:

50 saw palmetto (Serenoa repens)/acre
30 rusty lyonia (Lyonia fruticosa)/acre
20 shiny blueberry (Vaccinium myrsinites)/acre
10 South Florida slash pine (Pinus elliottii var. densa)/acre.

Procedures will be basically the same for Site P2 as for P1. In addition to removing cabbage palms, some areas dominated by grape vines and areas with dense guineagrass (Panicum maximum) will need appropriate treatment to eliminate competing vegetation. Other modifications to the original procedure may be required based on experience with the initial effort.

1.2.2 Scrub Restoration

Scrub restoration is recommended for areas of scrub or scrubby flatwoods vegetation that have remained unburned for so long that 1) habitat quality for Scrub Jays has declined and 2) prescribed burning by itself is unlikely to return the site to good habitat conditions.

Three areas on KSC are recommended to provide the 259.7 acres required for habitat restoration and development of the 300 acre compensation. Restoration is recommended for approximately 54 acres at Happy Creek (Site HC), 160.7 acres in 7 sites in the northern part of KSC (Sites 1N-1, 1N-2, 2N, 3N, 4N-1, 4N-2 and 5N) and 45 acres in an area between Launch Complexes 39A and 39B (Site 39A/B). The areas selected at Happy Creek and near the launch pads are inside the launch impact zone but outside the crawlerway for Pad C, as shown in the master plan maps (F2, F3). This will minimize the chance of future development of these sites. There is too much prime habitat in areas that may or may not be developed to

ignore the future habitat suitability of such areas. Happy Creek is one of the most important areas for the Scrub Jay on KSC. Furthermore, detailed studies of Scrub Jays and their habitat have been performed for four nesting seasons at Happy Creek. Comparison of Florida Scrub Jay density, territory size, mortality and reproductive rates, before and after restoration, will provide data useful to design restoration projects elsewhere.

Restoration at Happy Creek (Site HC) will include one major application of mechanically cutting selected areas (54 acres) based on a detailed vegetation map that has been developed and a knowledge of Scrub Jay territories present within the area. Based on studies elsewhere, this should be sufficient to prepare the fuel bed for prescribed fire. Areas mechanically cut will be prescribed burned soon thereafter to remove excessive slash material and reduce fire danger. The prescribed burn will be conducted using a combination of ground and/or aerial techniques as appropriate. Objectives of the burn will be to reduce 1-hour fuels by 80-90%, 10-hour fuels by 70-80%, and 100-hour fuels by 40-50%.

Prescribed burning will be conducted by an organization experienced in using prescribed burning for wildlife habitat management that has sufficient trained personnel and appropriate equipment to conduct the burn safely, prevent fire escape, and suppress any escaped fires. Prescribed burns must meet Florida state requirements (e.g., Florida Prescribed Burning Act of 1990) and Merritt Island National Wildlife Refuge safety standards, and be coordinated with appropriate NASA authorities. Personnel must include a Certified Prescribed Burner (Florida certified) to direct the prescribed burn and a Fire Behavior Analyst who will record fire weather and fire behavior hourly during the fire.

Approximately 3-5 years after the mechanical treatment and initial prescribed burn, prescribed fire will be used to burn approximately 400 acres of scrub and marsh adjacent to areas that were treated; this prescribed fire can also burn into some of the treated area as a mosaic. Fire objectives will be to achieve a 40-60% fuel reduction in the areas surrounding the mechanically cut treatment in a mosaic pattern. Exact timing of the second fire will be determined based on monitoring data of scrub regrowth and Scrub Jay responses. It is anticipated that this will result in a scrub landscape that can thereafter be maintained by prescribed fire and additional mechanical treatment will be unnecessary. Monitoring data collected each year for 10 years after beginning of treatment will be used to judge whether viable Scrub Jay habitat has been restored that can then be incorporated into Merritt Island National Wildlife Refuge Fire Management Plan.

The design for the northern area involves mechanically cutting strips or blocks of unburned habitat in 5 different sites followed by prescribed burning of the slash and adjacent scrub where needed. Site 1N-1 consists of 27.7 acres just west abd adjacent to the abandoned grove being used for scrub creation. Strips about 100 m wide will be treated; this should not result in negative impacts to Scrub Jays that reside in the area. The interior will be burned when the slash from the initial treatment is burned. A second prescribed fire approximately 4-7 years after the initial treatment may be needed in this interior area; this prescribed fire can burn into the mechanically treated area as a mosaic. Exact timing of this burn will be determined using monitoring data. Site 1N-2, which consists of two areas to the west and south of the creation site, for a total of 17.7 acres, will be treated similarly in the year following the treatment of Site 1N-1. After that, it is expected that both areas will be incorporated into the normal fire management of adjacent scrub vegetation. It is expected that this treatment will result in a scrub landscape that can be maintained by prescribed fire. Monitoring data collected each year for 10 years after beginning of treatment will be used to judge whether viable Scrub Jay habitat has been restored that can then be incorporated into normal management.

Part of the site 1N-2 as well as part of the adjacent scrub creation site are within the secondary zone (1500 ft radius) of an active Bald Eagle nest. Mechanical operations (cutting, mechanical planting) and prescribed burning will have to be conducted when the nest is not in use.

Site 2N is a strip of 10.4 acres of scrub vegetation along a firebreak about 840 m south of Site 1N-2. The interior of this block of scrub is in good condition but this edge is overgrown. One application of mechanical treatment followed by prescribed burning of the slash is recommended. After this, it is expected that the strip can be included with normal management of the adjacent vegetation.

Site 3N involves strips of 7.8 acres of scrub vegetation on both sides of a fire break about 1.6 km north of Site 1N. Adjacent vegetation is scrub and scrubby flatwoods in good condition, but the strips recommended for treatment are overgrown. One application of mechanical treatment followed by prescribed burning of the slash is recommended to return the vegetation to a state that should then be maintainable by prescribed burning. This site is near an active Bald Eagle nest; mechanical operations and prescribed burning will have to be conducted when the nest is not in use.

Sites 4N-1 and 4N-2 are south of Haulover Canal in scrub and disturbed scrub vegetation. Both blocks, total about 60.8 acres and partially separated by a hammock, are

recommended for mechanical cutting followed by prescribed burning of the slash. Previous burning of the area has not been sufficient to maintain the habitat that has been occupied by Scrub Jays in the past. Treatment will be done in phases so that all available habitat is not treated at the same time. Site 4N-1 will be treated first and Site 4N-2 will be treated later.

Site 5N is an area of about 60.4 acres south of Haulover Canal; restoration is proposed for about 36.3 acres of this site. Before NASA's acquisition of this land, several small canals had been cut and roads built, apparently as part of a planned subdivision. Scrub, disturbed scrub, and scrubby flatwoods exist on much of the site on well drained soil. However, roads and canals act as fire breaks complicating prescribed burning of the area, and not all previously cleared areas have revegetated with desirable species.

In order to reestablish better habitat on this site, a mix of treatments are required, including mechanical cutting of high scrub vegetation on the edges, removal of less desirable vegetation (grape vines, cabbage palms), prescribed burning, and perhaps supplemental planting of scrub species. Because this site is more complex than the others, work on it will be done later in the project when experience has been gained in restoration techniques. A site specific plan will be developed prior to implementation.

The final restoration site (39A/B)consists of about 45 acres located on a scrub ridge between Pad 39A and 39B outside of present Fire Management Units. Scrub in this area is occupied by Scrub Jays but is approaching the height and density of marginal habitat. Due to its proximity to operational areas, normal prescribed burning would be difficult on this site. With mechanical treatment, slash burning should be possible, as should the creation of smaller burning units that can then be maintained by prescribed burning. Treatment will be done in phases with about half the unit treated first and the second half later.

2.0 Monitoring Plan

Creation and restoration are new techniques in scrub management. Proposed compensation of impacts to existing Scrub Jay habitat includes not only the provision of new habitat but also the provision of habitat conditions that are of sufficient quality that reproductive success will exceed mortality rates. Additional monitoring objectives are to determine the success of developing habitat that can be maintained by prescribed fires.

2.1 Creation Sites

Monitoring of scrub creation will include evaluation of vegetation establishment by determining survival rate of planted shrubs annually for the first five years after planting. In addition, vegetation composition and cover by height strata and vegetation height will be determined annually on permanent vegetation transects for ten years to determine if created scrub develops toward a system similar to natural scrub vegetation. Monitoring of Scrub Jay use of these sites will be done in conjunction with monitoring of restoration sites. Monitoring of Scrub Jays will focus on detailed studies of two sites (Sites 1N-1 and 1N-2, see discussion below) and will document usage of this site by jays from the two restoration sites.

2.2 Restoration Sites

Vegetation monitoring of restoration sites will include establishing permanent sample transects several months prior to treatment. Sample data per transect will include vegetation composition and cover by height strata and vegetation height. Sampling will be of sufficient intensity to sample the spatial heterogeneity of the vegetation and result in statistically valid results. Resampling will be conducted post-treatment and annually for ten years after treatment.

Scrub Jay monitoring of the northern areas will concentrate on Sites 1N-1 and 1N-2. A survey will be conducted to color-band the resident Scrub Jays to determine the number of territories along the edge of the creation/restoration site prior to treatment. Scrub Jay monitoring will include studies of reproductive success and survival of color-banded Scrub Jays for ten years after the project in both study sites. Scrub Jay monitoring of restoration areas at Happy Creek will be incorporated into the ongoing long-term studies in that area. Studies involve territory mapping, nesting studies, and habitat use.

Success at all creation and restoration sites will be defined as an increase in habitat carrying capacity for and an increase in use by Scrub Jays in these areas within 10 years of restoration/creation of each site. Success at Happy Creek may also result in areas that are now population sinks becoming population sources. Relationships between mortality and reproductive success will also depend on management of surrounding areas. Nearly all the habitat created or restored is located on well drained sites so that reproduction should exceed mortality in most of these areas.

These success criteria will be reevaluated during the annual review process and refined as appropriate.

3.0 Technical Considerations

3.1 Scrub Jay Habitat Characteristics

Scrub Jays require well or moderately drained areas that have an abundance of scrub oaks. They occupy a broad range of habitat conditions and inhabit many areas that are marginal for them. Optimal habitat conditions have been defined where reproductive success is equal or greater than mortality rates. It is not yet possible to identify all conditions where reproduction exceeds mortality ("sources") and all conditions where mortality exceeds reproduction ("sinks"). The objective of Scrub Jay habitat creation or restoration is to design and manage for conditions where reproduction exceeds mortality. Conditions that define optimal habitat are given below. Although Scrub Jays occupy broader habitat conditions, their long-term success in such areas has not been established.

Scrub Jays occur in the highest densities in a habitat mosaic where 20-50% of the area is open sand or sparse herbaceous vegetation (open space) and the remaining area is shrubs that are 120-170 cm high with 50-100% of the shrub cover composed of scrub oaks. Good habitat has 10-50% open space. The value of 10% open space is significant because areas with more than 10% open space tend to be disturbed on KSC; areas with more than 10% open space tend not to burn well so that they eventually may become unsuitable habitat without special treatment. Slash pine trees are useful habitat features because they provide perch sites and fuels to carry fires; however, slash pine cover should not exceed 15% canopy cover. Naturally occurring fire or prescribed burning that simulates natural fire cycles is needed to maintain the appropriate habitat.

3.2 Scrub Creation as Compensation for Habitat Loss

Scrub creation was listed in the USFWS Biological Opinion for the Space Station Processing Facility as an option for compensating for future habitat loss, but the technique and its success have not been established. Unanswered questions concerning scrub habitat creation involve not only the success in establishing the appropriate vegetation but the success in developing a habitat structure that can be managed by prescribed fire. Some disturbed sites (especially areas that were cleared 30 or more years ago that have revegetated naturally) have not developed a sufficient fuel structure to successfully carry fire.

3.3 Scrub Restoration as Compensation for Habitat Loss

Mechanical treatments have not been demonstrated to be a substitute for fire in the long-term maintenance of scrub vegetation. However, a one-time application of mechanical cutting would be very useful for restoring most tall, unburned scrub habitats that will not successfully burn in most prescribed fires into scrub communities that can thereafter be managed by prescribed burning as good Scrub Jay habitat. Mechanical cutting reduces vegetation height and creates openings, but nutrients may not recycle in the same manner as occurs from fire. Mechanical cutting by itself may not result in an optimal habitat structure. For example, the understory in scrub is often open once scrub oaks have sprouted and grown for several years. An unnatural amount of debris may remain after mechanical treatment. Fire has been such an integral component of Florida Scrub Jay habitat that it may be extremely important in ways not readily apparent by simple measurements or observations. Most scrub researchers agree that Florida Scrub Jay habitat should be managed by fire unless long-term studies justify other suitable substitutes for certain situations.

Areas within scrub and scrubby slash pine flatwoods that have remained unburned for long periods (>30 years) are dominated by tree-size scrub oaks that are able to survive fires. These areas have not burned due to fire suppression and landscape fragmentation. Restoration involves habitat manipulation in addition to prescribed fire. Mechanical cutting can convert areas back into scrub or scrubby flatwoods and can be used to develop temporary firebreaks to allow better control of prescribed fire. Nearly 2700 acres of unburned habitat occur outside Fire Management Units (FMUs) on KSC. The acreage of tall, unburned habitat within FMUs is not currently known but is expected to increase because NASA operations limit the ability of USFWS to use prescribed fire in several areas. Anticipated industrial development will continue to increase this problem. Alternative strategies may be necessary to allow for smaller, more controlled fires.

Selection criteria for restoration sites should include tall, unburned areas that will have high potential to be optimal habitat. Potential here refers to intrinsic site characteristics and how effectively the site can be managed. Design of the restoration should prevent detrimental impact to Scrub Jays already residing in the general area. This requires either sequential treatments over a period of ten years or selecting narrow (e.g., 50-100 m) strips of habitat to be treated once. After initial restoration is completed, areas should be managed by prescribed fire. Additional small applications of mechanical cutting may be necessary if areas of high scrub remain. Height reduction is important because Scrub Jays occupy large territories and have an extremely

important predator warning system. Optimal habitat allows Scrub Jays to view their territories and detect avian predators from long distances. Patches of tall vegetation are exploited by avian predators. Mortality of Scrub Jays tends to exceed reproductive success in such areas.

Patches of vegetation within a territory typically include different age classes with respect to time since fire, in part due to natural landscape variation and the large size of territories. This is significant since different age classes vary in their suitability for nesting, feeding, and for providing cover to escape predators. If the entire territory burned (or was mechanically cut) at once, there would be no scrub oaks of the appropriate size to provide cover or acorns for several years.

4.0 Descriptions of Proposed Projects

The following is a list of proposed construction projects for the John F. Kennedy Space Center as of August 1991. All sites were located on a master planning map, traced onto an infrared aerial photo and interpreted on the GIS vegetation map. Areas of concern which may have scrub cover were visited to verify maps. Some construction acreages were unknown due to lack of design or detailed site plans; therefore, measurements were done using a grid counting system to estimate the size of the site. All estimates of impacted acreages are conservative, allowing a margin of error until a full biological assessment can be completed. Table 2 summarizes impacts on the proposed construction areas.

4.2 Projects and Estimated Impacts

IFLOT Camera Sites: Two of the three camera sites are located in wetlands. Only one of the proposed sites is located in potential Scrub Jay habitat (Site 3). The size of each camera pad is estimated as 1.0 acre; therefore, 1.0 acre will be impacted by site 3. In addition to this 1.0 acre, a small power line is being run off the pad for an additional 1/3 acre; however, no survey has been done for this acreage. For consistency, 1.4 acres is the approximated impact.

Payload Spin Test Facility: A biological assessment was made for this site and 6 of the 11 construction acres will impact potential Scrub Jay habitat.

ASRM Dock: The two acres to be impacted were surveyed and had Scrub Jays living in them. The vegetation is made up of scrub oak, much of that is covered with vines, and a mowed grass edge.

Railroad Car Unloader: This site will be placed in a previously disturbed area; however, the surrounding vegetation is oak scrub and is occupied by Scrub Jays. The estimated impact (1.0 ac) is half the construction site including all edges that come in contact with scrub.

New Landfill: The new landfill will be located due east of the existing landfill and will cover 67 acres. The site plan was overlaid on both an aerial photo and on the master planning map. The majority of the new landfill will occupy a disturbed area that is surrounded by excellent scrub habitat and occupied by Scrub Jays. The disturbed area is tall but has ample open areas that may be used by Scrub Jays. When an approximately rectangular area of 67 acres is overlaid on the aerial map in a position due east of the existing landfill,

it directly takes oak scrub equal to approximately half its entire acreage. Along with this, it may take habitat that is marginal to poor (disturbed) but still occupied by Scrub Jays due to the large population to the south of the construction site. Thirty-five acres of impact is the best appraisal at this time; however, this could either be too high or too low depending on the placement of the landfill.

Space Station Hazardous Processing Facility and Assured Crew Return: No finalized plans are available for these sites; however, possible sites and acreage estimates have been provided. The proposed site lies to the west of the Payload Spin Test Facility (PSTF) and may have a similar "footprint" as the PSTF. This area is mapped on the GIS as scrub and slash pine, some of which is well-drained. Aerial photo analysis shows a well-drained ridge in the area and ample open space. It is likely that this whole area represents, at least potentially, good Scrub Jay habitat. Based on the photo/GIS analysis, as well as the site survey done on the PSTF, it is likely that the entire construction area will impact Scrub Jay habitat. Since the area of the PSTF (11.0 acres) is approximately equal to the combined area of the proposed facilities, the two impact estimates were evenly divided into 5.5 acres each.

Astronaut Crew Quarters: Two different sites have been proposed for this facility. The first (a) is approximately half way between the environmental health facility and NASA Causeway. This site was surveyed and determined to be a mixed oak scrub. If this site is used, the facility will impact the entire 10 acres of construction. The second site (b) is located near the corner of NASA Causeway and C Avenue. This site was also surveyed and determined to be a pine woodland.

LRU repair depot: This site, located just off Contractor Road is Scrub Jay habitat surrounded by development. The oak scrub located at this site represents nearly optimal Jay habitat, and Scrub Jays have been seen using the entire area including the mowed grass. Construction at this site will impact at least 9.0 acres of habitat and may displace the remaining Scrub Jay families.

LC 39 Incremental Improvements: An aerial photo and GIS map interpretation shows this whole area as mixed scrub. Scrub Jays have been seen in the vicinity. It was assumed that this area is Scrub Jay habitat and the total construction acreage (40 ac) will impact Scrub Jays.

Space Station Logistics Warehouse and Space Station Maintenance & Repair Bldg.: These two sites are located just north of the PSTF. Because of the similarity in habitats of this area and the PSTF area, impacts were estimated based on the PSTF biological assessment. The warehouse was calculated to be 10.0 acres and the maintenance building to be 6.0 acres. Because the PSTF impacted between 50 and 75% of its total acreage, 75% of the area (11 ac total) in the other two facilities was predicted to be a Scrub Jay habitat impact.

Duct Tray: No specific plans are available for this work, but impacts seem to be minimal as long as the duct tray is kept along the existing rights-of-way. Some scrub may be impacted by splice buildings and by some of the duct routes. The present estimate is 2 acres.

Streets South of 5th Street: This area is mapped as scrub and slash pine, some of which is well-drained; therefore, it represents potentially good Scrub Jay habitat. The information received indicates that the roads with ditches, shoulders, etc. will be 50 ft. in width. Measurements taken from the master planning map give a total of 21,168 ft. of roadway. This translates into 1,058,400 sq. ft. or 36.6 acres of impact. Because of the likelihood that this area is occupied by Scrub Jays, the entire acreage (36.6 ac) was considered an impact.

APPENDIX F

USFWS BIOLOGICAL OPINION AND INCIDENTAL TAKING PERMIT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3100 University Blvd. South
Suite 120
Jacksonville, Florida 32216

28 DEC 92 AM 2

December 17, 1992

Mr. William W. Bailey
National Aeronautics and Space Administration
John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

FWS Log No: 4-1-93-079C (NASA)

Dear Mr. Bailey:

This represents the Biological Opinion of the U.S. Fish and Wildlife Service (Service) in accordance with Section 7 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 et seq.). This Biological Opinion satisfies the consultation requirements of Section 7 (a)(2) of the Act. It does not address the requirements of other environmental statutes, such as the National Environmental Policy Act. A complete administrative record of this consultation is on file in this office.

PROJECT DESCRIPTION

The National Aeronautics and Space Administration (NASA) proposes to construct a Class III landfill on 29.2 acres, adjacent to the existing Class III landfill, on Kennedy Space Center (KSC). The life expectancy for this landfill is approximately 30 years. A Class III landfill is for plant material, construction debris, paper, cloth, glass and plastic only.

CONSULTATION HISTORY

NASA formally notified the Service of this project on November 25, 1992. The Service had previously conducted a cursory field inspection of the proposed site on November 5, 1992. NASA evaluated the impact this landfill would have on the following federally threatened and endangered species: Florida scrub jay (*Aphelocoma coerulescens*), eastern indigo snake (*Drymarchon corais couperi*) and bald eagle (*Haliaeetus leucocephalus*), and determined the action "may affect" the scrub jay and eastern indigo snake and would have no effect on the bald eagle.

BIOLOGICAL BACKGROUND

The Service has prepared other biological Opinions for NASA on Florida scrub jays and eastern indigo snakes on KSC (FWS Log No. 4-1-91-061, April 15, 1991; and FWS Log No. 4-1-92-033D, Nov. 26, 1991). We refer NASA to these opinions regarding life histories and distribution of these species on KSC.

The proposed landfill will impact approximately 29 acres of habitat, of which about 70 percent is comprised of scrub oaks. Large portions of this site were previously cleared and ditched. Saw palmetto revegetates poorly in disturbed areas and is the principal species that carries fire through scrub. As a result of past disturbance to this site, the scrub oak habitat has not been burned and the oaks have attained tree height (9-12 feet). The site has numerous open areas of bare sand. There is one small forest located in the northeast corner of the site. Pine canopy cover is less than 2 percent throughout the site.

The biological information report stated that while the site has been disturbed, it does contain about 21 acres of habitat that provides the basic requirements for the scrub jay. The investigators believed while these areas were suitable for scrub jays, the habitat was of marginal quality. Nevertheless, based on wildlife surveys, six scrub jays were observed using the site, representing three family groups. One old scrub jay nest was found within the proposed landfill site.

While no eastern indigo snakes were observed during the wildlife surveys, the proposed site does have many of the qualities typical of this species habitat. In all likelihood this species will be found within the proposed site. No bald eagle nests are located within the area of the landfill.

The landfill will remove approximately 21 acres of occupied scrub jay habitat, which will impact at least three families of scrub jays. While the site will eliminate suitable eastern indigo snake habitat, an individual species' territory has been documented to be large (300 acres for males and 77 acres for females). This habitat loss is not considered significant for the indigos and any snakes found on the site will relocate to adjacent habitats.

NASA and the Service, in an attempt to reduce the level of impact to scrub jays on KSC as a result of construction projects, developed the document, **Compensation For Scrub Jay Habitat Loss From Proposed New Construction At The John F. Kennedy Space Center** (Enclosure 1). The intent of this plan is to provide for future, suitable scrub jay habitat, either through restoration or enhancement. The goal is to provide two acres of scrub habitat for each acre destroyed. Habitat restored or enhanced will be on KSC to insure that scrub jay populations are not isolated. In the document, NASA has identified the acreage for enhancement to offset the loss of the 21 acres for the landfill. The required enhancement is proposed for implementation in FY 94.

With reference to eastern indigo snakes, while the possibility exists that this species may be found on the project site, construction personnel should be instructed not to harm this species. The snakes, if encountered, should be permitted to move away from the disturbance.

Based on our review, the Service believes the construction and use of the land fill is not likely to jeopardize the continued existence of the Florida scrub jay or eastern indigo snake. With reference to the bald eagle, the Service concurs in the determination of "no effect".

INCIDENTAL TAKE

Florida Scrub Jay

Section 9 of the Endangered Species Act, as amended, prohibits the taking of listed species without a special exception. Taking is defined in the Act to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect or to attempt to engage in any such conduct. "Harm" and "harass" are further defined in Service regulations (50 CFR 17.3). "Harass" is defined as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding or sheltering. "Harm" is defined as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

"Taking" can only be authorized through special provisions. Under the terms of Section 7(b(4) and Section 7(o(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the meaning of the Act, provided that such taking is in compliance with the terms and conditions of the Biological Opinion.

The Service has reviewed the biological information for this species, information presented by the applicant's consultants, and other available information relevant to this action, and based on our review, incidental take, in the form of harassment is anticipated for six Florida scrub jays on the project site.

When providing an incidental take statement the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the take along with terms and conditions that must be complied with, to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service believes the following reasonable and prudent measure is necessary and appropriate to reduce take:

Implement the scrub jay compensation plan discussed above.

To implement the above reasonable and prudent measure, the Service has outlined the following term and condition for incidental take. In accordance with the Interagency Cooperation Regulation (50 CFR 402), this term and condition must be complied with to implement the reasonable and prudent measure for incidental take:

> Table 3 of the scrub jay compensation plan, calls for providing $80,600 to Merritt Island National Wildlife Refuge in FY 94 to enhance 70 acres of unoccupied scrub jay habitat. NASA will provide an additional $25,000 to a contractor to monitor the enhancement site for vegetation recovery and scrub jay occupancy.

Eastern Indigo Snake

In meeting the provisions for the incidental take in Section 7 (b)(4) of the Act, the Service has reviewed the Biological Opinion and all available information relevant to the project. Based on our review, incidental take is not authorized for the eastern indigo snake during the implementation of this project. If an incident involving an eastern indigo snake occurs, all work must cease and the Jacksonville Field Office at 904-232-2580 must be notified immediately.

This concludes consultation under Section 7 of the Act. If there are modifications made in the project, if the amount or extent of taking specified in the incidental take statement is exceeded, or if additional information becomes available relating to threatened or endangered species, reinitiation of consultation may be necessary.

Sincerely yours,

David J. Wesley,
Field Supervisor

Enclosure

cc:
Ron Hight-MINW