

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



Canaveral National Seashore

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Canaveral National Seashore

cana_geology.pdf

Version: 2/5/2021

Geologic Resources Inventory Map Document for Canaveral National Seashore

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Geologic Resources Inventory Map Document



Canaveral National Seashore, Florida

Document to Accompany Digital Geologic-GIS Data

[cana_geology.pdf](#)

Version: 2/5/2021

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Canaveral National Seashore, Florida (CANA).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

- 1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.
- 2) **GRI Digital Map and Source Citation** – A listing of the GRI digital geologic-GIS map produced for this project along with source map used in its completion. In addition, a brief explanation of how the source map was used is also provided.
- 3) **Map Unit List** – A listing of all mapped units present in the GRI digital geologic-GIS data.
- 4) **Map Unit Descriptions** – Descriptions for all mapped units present in the GRI digital geologic-GIS data.
- 5) **Geologic Section Lines** – Geologic cross section line graphics and explanation. Section lines are present in the GRI digital geologic-GIS data.
- 6) **Ancillary Source Map Information** – Additional source map information. Includes source map graphics and report.
- 7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

Stephanie O'Meara
Geologist/GIS Specialist/Data Manager
Colorado State University Research Associate, Cooperator to the National Park Service
Fort Collins, CO 80523
phone: (970) 491-6655
e-mail: stephanie_o'meara@partner.nps.gov

About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <https://www.nps.gov/articles/gri-geodatabase-model.htm>

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: <https://go.nps.gov/gripubs>. GRI digital geologic-GIS data is also available online at the NPS Data Store: <https://irma.nps.gov/DataStore/Search/Quick>. To find GRI data for a specific park or parks select the appropriate park(s), enter "GRI" as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <https://>

www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a “Contact Us” link if you need additional information. You may also directly contact the program coordinator:

Jason Kenworthy
Inventory Coordinator
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 987-6923
fax: (303) 987-6792
email: Jason_Kenworthy@nps.gov

The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: <https://www.nps.gov/im/inventories.htm>.

GRI Digital Map and Source Map Citation

The GRI digital geologic-GIS map for Canaveral National Seashore, Florida (CANA):

Digital Geologic-GIS Map of Canaveral National Seashore, Florida (*GRI MapCode CANA*)

The GRI digital geologic-GIS map was produced from the following source:

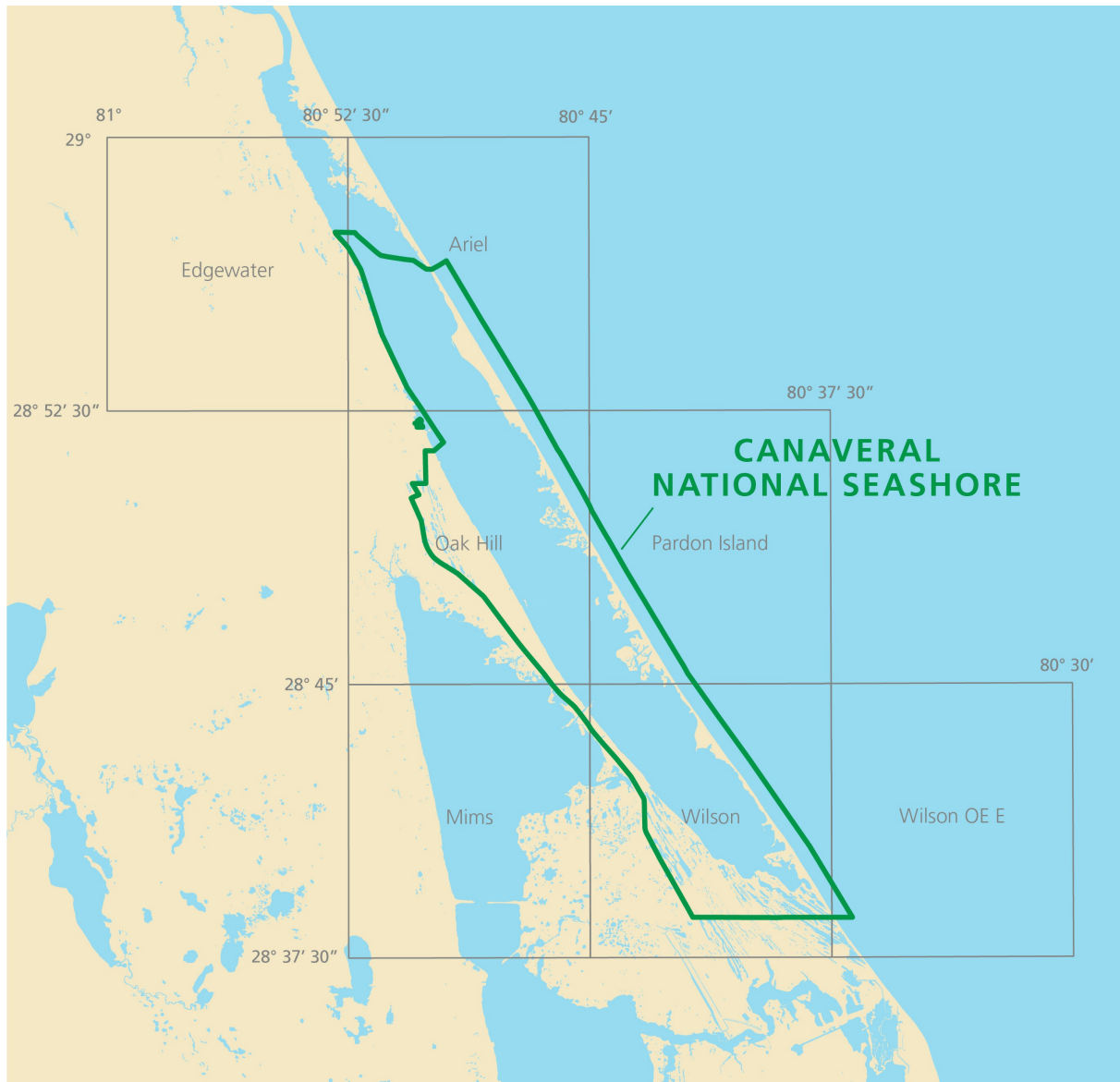
Parkinson, Randall W., and Schaub, Ron, 2007, Geologic Map of Canaveral National Seashore, scale 1:24,000, 7.5 Minute Series Quadrangles and Report: National Park Service, National Aeronautics and Space Administration (NASA), RW Parkinson Inc. and Dynamic Corp., scale 1:24,000, 6 plates and report ([Canaveral National Seashore \(2007\)](#)) (*GRI Source Map ID 7247*).

The full extent of the map and all geologic features were included in the GRI digital geologic-GIS data and product.

Additional information pertaining to each source map is also presented in the GRI Source Map Information (CANAMAP) table included with the GRI geologic-GIS data.

Index Map

The following index map displays the extents of the GRI digital geologic-GIS map produced for Canaveral National Seashore (CANVA). The boundary for Canaveral National Seashore (as of February, 2021) is outlined in green. 7.5' quadrangle extents are also displayed for the quadrangles with source map (cartographic) plates.



Index map by Jake Suri (Colorado State University).

Map Unit List

The geomorphic/morphogenetic and geologic units present in the digital geologic-GIS data produced for Canaveral National Seashore, Florida (CANA) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., OSi - Atlantic Ocean, Continental Shelf, inner shelf). Information about each geologic unit is also presented in the GRI Geologic Unit Information (CANAUNIT) table included with the GRI digital geologic-GIS data. Some source unit symbols were changed to ensure units were more easily discernable (e.g., Llu was changed to Lniu with 'ni' used to designate "natural island"). With the exception of Low Relict Beach Ridge and Qan (Anastasia Formation), all units listed are represented (i.e., mapped) in the GRI Geomorphic Units (CANAMRPH) digital geologic-GIS data layer.

Quaternary Period

Recent Epoch

[Atlantic Ocean](#)

[Continental Shelf](#)

[OSi](#) - Atlantic Ocean, Continental Shelf, inner shelf

[Barrier Island](#)

[Open Ocean](#)

[BOi](#) - Barrier Island, Open Ocean, shoreface

[BOb](#) - Barrier Island, Open Ocean, beach

[BOd](#) - Barrier Island, Open Ocean, dune

[Platform](#)

[BPu](#) - Barrier Island, Platform, upland

[BPw](#) - Barrier Island, Platform, wetland

[Lagoon](#)

[Natural Island](#)

[Lniu](#) - Lagoon, Natural Island, upland

[Lniw](#) - Lagoon, Natural Island, wetland

[Spoil Island](#)

[Lsiu](#) - Lagoon, Spoil Island, upland

[Lsiw](#) - Lagoon, Spoil Island, wetland

[Mixed Island](#)

[Lmiu](#) - Lagoon, Mixed Island, upland

[Lmiw](#) - Lagoon, Mixed Island, wetland

[Subtidal](#)

[LSsc](#) - Lagoon, Subtidal, continuous seagrass

[LSsd](#) - Lagoon, Subtidal, discontinuous seagrass

[LSb](#) - Lagoon, Subtidal, barren

Pleistocene Epoch

[Cuspate Foreland](#)

[Relict Beach Ridge](#)

[FRr](#) - Cuspate Foreland, Relict Beach Ridge Complex, ridge

[FRs](#) - Cuspate Foreland, Relict Beach Ridge Complex, swale

[FRu](#) - Cuspate Foreland, Relict Beach Ridge Complex, undifferentiated

[Low Relict Beach Ridge](#)

[Formation Features](#)

[Qan](#) - Anastasia Formation

Map Unit Descriptions

Descriptions of all mapped units as taken from the source map report. Users of the GRI digital geologic-GIS data are strongly encouraged to utilize the [report](#) for additional information.

Atlantic Ocean

Second largest and geologically youngest major ocean basin. Continental rifting initiated about 180 myrs BP and spreading continues today along the mid-Atlantic ridge ([Canaveral National Seashore \(2007\)](#)).

Hierarchical scheme of CNS Atlantic Ocean morphogenetic units as presented in source data.

Level 1

Atlantic Ocean

Level 2

[Continental Shelf](#)

Level 3

[OSi](#) - Atlantic Ocean,
Continental Shelf, inner shelf

Continental Shelf

Broad, gently seaward sloping segment of continental margin and bordered by the shoreface (landward) and shelf break (seaward) with water depths generally between 10 m and 100 m. Plainer or shelf-like morphology generated by cumulative effects of water wave erosion over numerous sea-level oscillations caused by growth and decay of glacial ice. Generally composed of sediments derived from the weathering and erosion of rocks and minerals found on or within the adjacent upland area. Relative abundance of shell material is directly proportional to water temperature. Fining offshore grain-size trend is typical and reflects decreasing wave energy with increasing depth ([Canaveral National Seashore \(2007\)](#)).

OSi - Atlantic Ocean, Continental Shelf, inner shelf (Recent)

Landward-most sub-segment of continental shelf, extending from the toe of the shoreface or fair weather wave base seaward to "storm weather" wave base. At this depth, wave orbitals only interact with the seabed during storm conditions or catastrophic events (i.e., hurricanes). Sediments generally consist of terrigenous clay with localized accumulations of biogenous sediment (i.e., reef debris) ([Canaveral National Seashore \(2007\)](#)).

Barrier Island

Shore-parallel, emergent linear sediment prism generally located along wave-dominated, passive continental margins subject to relative sea-level rise. Part of a barrier island system or complex which consists of: (1) barrier island, (2) back-barrier lagoon (or estuary) and (3) mainland shoreline. Barrier island is further divisible into (a) [open ocean shoreline](#) and (b) [platform](#). Open ocean shoreline further subdivided into (i) [shoreface](#), (ii) [beach \(foreshore and backshore\)](#), and (iii) [dune](#). The island platform is further subdivided into: (i) [upland](#) and (ii) [wetland](#) ([Canaveral National Seashore \(2007\)](#)).

Hierarchical scheme of CNS Barrier Island morphogenetic units as presented in the [source map report](#).

Level 1

Barrier Island

Level 2

[Open Ocean](#)

[Platform](#)

Level 3

[BOf](#) - Barrier Island, Open Ocean, shoreface

[BOb](#) - Barrier Island, Open Ocean, beach

[BOd](#) - Barrier Island, Open Ocean, dune

[BPu](#) - Barrier Island, Platform, upland

[BPw](#) - Barrier Island, Platform, wetland

Open Ocean

Boundary between oceanic and continental realms or the land-sea interface. Extends from the toe of the primary dune seaward to the toe of the shoreface (-10 m MSL). Exhibits concave upwards bathymetric profile sculpted by the daily to seasonal interaction of waves, tides, and wind. Sediments generally consist of well-sorted sand, with the amount of shell material inversely proportional to latitude ([Canaveral National Seashore \(2007\)](#)).

BOf - Barrier Island, Open Ocean, shoreface (Recent)

Nearshore zone extending from mean low tide to fair weather wave base (-10 m). Sediments generally consist of gravel, sand, and silt which exhibit a fining-offshore textural trend as a consequence of diminishing wave energy ([Canaveral National Seashore \(2007\)](#)).

BOb - Barrier Island, Open Ocean, beach (Recent)

Shore parallel zone extending from the toe of the dune to mean low water. This gently seaward sloping feature (~5 degrees) consists of well sorted sand derived primarily from littoral drift and local erosion. This unit is relatively narrow throughout the study area, reflecting low sediment supply and moderate to high wave energy. Biogenic shell production may increase carbonate content and grain size in localized areas. Foreshore segment submerged during daily tides. Backshore submerged during spring tides or storms ([Canaveral National Seashore \(2007\)](#)).

BOd - Barrier Island, Open Ocean, dune (Recent)

Hills or ridges of wind-blown, fine-grained sand that form a hummocky topography just landward of the beach. May be barren or covered with salt-tolerant grass (i.e., sea oats) and shrub (sea grape, saw palmetto). Dune morphology is a function of (1) sediment supply, (2) wind speed, direction, and persistence, and (3) availability of water. Dune development is greatest in the northern section of the study area and diminishes in size towards the south ([Canaveral National Seashore \(2007\)](#)).

Platform

Core of the barrier island, extending from landward margin of dune complex to the back-barrier lagoon shoreline. Surface is generally flat and gently landward dipping ([Canaveral National Seashore \(2007\)](#)).

BPu - Barrier Island, Platform, upland (Recent)

Topography generally flat and or consisting of progradational beach ridge sets. Surface elevations range from a maximum near the dune margin of about + 2 m and dipping landward to <1 m. Vegetation typically xeric (i.e. scrub oak) when elevations exceed 2 m; at lower elevations mesic communities prevail. Sediments or poorly developed soils consist of mixtures of quartz and shell sand, silt, and clay. This may be locally enriched with organic matter (rooting, litter fall)

Broad expanses of relatively flat and featureless topography in upland areas is constructed by landward transfer of littoral drift in association with (a) island overwash events or (b) relict tidal inlets. Ridge and swale features were not observed within the barrier island unit of the study area and thus the construction of an island platform is attributed to overwash events or tidal inlets.

Information available at the time of this investigation did not provide the detail necessary to distinguish between overwash and flood tidal delta features. Clearly, much of the platform morphology is attributable to island overwash or flood tidal delta sedimentation. However, the erosional end product of both features (driven primarily by sea-level rise) is generally the same: an irregular shoreline, consisting of island clusters, bays, and promontories ([Canaveral National Seashore \(2007\)](#)).

BPw - Barrier Island, Platform, wetland (Recent)

Barrier island wetlands are confined to an area subjected to extended submergence caused by astronomical tides or seasonal patterns in rainfall and wind. Tidal fluctuation is minimal (<0.25 m) in the study area and therefore this zone is relatively narrow about the island fringe. The wetland zone may be vegetated or barren (i.e., salt pan, flats, tarn, or pond). However these two wetland subunits were not mapped because the boundaries between them are transient over time intervals as short as a tidal cycle and therefore not necessarily reproducible. Wetland vegetation is indicative of (a) climate (marsh vs mangrove), (b) salinity (salt vs freshwater marsh), and (c) hydroperiod (low vs high marsh). The study area is located at the subtropical/temperate ecotone and therefore both mangrove and marsh vegetation is present. As the study area is micro-tidal, the extent of and boundaries between low and high marsh are not well established nor reliably distinguished on the basis of aerial photography. Therefore, this boundary was not mapped. Species tolerant of marine or brackish water are typically found along lagoon margin or platform fringe and along the margins of tidal creeks. Freshwater taxa generally present in topographic depressions within the platform interior.

More than 75% of the historic wetlands located along the east-central Florida coast were impounded or ditched for mosquito control between the 1940s and 1960s. Over the past two decades however, regulatory agencies and mosquito control districts have introduced programs and techniques designed to minimize or even reverse historical trends in wetland disturbance and habitat loss. Disturbed wetlands are generally distinguished by the present of: (a) perimeter ditch and dike system, (b) linear dragline ditches often organized into a set of parallel depressions, and (c) spoil placed adjacent to the ditch as isolated piles or linear mounds. Spoil features altered topography and were quickly colonized by exotic and native vegetation that would not otherwise be present. We did not distinguish between natural and disturbed wetlands, given the difficulty in determining boundaries between and within these units. However, a disturbed wetland can generally be identified by association with dikes and ditches (mapped as anthropogenic units) or a distinct plant assemblage ([Canaveral National Seashore \(2007\)](#)).

Lagoon

Shallow (<5 m), low energy, brackish water lagoons separate the mainland shoreline from the barrier island. These shallow water bodies formed as a consequence of Holocene sea-level rise and the concomitant submergence of low-lying topography along the margins of the Florida peninsula. Because the nearest inlet (Ponce de Leon) is 10 km north of the project area, astronomic tides are limited (<0.25 m). Lagoon physiochemical and biological conditions reflect a mixture of marine and terrigenous processes.

In distinct contrast to the fine-grained sediments (i.e., silt and clay) found in temperate lagoons, the sediments in this area are composed of quartz and skeletal sand, with local accumulations of gravel-sized shell (i.e., oysters), limestone clasts (c.f. Intracoastal waterway), silt and clay, or organic matter (c.f. seagrass beds) ([Canaveral National Seashore \(2007\)](#)).

Hierarchical scheme of CNS Lagoon morphogenetic units as presented in the [source map report](#).

Level 1

Lagoon

Level 2

[Natural Island](#)

[Spoil Island \(Island - Part Spoil\)](#)

[Mixed Island \(Island - Spoil\)](#)

[Subtidal](#)

Level 3

[Lniu](#) - Lagoon, Natural Island, upland

[Lniw](#) - Lagoon, Natural Island, wetland

[Lsiu](#) - Lagoon, Spoil Island, upland

[Lsiw](#) - Lagoon, Spoil Island, wetland

[Lmiu](#) - Lagoon, Mixed Island, upland

[Lmiw](#) - Lagoon, Mixed Island, wetland

[LSsc](#) - Lagoon, Subtidal, continuous seagrass

[LSsd](#) - Lagoon, Subtidal, discontinuous seagrass

[LSb](#) - Lagoon, Subtidal, barren

Natural Island

This unit of the lagoon consists of emergent (aka supratidal) landscape features formed by physical (i.e., shoaling) or biological (i.e., peat accumulation) processes. They are composed of quartz sand and gravel-sized shell with silt, clay and/or peat.

Emergent landscape features in close proximity to the barrier island were mapped as natural lagoon islands, although many are probably genetically related to the barrier island; i.e., the distal limit of an overwash fan or flood tidal delta now separated from the barrier island platform by sea level rise and/or sediment compaction. Corrections to this mapping scheme require a sedimentologic and stratigraphic analysis that was beyond the scope of this investigation ([Canaveral National Seashore \(2007\)](#)).

Lniu - Lagoon, Natural Island, upland (Recent)

The presence of an upland unit on a natural lagoon island requires the accumulation of physical or biological sediment above the tidal zone. No natural island upland units were identified during this investigation. Natural islands may host isolated spoil piles which rise above high water and support a

distinct upland plant assemblage of juniper, Brazilian pepper and cabbage palm. However, the overall geometry or footprint of the island reflects the predominance of natural process and therefore these islands are mapped as such. The spoil is readily identified by the circular or lobate geometry produced by one or more spoiling event ([Canaveral National Seashore \(2007\)](#)).

Unit is denoted as Llu in the source GIS data, map and report.

Lniw - Lagoon, Natural Island, wetland (Recent)

Natural island wetlands consist of plant species tolerant of marine or brackish water and extended intervals of submergence (hydroperiod). Freshwater taxa may be present in the interior of larger islands. Sediments typically consist of organic-rich shelly quartz sand and peat ([Canaveral National Seashore \(2007\)](#)).

Unit is denoted as Llw in the source GIS data, map and report.

Spoil Island

Any lagoon island with a footprint or shoreline configuration that has been created by the accumulation of spoil material onto a pre-existing island and/or directly upon subtidal sediments of the lagoon is mapped as a spoil island. This island unit is always found in close proximity to the Intracoastal Waterway, which is subject to excavation maintenance and associated spoiling. Sediments on Spoil Islands are distinct from natural islands as they are composed of coarse-grained sand- and gravel-sized material, locally enriched with Pleistocene limestone (coquina) fragments when dredging exceed depths of about 5 meters.

Because these islands were generated by spoiling, the shorelines are frequently not in equilibrium with the prevailing wind-induced wave conditions. As a consequence, it is common to observe linear, inter-tidal sand bars or sand spits prograding south-westward and into the lagoon from the spoil island's leeward shoreline. Although these features were not mapped as a distinct geomorphic unit, their presence is diagnostic of spoiling and therefore these features may be used to distinguish between the three island types. Sand spits are composed of sand and gravel-sized sediment derived from erosion of windward island shoreline and in situ biogenic production. The spit terminus may consist of one or more recurved or fan-shaped splays. The active terminus of a sand spit is barren of vegetation, but pioneering and climax taxa become abundant towards island and thus indicative of the relative age of spit segments ([Canaveral National Seashore \(2007\)](#)).

Lsiu - Lagoon, Spoil Island, upland (Recent)

The upland unit reflects spoiling above mean high water. This is created by a slurry of sand, gravel, mud, and water blown outwards from a large-diameter (~0.5 m) pipe. The volume and distribution of discharge determines the morphology of a spoil island; a stable pipe produces a cone, while the advancement of pipe concomitant with channel excavation will generate a more linear mound with the crest location approximating the average point of dredge slurry discharge.

Spoil island upland units may be barren or with grass, shrub, and trees reflecting increasing elevation and associated mesic and xeric hydrologic conditions. Vegetation typically consists of exotic taxa capable of rapid colonization subsequent to termination of spoiling. Sediment and/or soils consist of a mixture of quartz sand, shell, and limestone, locally enriched with silt, clay, and peat ([Canaveral National Seashore \(2007\)](#)).

Unit is denoted as Liu in the source GIS data, map and report.

Lsiw - Lagoon, Spoil Island, wetland (Recent)

Natural island wetlands consist of plant species tolerant of marine or brackish water and extended intervals of submergence (hydroperiod). Freshwater taxa may be present in the interior of larger islands. Sediments typically consist of organic-rich shelly quartz sand and peat ([Canaveral National Seashore \(2007\)](#)).

Unit is denoted as Liw in the source GIS data, map and report.

Mixed Island

When a lagoon island footprint or shoreline configuration appears to reflect a mixture of natural and spoiling processes, it is mapped as a mixed island. This island unit is generally found in close proximity to a navigable waterway subject to excavation maintenance. Unless a site visit is conducted, it is frequently difficult to distinguish the precise boundary between island features created by natural processes or spoiling. Because of this difficulty, some mixed islands may have a relatively large component of natural wetland. Sediments associated with natural processes will generally consist of fine quartz sand and organic matter, while those associated with spoiling are coarser grained, with common limestone clasts ([Canaveral National Seashore \(2007\)](#)).

Lmiu - Lagoon, Mixed Island, upland (Recent)

Upland areas on mixed islands are generated via spoiling of material excavated in association with the maintenance of navigable waterways. The presence of an upland unit on a natural lagoon island requires the accumulation of physical or biological sediment above the tidal zone. No natural island upland units were identified during this investigation. Natural islands may host isolated spoil piles which rise above high water and support a distinct upland plant assemblage of juniper, Brazilian pepper and cabbage palm. However, the overall geometry or footprint of the island reflects the predominance of natural process and therefore these islands are mapped as such. The spoil is readily identified by the circular or lobate geometry produced by one or more spoiling event ([Canaveral National Seashore \(2007\)](#)).

Unit is denoted as LiU in the source GIS data, map and report.

Lmiw - Lagoon, Mixed Island, wetland (Recent)

Natural island wetlands consist of plant species tolerant of marine or brackish water and extended intervals of submergence (hydroperiod). Freshwater taxa may be present in the interior of larger islands. Sediments typically consist of organic-rich shelly quartz sand and peat ([Canaveral National Seashore \(2007\)](#)).

Unit is denoted as LiW in the source GIS data, map and report.

Subtidal

The back-barrier lagoon environment located at elevations below mean low water is mapped as a subtidal unit. It has been further subdivided into seagrass and barren ([Canaveral National Seashore \(2007\)](#)).

LSsc - Lagoon, Subtidal, continuous seagrass (Recent)

This unit of the subtidal lagoon consists of plant communities typical of warm, shallow (<2 m), relatively clear waters where in the substrate is stable and hence suitable for successful benthic colonization. Typically consists of one or more of three predominant species; *Thalassia testudinum*, *Syringodium filiforme*, and *Halodule beaudettei*. Plant distribution and vigor now commonly used as a proxy for water quality or subtidal environmental conditions ([Canaveral National Seashore \(2007\)](#)).

LSsd - Lagoon, Subtidal, discontinuous seagrass (Recent)

This unit of the subtidal lagoon consists of plant communities typical of warm, shallow (<2 m), relatively clear waters where in the substrate is stable and hence suitable for successful benthic colonization. Typically consists of one or more of three predominant species; *Thalassia testudinum*, *Syringodium filiforme*, and *Halodule beaudettei*. Plant distribution and vigor now commonly used as a proxy for water quality or subtidal environmental conditions ([Canaveral National Seashore \(2007\)](#)).

LSb - Lagoon, Subtidal, barren (Recent)

Areas of the subtidal back-barrier lagoon wherein the substrate is devoid of vegetation. These areas are generally associated with (a) relatively deep water (> 2 m) with limited light or (b) unstable seabed induced by water waves and currents ([Canaveral National Seashore \(2007\)](#)).

Cuspate Foreland

Occurring as a cape or broadly triangular point of sand, with the most predominant apex pointing seaward along an open coast. Cuspate forelands extend for tens of kilometers along the mainland and extend seaward for several kilometers. They are formed by long-continued shore drifting of sediment, as by the convergence of separate spits or beach ridges from opposed directions, or by the progradation of cuspate bars. Type examples include Cape Hatteras, NC and the study area ([Canaveral National Seashore \(2007\)](#)).

Hierarchical scheme of CNS Cuspate Foreland morphogenetic units as presented in the [source map report](#).

Level 1

Cuspate Foreland

Level 2

[Relict Beach Ridge Complex](#)

Level 3

[FRr](#) - Cuspate Foreland, Relict Beach Ridge Complex, ridge

[FRs](#) - Cuspate Foreland, Relict Beach Ridge Complex, swale

[FRu](#) - Cuspate Foreland, Relict Beach Ridge Complex, undifferentiated

Relict Beach Ridge Complex

Relict beach ridge complex occurs as sets of parallel to sub-parallel ridges and swales located near the northern boundary of study area along the mainland shoreline just south of Oak Hill. To the south, this complex has been mapped on Merritt Island as the Dune and Swale terrain (Clark 1987) and lies

seaward of State Road (SR) 3. This undulatory terrain formed in association with the progradation of a sandy, wave-dominated coastline during a sea level high stand or inter-glacial episode proceeding the Holocene epoch. Truncation of parallel ridge and swale sets by younger parallel sets oriented at a slightly different angle suggests the Pleistocene coastline was dynamic and subject to reorientation in response to changing climate and/or sediment flux. These cross-cutting relationships provide a basis for establishing relative age of each set. Absolute ages were most recently quantified using age-dating methods of radiocarbon and quartz luminescence by Rink and Forrest (2005).

Distinct vegetative communities occupy each ridge and swale, reflecting soil moisture content and therefore proximity to the groundwater table. Ridge and swale elevations on east Merritt Island slope gently seaward, such that mesic and xeric plant communities occupy swales at the western edge of this complex. Towards the east, swale area vegetation grades into freshwater marsh or open water ([Canaveral National Seashore \(2007\)](#)).

FRr - Cuspate Foreland, Relict Beach Ridge Complex, ridge (Pleistocene)

Low, essentially continuous mound of beach or beach-and-dune material heaped up landward and beyond the backshore of a beach by the action of storm-induced waves and currents. Over centuries to millennia, a series of ridges may prograde seaward and over inter-tidal sediment to generate a beach ridge complex. This growth or progradation requires a persistent increase in the volume of littoral drift and/or a fall in the elevation of relative sea level. Trends in complex elevation, soils, and vegetation observed in the Merritt Island complex suggest this feature formed in conjunction with falling sea level. Sediments consist of quartz sand, with rooting and organic matter at surface ([Canaveral National Seashore \(2007\)](#)).

FRs - Cuspate Foreland, Relict Beach Ridge Complex, swale (Pleistocene)

Topographic depressions or linear troughs within a beach ridge complex which develop during intermittent and prevailing oceanographic conditions. Sediments consist of quartz sand, with silt, clay, organic matter and rooting at surface; surface sediment especially rich in fine-grained material and organic matter when swale is submerged ([Canaveral National Seashore \(2007\)](#)).

FRu - Cuspate Foreland, Relict Beach Ridge Complex, undifferentiated (Pleistocene)

Terrain within Relict Beach Ridge Complex not readily differentiated into either ridge ([FRr](#)) or swale ([FRs](#)) using data available during this investigation ([Canaveral National Seashore \(2007\)](#)).

Low Relict Beach Ridge

Within the relict beach ridge complex of the cuspate foreland, there appears to be a distinct terrain of low-relief elevation located along the eastern margin. The boundaries of this terrain could not be accurately delineated using elevation or vegetation data. But, the abundance or clustering of linear, open-water features are clearly visible to the unaided eye (c.f., Wilson 7.5 minute quadrangle map).

We have chosen to map this terrain as distinct from the relict beach ridge complex because it is readily distinguishable from the other areas of higher elevation and/or local relief. However, because boundaries could not be mapped with the same accuracy as all other morphogenetic units, it has been classified as a separate theme (Table 1). The significance of this terrain is not known at present. It may reflect one or more of the following: (a) a cluster or set of beach ridges which were deposited during a distinct set of environmental conditions, (b) the effects of surface water management, and/or (c) a combination of the two ([Canaveral National Seashore \(2007\)](#)). See the [source map report](#) for

additional information.

Mapped low relict beach ridge is represented in the GRI digital geologic-GIS data as its own data layer, Geomorphic Area Features (CANAGMAF).

Formation Features

Formation features are composed of rock units which: (1) are easily identified by a specific set of distinct physical properties, (2) can be traced in the field using macroscopic properties, and (3) exist over an area large enough to be represented on a geologic map ([Canaveral National Seashore \(2007\)](#)).

Qan - Anastasia Formation (Pleistocene)

Weathered, skeletal limestone (aka coquina) is exposed along an outcrop belt striking parallel to SR 3 and therefore along the north-western boundary of CNS. This formation is exposed both as natural outcrops and in association with SR 3 construction excavation and maintenance. Along the eastern side of SR 3, natural outcrops are present within a few 10s of meters and at some locations exhibit about one meter of local relief. The construction of drainage ditches along SR 3 has also exposed this limestone formation.

Two field days were spent documenting the extent of this formation. It appears very similar to local road building materials and therefore surface exposures can easily be missed. Based upon that field work and subsurface data obtained during unrelated investigations, the limits of surface exposure have been identified and mapped as the Pleistocene Anastasia Formation. The sedimentology, paleontology, and stratigraphy suggest this formation is a paleo-Atlantic shoreline ([Canaveral National Seashore \(2007\)](#)). See the [source map report](#) for additional information.

Mapped formation features (i.e., Anastasia Formation) is represented in the GRI digital geologic-GIS data as its own data layer, Geologic Units (CANAGLG).

Ancillary Source Map Information

The following section presents ancillary source map information associated with source map used for this project.

Canaveral National Seashore (2007)

The formal citation for this source.

Parkinson, Randall W. ⁽¹⁾, and Schaub, Ron ⁽²⁾, 2007, Geologic Map of Canaveral National Seashore, 1:24,000 scale 7.5 Minute Series Quadrangles: National Park Service, National Aeronautics and Space Administration (NASA), RW Parkinson Inc. and Dynamic Corp., scale 1:24,000, 6 plates and report (*GRI Source Map ID 7247*).

⁽¹⁾ RW Parkinson Inc.

⁽²⁾ Dynamic Corp.

Prepared for and funded by the National Park Service (NPS) Geologic Resource Evaluation (GRE)⁽³⁾ Program and the National Aeronautics and Space Administration (NASA).

⁽³⁾ The Geologic Resources Inventory (GRI) program was once known as the Geologic Resource Evaluation (GRE) Program.

Morphogenetic feature schema and sub-surface interpretation by R.W. Parkinson, Ph.D., P.G..

Spatial data and cartographic development by R. Schaub.

Prominent graphics and report associated with this source.

Source Map Figures

[Explanation](#)

[Hierarchical Scheme of CNS Morphogenetic Units](#)

[Morphogenetic Units Level 1 Map](#)

[Area Location Map](#)

[Federal Lands Map](#)

[Sub-Surface Geology](#)

[Sub-Surface Cross Section 1 \(northern\)](#)

[Sub-Surface Cross Section 2 \(southern\)](#)

Source Map Report

[Report](#)

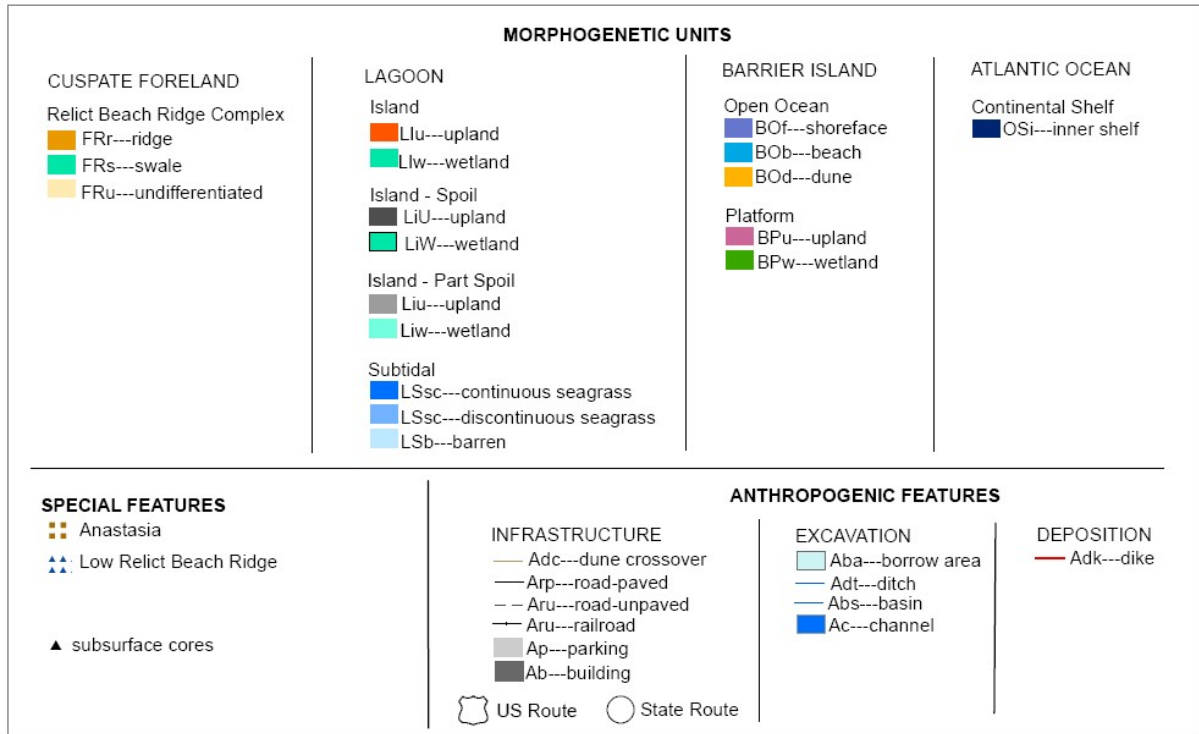
Users of the GRI digital geologic-GIS data are strongly encouraged to utilize the report for additional information.

Source Map

[Map Plates](#)

The source map authors produced cartographic map plates of the seven 7.5' quadrangles the comprise the source map.

Explanation



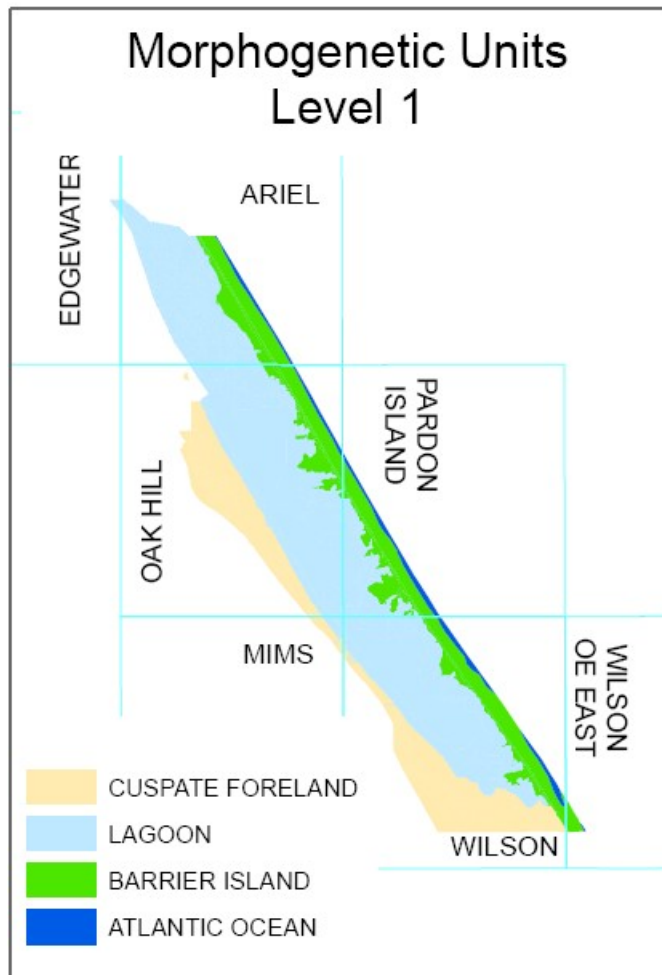
Infrastructure features not included in GRI digital geologic-GIS data. Morphogenetic units are present in the Geomorphic Units (CANAMRPH) data layer, the Anastasia (Formation) is present in the Geologic Units (CANAGLG) data layer, and Low Relict Beach Ridge is present in the Geomorphic Area Features (CANAGMAF) data layer. Borrow areas, ditch, and basin (lines) are present in the GRI digital geologic_GIS data as well, as are subsurface cores (Mine Area Features (CANAMAF), Mine Line Features (CANAMFL) and Mine Point Features (CANAMIN), respectively).

Graphic from [Canaveral National Seashore \(2007\)](#).

Hierarchical Scheme of CNS Morphogenetic Units

LEVEL 1	LEVEL 2	LEVEL 3	COD E	SOURCE DATA
ATLANTIC OCEAN	Continental Shelf	inner shelf	OSi	USGS 1:24,000 quads
BARRIER ISLAND	Open Ocean	shoreface	BOf	USGS 1:24,000 quads + hi-res imagery
		Beach	Bob	hi-res imagery
		Dune	BOd	LiDAR + hi-res imagery
	Platform	Upland	BPu	hi-res imagery
		wetland	BPw	hi-res imagery
LAGOON	Island	Upland	Llu	hi-res imagery
		wetland	Llw	hi-res imagery
	Island - Part Spoil	Upland	Liu	hi-res imagery
		wetland	Liw	hi-res imagery
	Island – Spoil	Upland	LiU	hi-res imagery
		wetland	LiW	hi-res imagery
	Subtidal	seagrass - continuous	LSsc	hi-res imagery
		seagrass - discontinuous	LSsd	hi-res imagery
		Barren	LSb	hi-res imagery
CUSPATE FORELAND	Relict Beach Ridge Complex	Ridge	FRr	LiDAR + hi-res imagery
		Swale	FRs	LiDAR + hi-res imagery
		undifferentiated	FRu	LiDAR + hi-res imagery

Graphic from [Canaveral National Seashore \(2007\)](#).

Morphogenetic Units Level 1 Map

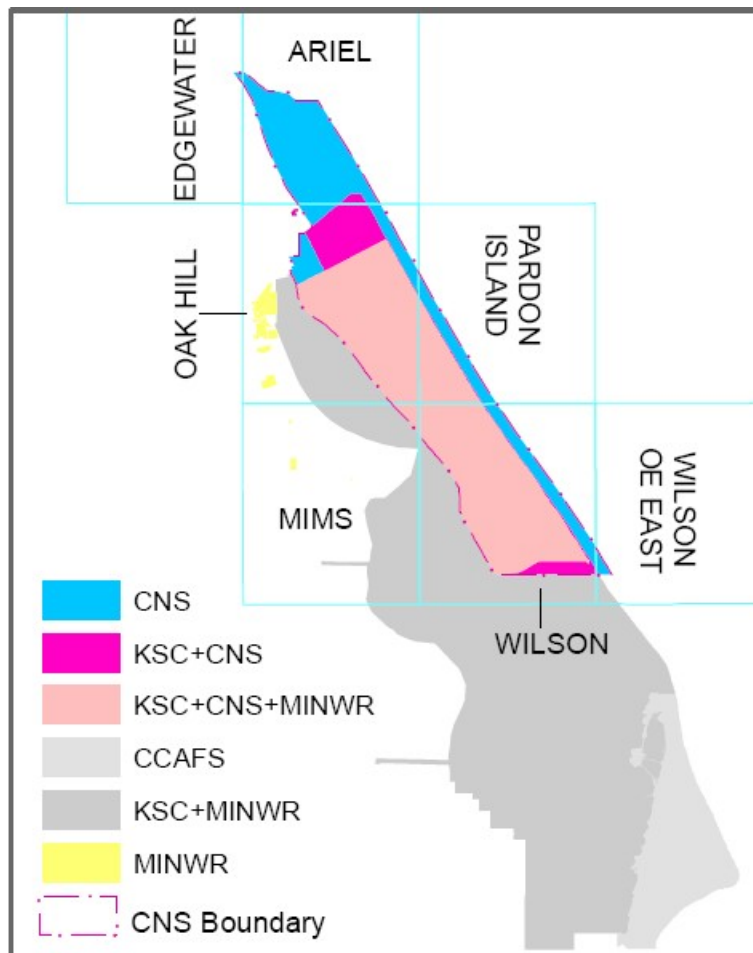
Graphic from [Canaveral National Seashore \(2007\)](#).

Area Location Map



Graphic from [Canaveral National Seashore \(2007\)](#).

Area Federal Lands Map



Much of the federal lands on the Merritt Island - Cape Canaveral Barrier Island Complex are under multiple administrations.

CCAFS = Cape Canaveral Air Force Station - US Air Force

CNS = Canaveral National Seashore - National Park Service

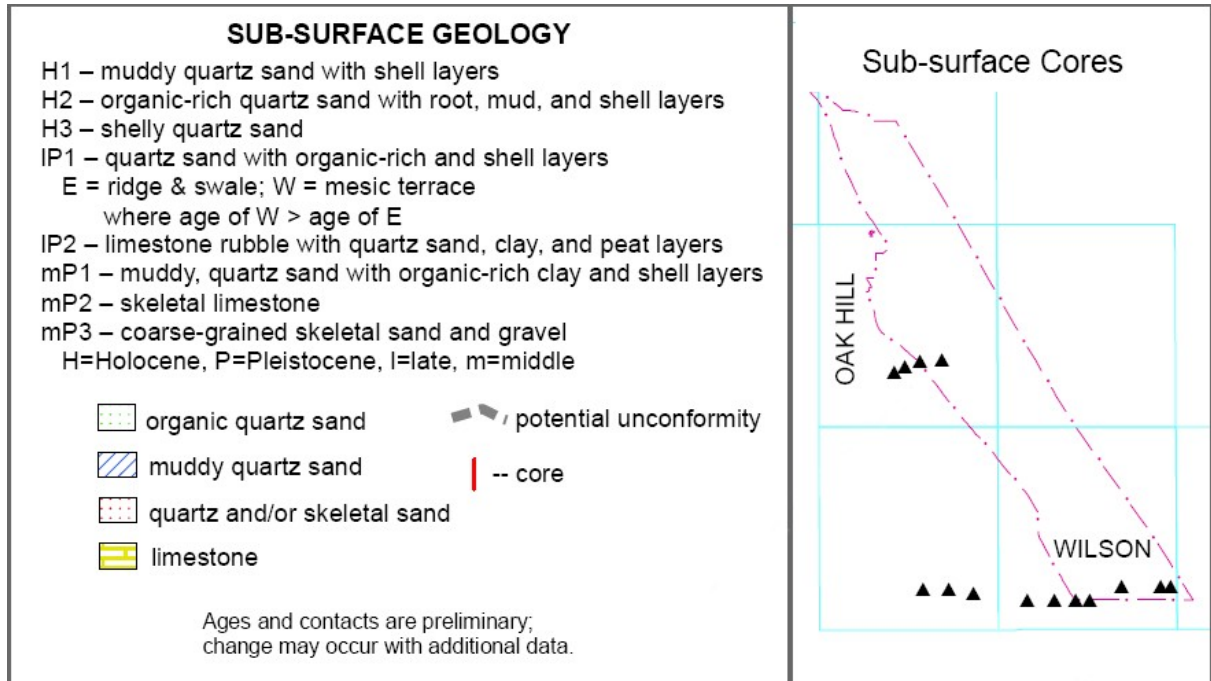
KSC = Kennedy Space Center - National Aeronautics and Space Administration

MINWR = Merritt Island National Wildlife Refuge - US Fish and Wildlife Service

The above graphics present the extent of federal lands at the time the source map was published (i.e., 2007).

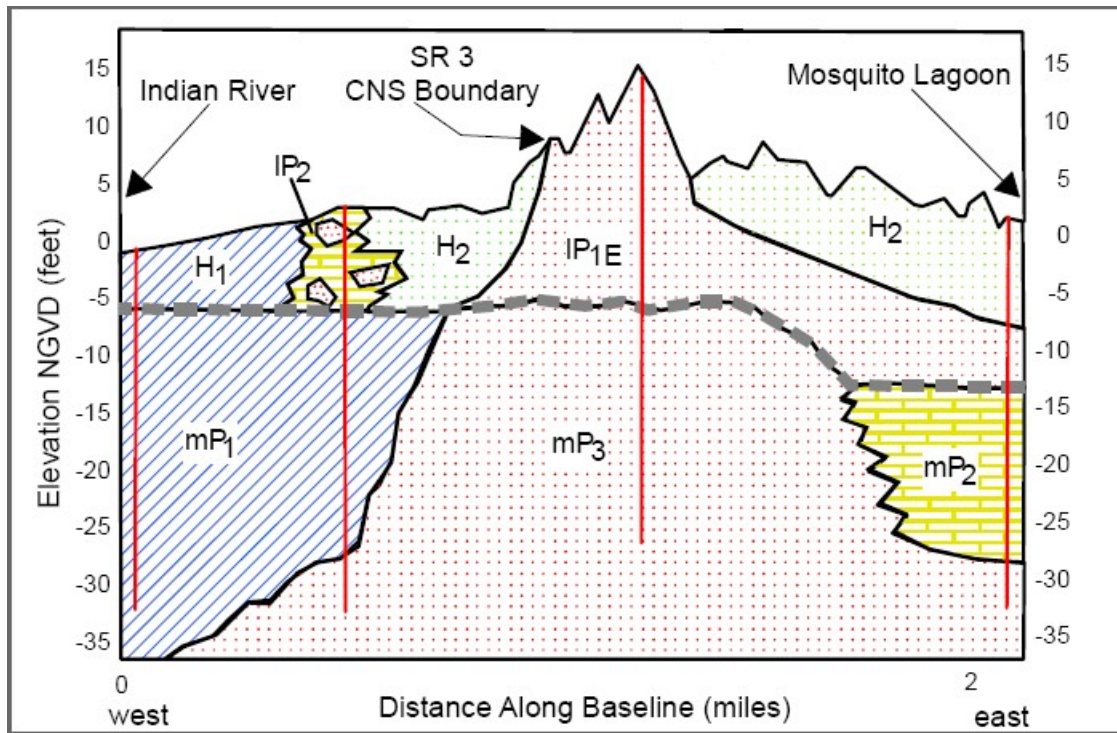
Graphics from [Canaveral National Seashore \(2007\)](#).

Sub-Surface Geology



Graphic from [Canaveral National Seashore \(2007\)](#).

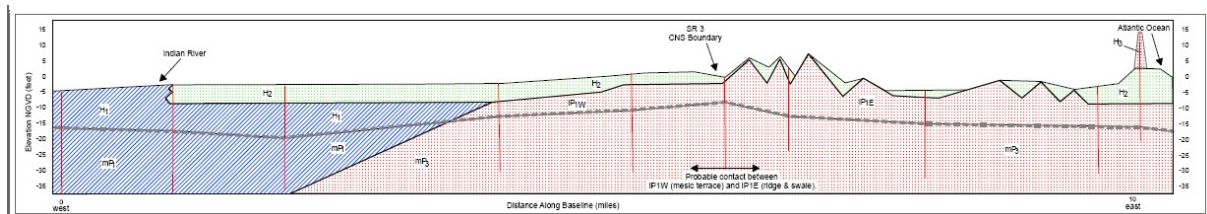
Sub-Surface Geology Cross Section 1 (northern)



The above section line graphic uses the line of cores in the Oak Hill quadrangle (see the Sub-Surface Geology graphic above for the location and for an explanation of section symbols). The section line is deemed Section 1 in the GRI digital geologic-GIS data.

Graphic from [Canaveral National Seashore \(2007\)](#).

Sub-Surface Geology Cross Section 2 (southern)



The above section line graphic uses the line of cores in the Wilson quadrangle (see the Sub-Surface Geology graphic above for the location and for an explanation of section symbols). The section line is deemed Section 2 in the GRI digital geologic-GIS data.

Graphic from [Canaveral National Seashore \(2007\)](#).

Report

The report associated with the source map publication can be viewed by double-clicking the following link, [cana_geology_1to24000_report_071027.pdf](#) (embedded document). Users of the GRI digital geologic-GIS data are strongly encouraged to utilize the report for additional information.

The report's table of contents is presented below.

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Map Plates

See the GRI Data Store record for source map cartographic map plates of the seven 7.5' quadrangles the comprise the source map.

GRI Digital Data Credits

This document was developed and completed by Stephanie O'Meara (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Ron Karpilo (Colorado State University).

The information in this document was compiled from the source map and is intended to accompany the GRI digital geologic-GIS map and digital data for Canaveral National Seashore, Florida (CANA) developed by Stephanie O'Meara (see the [GRI Digital Map and Source Map Citation](#) section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS map).

GRI finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).